
Literature Report

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Abstract

Adaptation to Climate Variability: Evidence for German Households

- Ecological Economics---2018---Gerhard Kussel

Using panel data originating from two household surveys conducted in 2012 and 2014, we investigate German households' adaptation behavior in response to indoor heat stress during summer months. Providing detailed information of household characteristics, behavior and technical equipment, our database allows us to estimate a random effects probit model on households' vulnerability and adaptive capacity. The estimates indicate that even moderate increases in temperatures are sufficient to trigger investments in adaptation measures: While the propensity to adapt is heterogeneous across socio-economic groups, an increase of one degree Celsius in average summer temperature is associated with a rise of 2.3 percentage points in adaptation probability.

Conceptualizing the Commons: Moving Beyond the Goods-based Definition by Introducing the Social Practices of Commoning as Vital Determinant

- Ecological Economics---2018---Johannes Euler

The paper proposes a practice theoretical conceptualization of commons. The first part of the paper asks the question how a convincing conceptualization of commons could look like. Despite of the increased attention to the concept of the commons different notions thereof exist. Ostrom and her colleagues often define commons as common pool resources, a specific type of good. The underlying classification is based on different degrees of excludability and subtractability. In the paper this is criticized for disregarding the importance of the social processes at hand. It is argued that instead of being a type of good, commons need to be conceptualized taking the relevant social dimensions into account. Commons are hence conceptualized as the social form of (tangible and/or intangible) matter that is determined by commoning. Commoning creates commons. In the second part the social practices of commoning are argued to be voluntary and inclusively self-organized activities and mediation of peers who aim at satisfying needs. The abstractness of the proposed conceptualization allows to aim at the core of the practices, at finding a way to find the common characteristics or dimensions of these practices, without defining away their ever specific way of being and becoming in the concrete.

How Does Virtual Water Flow in Palestine? A Political Ecology Analysis

- Ecological Economics---2018---María J. Beltrán, Giorgos Kallis

There is an exhaustive literature on Israel, Palestine and water, which has documented how the asymmetric power of Israel in the Oslo negotiations ensured its control of land and water over Palestine. Less attention however has been paid on the interface of water, trade and agriculture, and the ways in which controlling trade, Israel controlled the virtual flows of water too. The concept of virtual water makes the water-agriculture-trade relationship visible, shedding light on agricultural trade flows in terms of water. Applying a political ecology approach, this paper shows how socio-ecological conditions are sustained by and organised through both social and metabolic-ecological processes. A biophysical analysis - the agricultural flows of virtual water from and to Palestine in the Post-Oslo period - is combined with the examination of the power relations that governed these flows. The analysis reveals that virtual water flows are not static but instead evolve within the (geo)political-economic context in which they are embedded, bringing to light Israel's control over the flow of Palestinian agricultural virtual water. We argue that a political ecology approach to virtual water offers a theoretical basis to move beyond the currently techno-managerial emphasis in the virtual water literature, illuminating the link between the control of virtual flows and the consolidation of political and economic power.

More Leisure or Higher Pay? A Mixed-methods Study on Reducing Working Time in Austria

- Ecological Economics---2018---Stefanie Gerold, Matthias Nocker

Working-time reduction has become a central topic in the debate on social-ecological transformation, as it has the potential to mitigate unemployment, improve well-being, and reduce environmental pressures. This article analyses which groups of employees want to reduce their working time, and for which reasons. A

novel working-time policy in Austria, the leisure option, provides a unique possibility to examine this question. This policy enables employees to choose between a wage increase and more leisure time. We use a mixed-methods approach to analyse employees' preferences and the decision to reduce working time with two empirical parts run in parallel. A binary logit regression based on Austrian Microcensus 2012 data investigates factors associated with a preference for reduced working time. Qualitative interviews are conducted among employees at a firm in the electronics industry that offers the leisure option. Our results suggest that working-time preferences are to a large extent shaped by social norms, such as the full-time working norm and gender roles. We also find that the desire to work less is strongly moulded by personal values placed either on leisure and family time, or on financial security.

Circular Economy: The Concept and its Limitations

- Ecological Economics---2018---Jouni Korhonen, Antero Honkasalo, Jyri Seppälä

Circular economy (CE) is currently a popular concept promoted by the EU, by several national governments and by many businesses around the world. However, the scientific and research content of the CE concept is superficial and unorganized. CE seems to be a collection of vague and separate ideas from several fields and semi-scientific concepts. The objective of this article is to contribute to the scientific research on CE. First, we will define the concept of CE from the perspective of WCED sustainable development and sustainability science. Second, we will conduct a critical analysis of the concept from the perspective of environmental sustainability. The analysis identifies six challenges, for example those of thermodynamics and system boundaries, that need to be resolved for CE to be able to contribute to global net sustainability. These six challenges also serve as research themes and objectives for scholars interested in making progress in sustainable development through the usage of circular economy. CE is important for its power to attract both the business community and policy-making community

to sustainability work, but it needs scientific research to secure that the actual environmental impacts of CE work toward sustainability.

Reasons for Adoption and Advocacy of the Ecosystem Services Concept in UK Forestry

- Ecological Economics---2018---Susanne Raum

The ecosystem services concept has enjoyed widespread interest and recognition in recent years. In particular, the monetary valuation and commodification of ecosystem services in form of payments for ecosystem services schemes and the development of new markets for ecosystem services has appreciated large popularity. However, who is behind this strong momentum towards ecosystem services and especially why is less well known. In this paper I aim to shed light on this by looking specifically at advocates of the concept of ecosystem services, using forestry in the United Kingdom (UK) as an example. I explore the motivations for accommodating or actively pursuing ecosystem services thinking in this important sector through interviews with forestry and conservation experts. Four prominent groups with a specific interest in the ecosystem services concept in the context of UK forestry are governmental organisations, non-governmental conservation organisations, private forest owners, and the timber and forest industry. These stakeholder groups are interested in this new perspective, chiefly, but not exclusively, because (1) it is required under international obligations; (2) it is in line with dominant market political philosophy; (3) it holds the promise to include the environment more fully into prevailing economic decision-making processes; (4) it can help to draw more attention to biodiversity conservation; (5) it holds the promise of new sources of income from both public and private sources; and (6) it can be used as a convenient argument to promote further tree planting. However, these groups have different, but frequently overlapping reasons for pursuing this new perspective. The results provide a baseline and important insights into who was embracing ecosystem services thinking and why during the early years of the adoption of this approach in the UK.

The Environmental Behaviour of Farmers – Capturing the Diversity of Perspectives with a Q Methodological Approach

- Ecological Economics---2018---Peter Walder,Jochen Kantelhardt

The aim of this investigation is to understand more deeply farmers' attitudes and behaviour towards multifunctional agricultural ecosystems and sustainable production. By discovering and describing these viewpoints in relation to a wider societal discourse, we are adding to a holistic picture of what role influencing factors play in farmers' viewpoints towards natural resources. Consequently, we make use of a Q methodological approach which offers a way of identifying and describing the diversity of farmers' viewpoints. Based on data from 30 farmers in Lower Austria we identify the Diversity-maintaining, the Context-depending, the Economic Aspects-emphasising and the Change-promoting viewpoints. To our knowledge, especially the Context-depending viewpoint in particular is not yet described in the scientific literature and, therefore, they allow a novel approach to treating environmental problems. Based on these markedly different notions, there are reasonable grounds for questioning a blanket approach from agricultural policies which does not take into account the specific differences of farmers' mindsets. It can, instead, be argued that taking this diversity of mindsets into consideration when trying to alter behaviour can contribute to a more stable environmental performance, since specifics of various farmer-groups can be tackled with more accuracy.

Beneath the Canopy: Tropical Forests Enrolled in Conservation Payments Reveal Evidence of Less Degradation

- Ecological Economics---2018---Phillip M. Mohebalian,Francisco X. Aguilar

Assessments of programs offering payments for forest conservation have largely focused on their contribution to avoiding deforestation but have overlooked degradation. We integrated remotely-sensed forest cover images, georeferenced landscape information, field-level

forest inventories and face-to-face landowner surveys to quantify avoided deforestation and degradation within the context of Ecuador's Socio Bosque Program (PSB). We found the PSB prevented 9% of enrolled forest area in Ecuador's Amazon Basin from being deforested over the 2008–2014 period. This value is higher than previous assessments conducted in other Latin American nations. Inventory data suggest that forests within PSB-enrolled areas exhibited less evidence of degradation although statistical differences were only marginally significant. On average, PSB-enrolled forests had between one and two more tree species per hectare than non-enrolled forests. These additional tree species were twice as likely to be of commercial timber value and at greater threat of extinction.

Habitat and Resource Equivalency Analysis: A Critical Assessment

- Ecological Economics---2018---William H. Desvousges, Nicholas Gard, Holly J. Michael, Anne D. Chance

Restoration of ecological resource services from oil spills or chemical releases is a central component of natural resource damage assessments (NRDA) in the U.S. Equivalency analysis methods, particularly habitat equivalency analysis (HEA) and resource equivalency analysis (REA), are widely used methods for scaling compensatory restoration requirements. Although originally conceived for relatively modest habitat and/or short-duration injury, HEA is now widely used in service quantification and restoration scaling at large, complex NRDA sites. HEA can be viewed as a simplified alternative to a comprehensive ecosystem approach that requires more extensive primary data collection and differing assumptions.

Natural Capital as an Economic Concept, History and Contemporary Issues

- Ecological Economics---2018---Antoine Missemer

Natural capital is usually presented as a recent concept, used for the first time in the 1970s, adopted in an important contribution by David Pearce in 1988, and widely

used by ecological economists in the early 1990s. First employed to incorporate natural constraints into the economic lexicon, and to oblige economists to take the environment into account, the concept has also been used to include the environment in narrow economic valuations. To take a global view of these controversial uses, this paper reconsiders the genesis of natural capital as an economic concept, not in its present-day form, but from its almost unknown, ancient origins in the 1900s–1910s, in the writing of Alvin S. Johnson. The article first sheds light on this historical and theoretical moment, and then shows how it can help interpret current controversies about natural capital.

Beyond Rationality, Towards Reasonableness: Enriching the Theoretical Foundation of Deliberative Monetary Valuation

- Ecological Economics---2018---Bartosz Bartkowski, Nele Lienhoop

Economic valuation is often deemed an important source of information for land-use decisions. Stated preference (SP) methods are a particularly potent class of economic valuation methods, but they are also particularly controversial. In response to accumulating criticism of SP, deliberative monetary valuation (DMV) has been proposed as an alternative approach and has gained considerable attention in recent years. However, being a combination of elements from two theories – neoclassical welfare economics and theory of deliberative democracy – it lacks a convincing, consistent theoretical foundation. In our paper, we propose some clarifying adjustments regarding rationality assumptions and aggregation issues by drawing upon the work of Amartya Sen. We find that many of his ideas lead to a harmonisation of DMV's theoretical foundations, e.g. meta-rankings of preferences, impartial spectator and the plurality of impartial reasons.

Assessment of Sustainable Well-being in the Italian Regions: An Activity Analysis Model

- Ecological Economics---2018---Maria Francesca Cracolici, Miranda Cuffaro, Valerio Lacagnina

Applying the theoretical framework of productive analysis, the paper proposes an evaluation of regional sustainable well-being (SWB) in terms of efficiency. By means of an Activity Analysis Model (AA) (Färe et al., 1996), desirable and undesirable outcomes of development have been simultaneously used to evaluate the sustainable well-being of Italian regions. Data on equal and sustainable well-being provided by the Italian Statistical Office for the year 2010 has been used. The analysis reveals that only four regions achieve sustainable well-being, balancing socio-economic and environmental outcomes and resources. Finally, the study points out the advantages of AA for policy purposes by comparing it to a composite indicator of SWB.

Bird Killer, Industrial Intruder or Clean Energy? Perceiving Risks to Ecosystem Services Due to an Offshore Wind Farm

- Ecological Economics---2018---Sarah C. Klain, Terre Satterfield, Jim Sinner, Joanne I. Ellis, Kai M.A. Chan

Proposals to develop renewable energy technologies may threaten local values, which can generate opposition. Efforts to explain this opposition have focused on perceived negative aesthetic and environmental impact. Less attention has been paid to a fuller suite of the perceived risks and benefits associated with new energy technologies. This paper thus investigates impacts of an offshore wind farm pertaining to individual perceptions and judgments, and why risks to some ecosystem services might be cause for greater public concern than others. We find that this difference can be attributed to the affective and intuitive ways in which people perceive risk. Our mixed-methods design used interviews (n=27) that involved risk-benefit weighting tasks and an animated visualization to help people imagine an offshore wind farm in a familiar place. We found that affectively-loaded impacts (harm to charismatic wildlife and visual intrusion) were assigned greater weight than more easily quantifiable impacts (displacement of fishing, impact to tourism, cost of compliance with regulations). Interviewees identified increased regional energy self-sufficiency as the most valued po-

tential benefit of an offshore wind farm. These results have implications for ecosystem service assessments generally and, more specifically, for our understanding of ‘affective’ dimensions of development proposals.

Unpacking the Relationships Between Pro-environmental Behavior, Life Satisfaction, and Perceived Ecological Threat

- Ecological Economics---2018---Michael T. Schmitt, Lara B. Aknin, Jonn Axsen, Rachael L. Shwom

Using samples from Canada (N=1220) and the United States (N=1001), we examined how performing a variety of pro-environmental behaviors (PEBs) predicted life satisfaction. Controlling for demographic characteristics and perceptions of ecological threat, more frequent engagement in pro-environmental behaviors predicted higher life satisfaction. All but 2 of 39 PEBs were positively related to life satisfaction, suggesting that the relationship generalizes across behaviors. However, life satisfaction was more strongly predicted by behaviors that involved more social interaction, behaviors that were more easily observed, and by behaviors that involved direct costs in terms of money, time, and effort. Evidence for the role of direct costs was stronger than that for socialness or observability. In addition, perceptions of ecological threat negatively predicted life satisfaction, but this effect was partially suppressed by higher engagement in pro-environmental behavior. Results suggest that lifestyle changes that might be part of a sustainable society need not represent threats to well-being, and might even provide a means of enhancing well-being.

Integrating Cultural Ecosystem Services in an Ecosystem Satellite Account: A Case Study in the Gulf of Saint-Malo (France)

- Ecological Economics---2018---Jean-Christophe Martin, Rémi Mongrue, Harold Levrel

This paper develops an accounting approach for estimating cultural ecosystem services. Ecosystem satellite accounts should be able to include cultural ecosystem

services, which raise numerous assessment difficulties. A new assessment method is proposed, which uses the production for own use of households who carry out recreational activities depending on cultural ecosystem services. An application is carried out in the Gulf of Saint-Malo (France). A survey was implemented in order to collect the accounting data. Six recreational activities mixing the consumption of pure leisure (mainly sport) and marine cultural ecosystem services (mainly fishing and seascape watching) were considered: onshore fishing and shellfish gathering; hiking; recreational boating and offshore fishing; canoeing and kayaking; light sailing; scuba-diving and underwater fishing.

Ecosystem Services as Boundary Objects for Transdisciplinary Collaboration

- Ecological Economics---2018---Cara Steger,Shana Hirsch,Cody Evers,Benjamin Branoff,Maria Petrova,Max Nielsen-Pincus,Chloe Wardropper,Carena J. van Riper

The ecosystem services (ES) framework has potential to bring transdisciplinary teams together to achieve societal goals. Some label ES as “boundary objects” that help integrate diverse forms of knowledge across social groups and organizational scales. However, this classification masks complexities that arise from unique characteristics of ES types (i.e., provisioning, regulating, and cultural), which influence their ability to function as boundary objects. We argue that interpretive flexibility and material structures interact in distinct ways across ES types throughout a boundary object “life cycle.” Viewing a 2015 U.S. federal memorandum as a catalyst, we critically evaluate the evolution of ES and its role as a boundary object. We propose that provisioning and regulating services are transitioning out of boundary object status, moving into a more standardized state. However, we anticipate that cultural services may continue to behave as boundary objects if collaborators maintain them as such. This shift in the functionality of ES as boundary objects is an important consideration for future research that attempts to reach across social worlds and disciplinary

perspectives. We urge collaborations to rely on the most relevant disciplinary knowledge, rather than allowing the ease of standardized solutions to dictate the boundary of a given problem.

Focal Organisations and Eco-innovation in Consumption and Production Systems

- Ecological Economics---2018---Paul Dewick,Chris Foster

This paper explores the role of ‘focal organisations’ in stimulating eco-innovation at the locus of greatest environmental impacts within a consumption and production system (CPS). Focal organisations by definition have considerable power in these systems. We combine insights from the innovation studies literature with the sustainable/green supply chain literature to explore how focal organisations exercise this power in pursuit of system-wide sustainability. Through a case study of the milk CPS in the UK, we illustrate different strategies of the focal organisations to stimulate incremental eco-innovation along existing trajectories. We also show how, despite focal organisation support, radical eco-innovation is inhibited by inherent path dependencies and other institutional dimensions of the CPS. By demonstrating the complementarities of positioning the case study findings within two synergistic literatures, this paper contributes theoretically by extending and elaborating eco-innovation studies. It also has a practical utility for policy makers seeking to chart a path to more sustainable CPS by relying on focal organisations.

Conjunctive Implementation of Land Sparing and Land Sharing for Environmental Preservation

- Ecological Economics---2018---Sophie Legras,Elsa Martin,Virginie Piguet

In this paper, we investigate the concept of land sharing and land sparing management options for environmental preservation. We propose a general framework for the analysis of the conjunctive implementation of both land management options. This general framework provides an empirical rule of selection that can easily be

implemented by a land-planner without specific knowledge of optimization procedures. Our main finding is that both the environmental benefit to cost ratio and the benefit difference (between a sharing and a sparing management option) to cost difference ratio matter for selection of parcels. We then develop an empirical application of this framework for the Seine-Ource river catchment in Burgundy, France. We look for the best land management option to implement for water quality preservation. We show that it is more cost-effective to implement land sharing and land sparing management options conjunctively than separately.

Costs of Livestock Depredation by Large Carnivores in Sweden 2001 to 2013

- Ecological Economics---2018---Marit Widman,Katarina Elofsson

Livestock depredation by large carnivores entails economic damage to farmers in many parts of the world. The aim of this paper is to analyse and compare the costs of livestock depredation by carnivores in Sweden across different carnivore species and counties. To this end, we estimate the government's compensation cost function using Swedish data on the county level over the period of 2001 to 2013. Compensation costs due to depredation by three large carnivores are considered: the brown bear (*Ursus arctos*), the wolf (*Canis lupus*) and the lynx (*Lynx lynx*). The results show that a 1% increase in the density of the carnivores leads to a 0.3–0.4% increase in compensation costs, whereas a 1% increase in the density of sheep results in a 0.8 and 1.1% increase in the compensation costs for brown bears and wolves, respectively. A larger share of unfenced pastures is associated with higher compensation costs for brown bear. The marginal cost of an additional carnivore individual varies considerably between counties, ranging between 1 and 82 EUR for lynxes, 0 and 266 EUR for brown bears, and 52 and 1067 EUR for wolves.

Does It Pay to Participate in Decision-making? Survey Evidence on Land Co-management in Jiangsu Province, China

- Ecological Economics---2018---Ziming Liu,Jens Rommel,Shuyi Feng

Member participation in decision-making is a critical part of resource co-management. However, little is known about the welfare consequences of participation. This paper analyzes the impact of cooperative member participation in decision-making on their incomes, using data from 364 members of China's land cooperative program. We distinguish two levels of participation in decision-making – voting and obtaining financial information – and use a bivariate probit model and propensity score matching to estimate their impact. The results indicate that household head's age, gender and education and family size, wealth, and political affiliation determine participation in decision-making. Participation in either voting or obtaining financial information has a positive impact on cooperative members' land income. There is also a strong joint effect of voting and obtaining information, with an increase in land income of >16%. We conclude that broad participation can ensure more equitable access to land income for members.

Evaluating the Economic Potential of Uneven-aged Maritime Pine Forests

- Ecological Economics---2018---Renato Rosa,Paula Soares,Margarida Tomé

Continuous cover practices are likely to better respond to the increasing demand for social, aesthetic and environmental values provided by forest ecosystems than even-aged forest plantations. Also, uneven-aged forestry may be especially attractive for non-industrial private forest owners, as it provides more regular revenues and, by taking advantage of natural regeneration, reduce installation costs. Knowledge on alternative regimes to even-aged forestry is therefore in high demand. We first add to the literature by proposing a new maritime pine forest growth model that can be readily used in optimization studies. Second, we are

the first to analyze optimal uneven aged forest management for this species. Highlighting the contribution of this study, a comparison of our results with currently suggested silvicultural management scenarios is provided. We show that the economic profitability of this species significantly increases under optimal forest management and may thus present a viable alternative to rotation forests. In particular, we show that optimal forest management may entail harvesting cycles.

Is Environmental Income Reporting Evasive in Household Surveys? Evidence From Rural Poor in Laos

- Ecological Economics---2018---Priyanka Parvathi, Trung Thanh Nguyen

Literature has consistently reiterated that the self-employed non-poor underreport their business income to tax authorities and in household surveys. In this work, we measure the extent to which poor households engaging in illegal environmental activities underreport income in Laos. We use a two year panel data and apply the Engel curve to detect and estimate the reporting gap. We further use a switching probit regression to identify the factors of income underreporting and its impact on income poverty outcomes. Results show that on an average, rural households who earn at least a quarter of their income from the environment underreport by over 50% in household surveys resulting in overestimation of income poverty. Moreover, we find that a perceived threat to food security drives rural poor to engage in illegal environmental extraction.

Global Estimates of Ecosystem Service Value and Change: Taking Into Account Uncertainties in Satellite-based Land Cover Data

- Ecological Economics---2018---Xiao-Peng Song

Global estimates of ecosystem service value (ESV) and change are often produced using satellite-based land cover maps. However, uncertainties in global land cover data and their impacts on ESV estimation have not been fully recognized. Considerably inflated estimates of land cover change and ESV change could be

derived using a direct map comparison approach when classification uncertainties are not explicitly taken into account. This study collected all available global land cover datasets and applied an ensemble approach to derive the range and central tendency of terrestrial ESV estimates. Different input data caused ESV estimate varying between 35.0 and 56.5 trillion Int\$/year. Wetland classes, albeit having the highest per unit value, were the most uncertain classes mapped using satellite data. To reduce uncertainty, a spatial data harmonization procedure was developed, which resulted in an improved ESV estimate at 49.4 trillion Int\$/year. The study further illustrated the quantification of changes in forest ESV using a high-resolution global forest cover change dataset. An ESV loss of 716.0 billion Int\$/year was estimated between 2000 and 2012—a result representing one fifth of previous estimates. These findings highlighted the importance of improving the characterization and monitoring of land cover for global ESV and change estimation.

The Bobolink Project: Selling Public Goods From Ecosystem Services Using Provision Point Mechanisms

- Ecological Economics---2018---Stephen Swallow, Christopher M. Anderson, Emi Uchida

We report a two-year field experiment that solicited residents of Jamestown, Rhode Island, USA, to fund contracts with farmers willing to provide public goods associated with improving the nesting success of grassland birds, particularly the Bobolink. This experiment explores the potential to leverage valuation research for the purpose of enhancing charitable contributions in a manner consistent with developing markets for ecosystem-service public goods; we focus on individuals' willingness to contribute revenue. The direct-mail marketing experiment collected over \$16,000 through four provision point, money-back guarantee mechanisms: a voluntary contribution mechanism with a proportional rebate; a pivotal mechanism based on the Clarke tax; and two novel uniform price mechanisms, each presented in discrete choice and open-ended response formats. We find that citizens do respond

strategically: consistently lower offers in the open-ended format suggest a high incidence of cheap riding, but also a significant effect of higher suggested offer thresholds. These framing effects dominated differences among mechanisms, as revenue generated from the proportional rebate and one of the uniform price mechanisms approached the potential for revenue generation estimated under the incentive compatible pivotal mechanism.

Do People Care About Future Generations? Derived Preferences from Happiness Data

- Ecological Economics---2018---Stefano Bartolini, Francesco Sarracino

The main approaches for computing very long-term discount rates – revealed and stated preferences – have limitations. We overcome previous shortcomings using derived preferences, i.e. we retrieve information on very long-term time preferences from happiness data and people’s expectations about the living conditions of future generations. We account for possible endogeneity between expectations about the future and current well-being using 2SLS. We find that negative (positive) expectations about future generations have a very large negative (positive) impact on subjective well-being. This finding suggests that the very long-term discount rate is lower than implied by most traditional economic analyses.

The Global Water Grabbing Syndrome

- Ecological Economics---2018---Dell’Angelo, Jampel, Maria Cristina Rulli, D’Odorico, Paolo

Large-scale acquisitions of agricultural land in developing countries have been rapidly increasing in the last 10 years, contributing to a major agrarian transition from subsistence or small scale farming to large-scale commercial agriculture by agribusiness transnational corporations. Likely driven by recent food crises, new bioenergy policies, and financial speculations, this phenomenon has been often investigated from the economic development, human right, land tenure and food security perspectives, while its hydrologic implications

have remained understudied. It has been suggested that a major driver of large-scale land acquisitions (LSLAs) is the quest for water resources that can be used (locally) to sustain agricultural production in the acquired land. The appropriation of water resources associated with LSLAs has often been termed ‘water grabbing’, though to date a formal definition of such a normative and inherently pejorative term is missing. The intrinsic assumption is that the acquisition of water undergoes the same dynamics of unbalanced power relationships that underlie many LSLAs. Here we invoke hydrological theories of “green” and “blue” water flows to stress the extent to which water appropriations are inherently coupled to land acquisitions and specifically focus on blue water. We then propose a formal definition of blue water grabbing based both on biophysical conditions (water scarcity) and ethical implications (human right to food). Blue water grabs are appropriations of irrigation (i.e., blue) water in regions affected by undernourishment and where agricultural production is constrained by blue water availability. We use this framework to provide a global assessment of the likelihood that LSLAs entail blue water grabbing.

When Individual Preferences Defy Sustainability — Can Merit Good Arguments Close the Gap?

- Ecological Economics---2018---Nikolai Hoberg, Sebastian Strunz

In this paper, we discuss how merit good arguments may contribute to discussions about sustainability. To this end, we clarify how merit good arguments deviate from individual preferences and relate the justification for deviations from individual preferences to two conceptions of well-being: an informed preference satisfaction and a perfectionist conception. Building on this framework, we analyze how merit good arguments can be helpful for discussing sustainability as justice, what challenges merit good arguments pose to future generations, and whether they can serve as a normative justification for green nudges. The analysis yields two main insights. First, a reflection on the concept of merit goods is helpful in sorting out the different

justifications that sustainability interventions may rely on. In particular, it allows separating the challenges of redistribution, internalization of externalities and increasing individual consumption of particular (merit) goods such as health care or education more clearly. Second, the precise notion of merit goods by itself, however, only offers a limited contribution and does not represent a blank check to justify deviations from individual preferences.

Energy Burden Alleviation and Greenhouse Gas Emissions Reduction: Can We Reach Two Objectives With One Policy?

- Ecological Economics---2018---Dorothee Charlier, Anna Risch, Claire Salmon

In this article, we assess French current public policies designed to reduce greenhouse gas (GHG) emissions and abate household energy burden, through a simulation of changes in residential sector characteristics over the long run. We build on an existing partial equilibrium model to take into consideration key determinants of excessive energy burden among vulnerable households. This analysis reveals that current public policies are not sufficient to reach the ambitious objectives for reducing energy consumption and GHG emissions in France. Moreover, the decreases that might occur mask significant social disparities across households. The joint implementation of multiple instruments leads to interactions that diminish overall policy outcomes. Overall, current public policies produce estimated free-riding rates of 75%. Energy efficiency measures are thus insufficient in themselves; the government should focus more on monetary poverty as a cause of low home improvement rates and consider subsidizing renovation costs as a potential solution.

Risk, Reciprocity and Retribution: Choosing to Extract Resources From a Protected Area

- Ecological Economics---2018---Catrina A. MacKenzie

Benefits for residents local to protected areas are often proposed to improve conservation attitudes and to

reduce illegal resource extraction. In this paper I investigate the relationship between protected area-based benefits and losses and the admission of illegal resource extraction in households neighbouring Kibale National Park, in Uganda. Using focus groups, a household survey, and member-checking interviews with local council chairpersons, binary logistic models were created for the admission of illegal resource extraction from the park. The desire for park resources and proximity to the park were the strongest factors predicting admitted extraction. Reciprocity and retribution in response to park-based benefits and losses were small or non-existent with only loss due to personal injury or livestock predation by wild animals increasing the likelihood of extraction. Lower wealth households were more likely to admit extraction, supporting the conservation narrative that poverty constrains conservation. Also, the inability of park-based benefits to reduce the probability of resource extraction implies that benefits need to be more targeted to livelihood needs. Compensation for losses should only be considered for personal injury, and to a lesser extent livestock predation, because only these losses demonstrated potential retaliation through resource extraction.

Genuine Progress Indicator 2.0: Pilot Accounts for the US, Maryland, and City of Baltimore 2012–2014

- Ecological Economics---2017---John Talberth, Michael Weisdorf

For over thirty years the Genuine Progress Indicator (GPI) has been used to evaluate economic performance, quantify benefits and costs of growth, and predict effects of policy changes on economic wellbeing. The popularity and use of the metric is increasing partially in response to new global demands for metrics that go beyond Gross Domestic Product (GDP). However, because the basic GPI accounting protocols have yet to be consistently updated to respond to theoretical critiques, new valuation methods, and new data sources a proliferation of studies at the global, national and sub-national level contain widely divergent methodologies. Because of this, GPI practitioners have called

for a new, consistent framework to guide future GPI studies – GPI 2.0. This paper is an attempt to operationalize some of the concepts that have emerged from GPI 2.0 deliberations online and at recent workshops in the form of GPI 2.0 pilot accounts for the US, State of Maryland, and City of Baltimore. The goal is to demonstrate the feasibility of multi-scale GPI accounts that provide a more accurate measure of current economic welfare than GDP and that incorporate new methods and sources of information to replace many of the outdated aspects of the prevailing GPI approach.

How We Come to Value Nature? - A Pragmatist Perspective

- Ecological Economics---2017---Taru Peltonen, Isabelle Arpin

Valuation studies have been mobilized to demonstrate the importance of nature to society and to incorporate concerns about nature into decision making. Although increasingly popular in ecosystem service research, such studies have also been criticized. In particular, tensions between the assumptions of valuation methods and the real-life processes of valuing have been identified. This article argues that a process-based, pragmatist approach to valuing helps to evaluate the relevance of valuation studies results. Pragmatism proposes a focus on activities through which people come to value natural elements in their everyday life rather than on the outcomes of valuing processes. Using this approach we examine three empirical cases: 1) restoration of natural springs in Finland; 2) protection of the bearded vulture in the French Alps; and 3) management of urban biodiversity in the City of Grenoble, France. Through these cases we demonstrate how nature's value to people emerges from commonplace ways of engaging with natural elements, such as domestication, inheriting and community building. We conclude by discussing the usefulness of acknowledging this kind of processes in nature conservation.

The Relevance of Complementarities in the Study of the Economic Consequences of Environmental Proactivity: Analysis of the Moderating Effect of Innovation Efforts

- Ecological Economics---2017---Concepción Garcés-Ayerbe, Joaquín Cañón-de-Francia

In this paper, we present arguments and empirical evidence that highlights one key aspect of the study of the relationship between environmental proactivity and economic performance in firms: The effect of complementarities with other innovation-related resources. According to the literature, environmental proactivity—defined as the tendency to go beyond compliance with basic requirements established by law or institutionalized adoption of environmental practices in industry—enables firms to improve both economic and environmental outcomes. Within the framework of the resource-based view and the dynamic capabilities approach, we find that this win-win situation is far more likely when environmental proactivity is adopted in conjunction with a proactive innovation strategy. By analyzing panel data with 336 observations (42 Spanish industrial firms over an eight-year period), we demonstrate that environmental proactivity generates complementarities with technological proactivity that are sustainable and especially profitable in dynamic environments. More precisely, empirical evidence reveals that complementarities between environmental and technological proactivity are sustainable in groups of firms subject to high external pressure (such as that generated in the European Union Emissions Trading System context). Complementarities are also greater for companies during a financial crisis, a period characterized by high uncertainty and dynamism of the environment. This particularly advantageous win-win situation generated by environmental proactivity justifies its interpretation as a dynamic capability.

What Factors Drive Inequalities in Carbon Tax Incidence? Decomposing Socioeconomic Inequalities in Carbon Tax Incidence in Ireland

- Ecological Economics---2017---Niall Farrell

Carbon taxes increase the cost of necessary household energy expenditures. In many developed countries, carbon taxes are regressive as they comprise a greater proportion of a poorer household's income. Certain socioeconomic groups are more negatively affected by these impacts than others. While inequality of incidence by income group has received great attention in the literature, a gap exists to quantify the inequality associated with socioeconomic characteristics. This information is policy-relevant as it may inform the most effective means to offset negative welfare impacts through changes to taxes and/or social transfers. This paper provides this contribution. First, the inequality of carbon tax incidence across the income spectrum is quantified using the concentration index methodology. A subsequent multivariate decomposition quantifies the contribution each socioeconomic factor makes towards this inequality of incidence. This is carried out for electricity, motor fuel and all other home fuels to elicit variation of socioeconomic incidence by source. While income contributes a great deal towards inequality of incidence for other home fuels, other socioeconomic characteristics are the primary determinants of electricity and motor fuel-related carbon tax incidence. The relative importance of each characteristic in determining regressive impacts is quantified and this varies by carbon tax source.

Cross-constrained Measuring the Cost-environment Efficiency in Material Balance Based Frontier Models

- Ecological Economics---2017---Ana M. Aldanondo-Ochoa, Valero L. Casasnovas-Oliva, M. Carmen Almansa-Sáez

Frontier models based on the material balance principle (MBP) constitute a major group of environmentally-adjusted efficiency methods that produce environmental and economic outcomes, but fail to integrate them with measures of allocative efficiency in order to perform a joint cost-environmental efficiency analysis. Drawing insight from the literature on multi-criteria analysis, the objective of this paper is to extend the MBP framework to new measures of cross-constrained

cost and environmental allocative efficiency using data envelopment analysis (DEA). Cross-constrained measures seek for efficiency improvement in one of the two relevant criteria, cost and environment, consistent with given levels of both production and the outcome of the other criteria. The incorporation of these measures into the MBP framework provides an extra decomposition of allocative efficiency in efficiency gains that involve an economic- environmental trade-off and those that do not. The proposed approach is illustrated with an application geared to assessing the efficiency of a sample of greenhouse horticultural production units in Almeria, Spain. The results for this case show that it is possible to increase environmental allocative efficiency by up to 34% on average without incurring additional costs.

Energy Metabolism of 28 World Countries: A Multi-scale Integrated Analysis

- Ecological Economics---2017---Valeria Andreoni

In this paper the Multi-Scale Integrated Analysis of Social Metabolism (MuSIASEM) is used to investigate the metabolic profile of 28 world countries. The years considered are 1995 and 2007 and the socio-economic and environmental data included in the World Input-Output Database (WIOD) are used to provide consistent comparisons between countries. The analyses are performed by considering the entire society (Level N), the household and the paid sectors (Level N-1) and the different economic sectors (Level N-2). The main results show that, despite the differences existing between countries, the increasing energy throughput and per-capita consumption contributed to change the metabolic profile of the countries considered in this paper.

Inside the Emerald Triangle: Modeling the Placement and Size of Cannabis Production in Humboldt County, CA USA

- Ecological Economics---2017---Van Butsic, Benjamin Schwab, Matthias Baumann, Jacob C. Brenner

Cannabis agriculture is a multi-billion dollar industry, yet the factors driving the spatial location of cannabis production are not well understood. That knowledge gap is troubling, as there is evidence that outdoor production takes place in ecologically sensitive areas. Policy aimed at mitigating the impacts of current and future cultivation should be based on an understanding of what drives cultivation siting. Using parcel level data and a Heckman sample selection model, we estimate where cannabis cultivation is likely to take place and the number of plants in each site using biophysical, historical, and network variables. We use this model to estimate drivers of greenhouse and outdoor cultivation siting. We find strong implied network effects – parcels are far more likely to have cultivation sites if there are cannabis plants nearby. However, the proximity of other cannabis sites does not impact the size of a parcel's own cultivation. Similarly, a history of timber harvest increases the likelihood of outdoor cultivation, but is linked to cultivation sites with fewer plants. Biophysical properties such as slope, aspect, and distance to water did not statistically impact the likelihood of a parcel to be cultivated. Our results are a first step toward understanding the emergence of an agricultural activity likely to grow in other locales in the future.

Renewable Energy as a Luxury? A Qualitative Comparative Analysis of the Role of the Economy in the EU's Renewable Energy Transitions During the 'Double Crisis'

- Ecological Economics---2017---Jan-Justus Andreas,Charlotte Burns,Julia Touza

The European Union (EU) faces a double crisis: both economic and environmental, which has brought into stark relief the question of whether climate change mitigation and economic growth are mutually exclusive. Is saving the environment a 'luxury' reserved for wealthy countries, with less affluent countries being too poor to be green? We seek to address this important and timely question using fuzzy-set Qualitative Comparative Analysis (fsQCA) to analyse the causal relationship between economic growth and stability, and the expansion of renewable electricity shares among

the European Union's (EU) 28 member states during the recent economic recession (2008–2013). Our paper, analyses the recent economic and financial crisis and its effects on sustainability transitions, and establishes a new indicator for progress in renewable electricity transitions in the context of Europe's 2020 targets. It therefore extends the 'sustainability as a luxury' debate to include renewable energy. The analysis reveals an ambivalent picture of the role of wealth in renewable energy transitions (RET) in Europe. Indeed, driven by the EU's common renewable energy targets, the findings suggest that RETs are promoted both because, and in spite of the means.

When Patience Leads to Destruction: The Curious Case of Individual Time Preferences and the Adoption of Destructive Fishing Gears

- Ecological Economics---2017---Aneeqe Javaid,Marco A. Janssen,Hauke Reuter,Achim Schlüter

The use of destructive fishing methods is a serious problem, especially for tropical and developing countries. Due to inter temporal nature of fisheries extraction activities, standard economic theory suggests that an individual's time preference can play a major role in determining the gear choice decision. Based on earlier theoretical work we identify two ways in which individual time preferences can impact the adoption of destructive extraction methods; (i) the conservation effect which posits that patient individuals (as indicated by relatively high discount factor) are less likely to use destructive extraction methods since they are more likely to account for the loss of future income that is accompanied by using these methods, (ii) the disinvestment effect which argues that patient individuals are more likely to use destructive extraction methods since they have greater investment capability.

Gold Mining Pollution and the Cost of Private Healthcare: The Case of Ghana

- Ecological Economics---2017---Wisdom Akpalu,Ametefee K. Normanyo

To attract greater levels of foreign direct investment into their gold-mining sectors, many mineral-rich countries in sub-Saharan Africa have been willing to overlook serious instances of mining company non-compliance with environmental standards. These lapses in regulatory oversight and enforcement have led to high levels of pollution in many mining communities. The likelihood is high that the risk of pollution-related sicknesses will necessitate increasingly high healthcare expenditures in affected communities. In this study, we propose and estimate a hedonic-type model that relates healthcare expenditure to the degree of residents' exposure to mining pollution using data obtained on gold mining in Ghana. This has been confirmed by our empirical results, with an elasticity coefficient of 0.12. Furthermore, while healthcare expenditure does not vary between males and females, younger household heads spend more on their health than their older counterparts after controlling for health status, income and access to health insurance.

Sustainable Seafood From Aquaculture and Wild Fisheries: Insights From a Discrete Choice Experiment in Germany

- Ecological Economics---2017---Julia Bronnmann, Frank Asche

There is an increasing focus on environmentally sustainable seafood, which creates a potential for segmentation in the seafood market. Several recent studies demonstrate that consumers prefer ecolabeled wild seafood over unlabeled seafood. In addition, there is increasing evidence of a preference for wild fish relative to farmed fish, despite the rapid increase of aquaculture production. Recently, ecolabels have also been introduced for farmed fish. An interesting question is whether the preference for wild fish is primarily related to the perceived lack of environmental sustainability in aquaculture, or whether it is a perceived quality difference. In this paper, a choice experiment is used to investigate these issues in Germany for salmon using the Aquaculture Stewardship Council (ASC) ecolabel for farmed salmon and the Marine Stewardship Council (MSC) ecolabel for wild salmon. Using a mixed

logit model, the random parameter specification indicates substantial variation in consumer preferences beyond demographic variables. With respect to the main question, the ASC ecolabel not only makes up for the negative association of farmed salmon, but gives a similar price for the ASC labeled salmon as for MSC labeled wild salmon. This is an indication that environmental concerns and not quality differences are the major issue in segmenting the market between farmed and wild fish.

Compensating Environmental Losses Versus Creating Environmental Gains: Implications for Biodiversity Offsets

- Ecological Economics---2017---Philippe Le Coent, Raphaële Préget, Sophie Thoyer

In the economic literature on the motivations underlying voluntary contributions to environmental public goods, little attention is granted to the way the overall objective of the environmental program is framed. A program which contributes to an increase of environmental quality can be perceived differently from a program designed to bring back the environmental quality to its original level, after it was damaged by human intervention. How does it impact participation rates and contribution levels? This paper addresses this issue in the context of agri-environmental schemes for biodiversity conservation. It compares farmers' willingness to participate in two contracts, one being framed as part of a biodiversity offset program, the other one as part of a biodiversity conservation program. We demonstrate with a discrete choice experiment that biodiversity-offsets programs need to offer a higher payment to enroll farmers compared to biodiversity conservation programs. This result is essentially driven by farmers who declare to have organic practices.

Are we in deep water? Water scarcity and its limits to economic growth

- Ecological Economics---2017---Tiziano Distefano, Scott Kelly

Water is an important factor of production contributing both directly and indirectly to economic activity across all sectors and regions of the global economy. Water scarcity may therefore go beyond having important consequences for people, society and ecological systems but may also pose a threat to economic growth. Using the latest IPCC RCP projections and the OECD Shared Socio-Economic Pathways (SSPs) for population growth and economic output, we develop a multi-regional input-output model to estimate future demand for water resources across different countries and sectors of the global economy.

Dealing with “Baggage” in Riparian Relationship on Water Allocation: A Longitudinal Comparative Study from the Ferghana Valley

- Ecological Economics---2017---Ilkhom Soliev, Insa Theesfeld, Kai Wegerich, Alexander Platonov

The purpose of this article is to analyze how path dependency combined with socio-economic and technological characteristics can lead to varying degrees of change in riparian water allocation. A longitudinal comparative study of three cases from the Ferghana Valley, each with a distinct degree of path dependency, is presented to understand how riparian parties responded when they faced pressure to reallocate. There-with we distinguish (a) drivers of pressure pushing toward a change from (b) sources of path dependency resisting a change. Establishing similarity in drivers of pressure across all three cases, we systematically study the varying impact of established institutional arrangements leading to strong, moderate, and weak resistance to a change. The analysis reveals three key sources of path dependency explaining the strength of resistance: (i) vested interests, (ii) infrastructure control, and (iii) network effects that form the so-called “baggage” in riparian relationships. We discuss the interplay among these sources and their corresponding impact on the short- and long-term outcomes. Overall, the study brings forward the importance of dealing with “baggage” in riparian relationships to be able to effectively respond to new challenges and implement reforms in a sustainable way.

A Multi-region Structural Decomposition Analysis of Global CO2 Emission Intensity

- Ecological Economics---2017---H. Wang, B.W. Ang, Bin Su

This paper studies changes in global and national CO2 emission intensities using the multi-region structural decomposition analysis (SDA) technique. Emission intensities such as the ratio of CO2 emissions to GDP have lately been widely used to characterize national emission performance. Meanwhile the impact of international trade has been found to be important in global emission accounting. It is therefore important to analyze changes in emission intensities by taking trade into consideration. In this study, we first propose two SDA models, one at the global level and the other at the country level, to quantify both the domestic and trade related effects on an intensity indicator. The models are then used to study changes in global and countries' CO2 emission intensities from 2000 to 2009. The results show that sectoral emission efficiency improvement was the main contributor to the slight decrease in global emission intensity during the period, while international trade marginally hampered improvement of global emission intensity. Comparisons of the performance between emerging economies and advanced economies reveal the importance of production structure and final demand structure in emission intensity reduction. The policy implications of the findings are presented.

Wood Extraction Among the Households of Zege Peninsula, Northern Ethiopia

- Ecological Economics---2017---Dagninet Amare, Wolde Mekuria, Menale Wondie, Demel Teketay, Abeje Eshete, Dietrich Darr

The dependence of smallholder farmers on forest resources for their sustenance and livelihoods is a major driver of deforestation and degradation of forest resources in tropical countries. Understanding the socio-economic drivers that aggravate the extraction and overexploitation of forest products is vital for designing effective forest conservation and restoration

measures. This particularly holds with regard to the importance of two fundamentally opposing motivations of smallholder forest exploitation, which we label “wood extraction for need” vs. “wood extraction for greed”. This study was conducted at Zege peninsula in Northern Ethiopia to investigate the factors affecting the extraction and marketing of wood from the peninsula’s primary dry Afromontane forest by smallholders. Data was collected using household survey, focus groups discussions and key informant interviews. Data analysis employed the Heckman two-steps econometric model. The predominant involvement of vulnerable households in forest exploitation suggests that wood extraction was driven by need and mainly served sustenance and safety net functions. In addition, we also found evidence of greed-driven forest exploitation. As a consequence of selective rule enforcement and nepotism, the forest enforcement committee was not effective in safeguarding the forest, there by contributing to increased wood extraction and marketing by community members for income generation. This suggests that, in order to protect the forest, interventions are needed that aim at creating alternative income opportunities for smallholders through improved production of non-timber forest products, enhanced market access and the provision of locally adapted technologies; as well as at increasing the integrity of law enforcement.

Counterintuitive Proposals for Trans-boundary Ecological Compensation Under ‘No Net Loss’ Biodiversity Policy

- Ecological Economics---2017---Joseph William Bull,Anna Lou Abatayo,Niels Strange

‘No net loss’ (NNL) policies involve quantifying biodiversity impacts associated with economic development, and implementing commensurate conservation gains to balance losses. Local stakeholders are often affected by NNL biodiversity trades. But to what extent are NNL principles intuitive to stakeholders when they are not experts? We surveyed 691 students with limited or no knowledge of NNL policy across three countries, eliciting perceptions of what constitutes sufficient ecological compensation for forest habitat losses

from infrastructure development.

A Decision-theory Approach to Cost-effective Population Supplementation for Imperiled Species

- Ecological Economics---2017---Amanda M. Kissel,Wendy J. Palen,Purnima Govindarajulu

Despite decades of managing endangered species, few have been successfully recovered. One option to reduce this gap is to use decision analysis to weigh alternative recovery actions. Using decision analysis, we evaluated tradeoffs between recovery actions to reduce extinction risk and financial cost for the imperiled Oregon spotted frog (*Rana pretiosa*). We simulated population supplementation via captive breeding or head-starting, and releasing offspring into the wild as larvae or young of the year. We ranked the efficacy of recovery scenarios, represented by a culmination of a series of decision points, to reduce the 10-year extinction risk below 10% while minimizing financial costs. We explored how rankings varied with respect to the extinction risk target, the endangered population size, and the reproductive output captive females. Our top-ranked pathway was to supplement with captive bred larvae, resulting in a 3% reduction in extinction risk for every \$100,000 spent. In general, supplementing with captive bred larvae resulted in the biggest reduction in extinction risk per dollar invested. Additionally, we found that increasing spending does not always result in a proportional reduction in extinction risk. These results link quantitative and applied conservation by considering the biological and economic efficacy to recover endangered species.

An Economic Analysis of the Threats Posed by the Establishment of *Aedes albopictus* in Brisbane, Queensland

- Ecological Economics---2017---Jonathan Darbro,Yara Halasa,Brian Montgomery,Mike Muller,Donald Shepard,Greg Devine,Paul Mwebaze

Aedes albopictus is an invasive mosquito, aggressive

biter and potential disease vector. Its establishment in Europe and the Americas resulted in local disease transmission and impacted quality of outdoor recreational activities. Economic implications of its likely invasion into Australia had not been considered.

Getting more ‘carbon bang’ for your ‘buck’ in Acre State, Brazil

- Ecological Economics---2017---Charles Palmer, Luca Taschini, Timothy Laing

Acre State in Brazil is at the forefront of efforts to institutionalize jurisdictional-scale policies that aim to reduce emissions from deforestation and forest degradation (REDD+). Given limited REDD+ funds and uncertain returns from alternative land uses, this paper estimates the minimum incentive payment Acre’s government would have to pay forest landowners in each of its 22 municipalities to ensure forest conservation. Despite lower profits but with lower conversion costs and more stable returns over time relative to corn and coffee production, cattle pasture generates the highest returns in 19 municipalities. Municipalities are ranked according to their relative policy costs, a ranking which is compared to the distribution of forest carbon stocks across Acre. Finally, the relative cost per tonne of carbon is derived, which enables the identification of a group of 13 municipalities with the greatest potential for ‘carbon bang’ for a given ‘buck’.

Managing the Risks of Sea Lice Transmission Between Salmon Aquaculture and Wild Pink Salmon Fishery

- Ecological Economics---2017---Biao Huang, Charles Perrings

A common external effect of aquaculture is the transmission of infectious diseases to wild fish stocks. A frequently cited example of this is the infection of wild salmon by sea lice from salmon farms. Management of the disease risk to wild salmon populations requires an understanding both of the disease transmission mechanisms and the control incentives faced by fish farmers. In this paper we develop a bioeconomic model that

integrates sea lice population dynamics, fish population dynamics, aquaculture, and wild capture salmon fisheries. Using an optimal control framework, we investigate options for managing the sea lice infection externality. We pay particular attention to the role of sea lice management on the stability of wild stocks, and the sensitivity of sea lice effects on wild fisheries. We find that the stability of wild stocks is related to sea-lice-induced mortality (inversely) and the value of wild fishery.

Pursuing a Low Meat Diet to Improve Both Health and Sustainability: How Can We Use the Frames that Shape Our Meals?

- Ecological Economics---2017---Joop de Boer, Harry Aiking

This paper adds to the food, health and sustainability literature by examining the content, merits, and limitations of a frame-based approach to assist consumers on the path to a healthy and sustainable diet, focusing on reducing conventional meat consumption. The paper combined literature on frames with literature on meat consumption. It showed that meat eating was connected to the frames that guide consumer choices through sensory-based associations (savory, satisfying) and conceptual interpretations of meals and social situations. It also showed that the science-based health and sustainability arguments in favor of a diet change do not sufficiently reach consumers or are too difficult for them to comprehend. To reach consumers, therefore, it is crucial to develop bridging frames that work as push factors away from routine meat eating, or pull factors that encourage the consumption of primarily plant-based protein and special meat types. These frames (recipes, point-of-sale information) should build on the familiar culinary principles of variety, balance, and moderation, offer a moderate amount of novelty, and enable consumers to make positive sensory associations and coherent interpretations of healthy and sustainable protein dishes. A potential limitation of a frame-based approach is that it requires much attention to detail and context.

The Trade-off Between Income Inequality and Carbon Dioxide Emissions

- Ecological Economics---2017---Nicole Grunewald,Stephan Klasen,Inmaculada Martínez-Zarzoso,Chris Muris

We investigate the theoretically ambiguous link between income inequality and per capita carbon dioxide emissions using a panel data set that is substantially larger (in both regional and temporal coverage) than those used in the existing literature. Using an arguably superior group fixed effects estimator, we find that the relationship between income inequality and per capita emissions depends on the level of income. We show that for low and middle-income economies, higher income inequality is associated with lower carbon emissions while in upper middle-income and high-income economies, higher income inequality increases per capita emissions. The result is robust to the inclusion of plausible transmission variables.

An Agent-based Model of the South African Offshore Hake Trawl Industry: Part II Drivers and Trade-offs in Profit and Risk

- Ecological Economics---2017---Rachel Cooper,Astrid Jarre

In South Africa's most valuable fishery, the offshore demersal hake trawl, participant companies differ in their rightsholdings, product streams, core business structure and their numbers and types of vessels. HakeSim, an agent-based model of this fishing industry, is used to explore these interactions, how companies could cope with increased fuel prices, and to provide insight into profit-risk trade-offs and vulnerabilities of companies. Apart from increasing catch per unit effort (CPUE), which is often detrimental to fish stocks, fuel price increases could be offset by increasing hake market value, achieved by processing fish to higher value end products with a lower catch cost per tonne. Industry's present fleet size and composition is demonstrated to result from profit-risk trade-offs: the flexibility to respond to mismatches between total allowable catch and CPUE, market demands for frozen and fresh product

types, and environmental variability. Smaller companies have less risk-averse strategies and are more vulnerable to uncertainty in catches than larger companies, which may explain ongoing trends in consolidation in the industry. Increasing the proxy for environmental uncertainty increased risk to all companies without increasing profits. Incorporating more realistic environmental effects and feedbacks with industry in HakeSim could be an exciting future direction.

An Agent-based Model of the South African Offshore Hake Trawl Industry: Part I Model Description and Validation

- Ecological Economics---2017---Rachel Cooper,Astrid Jarre

The most valuable component in South Africa's fishing industry is its hake fishery, which targets two species, the shallow-water (*Merluccius capensis*) and deep-water (*M. paradoxus*) Cape hakes. Modelling provides a means to assist in understanding the dynamics of the economic system of this fishery and identify potential links to the ecological system in future, which can inform management. This study develops and describes a novel agent-based model of the South African offshore hake trawl industry, HakeSim, which captures drivers such as fuel price, catch per unit effort, export markets, exchange rate, industrial organization and uncertainty in catches as a proxy for environmental uncertainty. It allows identification of key drivers and their relative importance to the industry to be assessed. It has desirable and realistic sensitivities and it can successfully reproduce profitability scenarios for the industry under different fuel prices. Fuel prices above ZAR18.783 per litre, which could result from increased prices or reduced subsidies, are demonstrated to push the modelled fishing companies to making losses, which could potentially reduce employment. This model represents a strategic tool for management and significant advancements over existing bio-economic and agent-based models of fisheries.

The Effects of Regulated Facilities' Perceptions About the Effectiveness of Government Interventions on Environmental Compliance

- Ecological Economics---2017---Dietrich Earnhart,Lana Friesen

Our study explores the effects of regulatory monitoring and enforcement activities on facilities' compliance with environmental regulatory laws. In particular, our study examines regulated facilities' perceptions of the effectiveness of monitoring and enforcement efforts for inducing compliance and the influence of these perceptions on facilities' responses to actual inspections and enforcement actions. No previous study explores this influence. For our conceptual analysis, we extend standard deterrence theory by incorporating the behavioral dimension of intrinsic motivation. For our empirical analysis, we examine chemical manufacturing facilities permitted under the Clean Water Act during the years 2002 to 2004. Using an original survey, we collect data on facilities' perceptions. We then compare responses to government interventions between facilities that perceive enforcement as effective and those that do not. For facilities perceiving enforcement as effective, increased deterrence of any type generates little gain. In contrast, for those facilities who perceive enforcement as ineffective, increased deterrence from inspections improves compliance with the Clean Water Act.

The Influence of Political Orientation on the Strength and Temporal Persistence of Policy Framing Effects

- Ecological Economics---2017---Samdruk Dharshing,Stefanie Lena Hille,Rolf Wüstenhagen

The objective of this research is to analyze how political orientation moderates the influence of framing effects on policy evaluation. Drawing on the theory of motivated reasoning, three interrelated experiments assess the strength and temporal persistence of framing effects in the context of an energy conservation program. In the first experiment (N=183), the delivery mechanism of the policy is described as either a tax rebate or a subsidy. Party identification of potential

beneficiaries moderates the existence and magnitude of framing effects. The second experiment (N=603) presents alternative frames of communication, which focus on either the economic or environmental benefits associated with the policy. Effects of the communication frames on policy support in comparison to a neutral text are significant, but only when the policy is consistent with respondents' pre-existing views on economic individualism and government spending. The third experiment (N=603) investigates the temporal stability of framing effects after cognitive deliberation and finds that no change in policy support occurs over time. A key implication is that tailoring frames to the target audience increases effectiveness in policy design and communication. Considering the persistence of framing effects, early frames may have a disproportionate impact in public discourse.

Social Sensitivity Analyses Applied to Environmental Assessment Processes

- Ecological Economics---2017---Serafin Corral,Yeray Hernandez

Social sensitivity analysis is aimed at exploring the robustness of complex governance processes through the involvement of stakeholders. This approach is based on the concepts of transparency and citizen participation. This paper presents a new methodology for the application of sensitivity analysis to environmental assessment projects. The general idea behind this method involves making the results of natural resource planning processes available to an "extended peer community". This community, also known as a stakeholder community, is allowed to evaluate the quality of planning processes and give their opinion on the results. A Decision Support System based on institutional analysis, multi-criteria analysis and focus group sessions is used to implement this approach in a case study involving sustainable land-based transport policies in Tenerife, Canary Islands. In this exercise, stakeholders are involved in framing transport governance issues appropriately and then in defining and assessing plausible policy alternatives. The results obtained highlight that social sensitivity analysis is a viable approach that

guarantees robustness in environmental governance. In addition, methodological suggestions are made that might be of use to the sustainability assessment community.

The Need for Robust, Consistent Methods in Societal Exergy Accounting

- Ecological Economics---2017---Tânia Sousa,Paul E. Brockway,Jonathan M. Cullen,Sofia Henriques,Jack Miller,André Cabrera Serrenho,Tiago Domingos

Studies of societal exergy use have the common aim of tracing the flow of exergy along society, and are used to gain insights into the efficiency of energy use and linkages to economic growth. However, their methodological approaches vary greatly, with significant impacts on results. Therefore, we make a review of past studies to identify, synthesize and discuss methodological differences, to contribute to a more consistent and robust approach to societal exergy accounting. Issues that should be taken into account when making methodological options are discussed and key insights are presented: (1) For mapping of primary inputs and useful exergy categories, the inclusion of all natural resources is more consistent but it has the cost of not being able to distinguish the various energy end-uses in the production of materials. (2) To estimate primary electricity, none of the methods currently used is able to capture simultaneously the efficiency of the renewable energy sector, the environmental impact and the efficiency of energy use in society. (3) To estimate final-to-useful exergy conversion efficiencies, standard thermodynamic definitions should be used because the use of proxies fails to distinguish between increases in exergy efficiency and increases in the efficiency of providing energy services.

Speculating a Fire Sale: Options for Chinese Authorities in Implementing a Domestic Ivory Trade Ban

- Ecological Economics---2017---Ross Harvey,Chris Alden,Yu-Shan Wu

Africa is losing approximately 27,000 elephants a year to a poaching epidemic driven predominantly by demand for ivory in East Asia. In response, the U.S. and China agreed to implement domestic ivory trade bans to complement the international trade ban. The U.S. executed this agreement on 6 July 2016. Chinese authorities announced, on 30 December 2016, that they would end the domestic ivory trade by 31 December 2017. This paper accepts that a large volume of ivory entering China illegally is being stockpiled for speculative purposes. It sketches several scenarios of how ivory speculators, as important interlocutors between supply and final demand, might respond to this domestic ban. We conclude that the optimal elephant conservation policy approach would be for Chinese authorities to provide more specific details about the scope of the ban and how it will deal with stockpiled ivory. Our game theoretic analysis suggests that the ban should be imposed indefinitely; this should be explicitly stipulated to avoid uncertainty and continued speculation. The introduction of any possibility of a future regulated trade will create strong incentives for speculators to bank on elephant extinction, and maximise poaching effort in the short run.

Understanding conditions for co-management: A framed field experiment amongst the Tsimane' , Bolivia

- Ecological Economics---2017---Jetske Bouma,Victoria Reyes-García,Tomas Huanca,Susana Arrazola

We experimentally assess the willingness to self-enforce restricted resource use by playing a common pool resource extraction game in four Tsimane' indigenous communities in the Bolivian Amazon. We analyse the role of trust in participant's willingness to self-restrict resource use and collaborate with the authorities. Contrary to game behaviour in the industrialized world, we find that amongst the Tsimane' extractions decrease across rounds. We also find that participants who trust a) non-Tsimane' and b) the authorities extract less than other participants, but findings are not robust across rounds. Using the economic and

anthropological literature, we interpret the findings arguing that trust in non-Tsimane', which is strongly correlated with market access, may capture generalized trust levels and that people with higher levels of generalized trust interact more easily in non-personal transactions, like the situation presented in the game. As co-management also entails non-personal interactions with and trust in the authorities, our findings seem relevant for community-based conservation and co-management.

A Framework for Decoupling Human Need Satisfaction From Energy Use

- Ecological Economics---2017---Lina I. Brand-Correa, Julia K. Steinberger

Climate change poses great challenges to modern societies, central amongst which is to decouple human need satisfaction from energy use. Energy systems are the main source of greenhouse gas emissions, and the services provided by energy (such as heating, power, transport and lighting) are vital to support human development. To address this challenge, we advocate for a eudaimonic need-centred understanding of human well-being, as opposed to hedonic subjective views of well-being. We also argue for a shift in the way we analyse energy demand, from energy throughput to energy services. By adopting these perspectives on either end of the wellbeing-energy spectrum, a "double decoupling" potential can be uncovered. We present a novel analytic framework and showcase several methodological approaches for analysing the relationship between, and decoupling of, energy services and human needs. We conclude by proposing future directions of research in this area based on the analytic framework.

The Role of Environmental Concern and Comfort Expectations in Energy Retrofit Decisions

- Ecological Economics---2017---Veronica Galassi, Reinhard Madlener

This study investigates the roles of environmental concern and comfort expectations in the decision to retrofit a dwelling and the implications of these two aspects

for the rebound effect. We ex-ante elicit individual preferences for deep thermal energy-saving measures in residential buildings by means of a Discrete Choice Experiment (DCE) among 3161 owner-occupiers and tenants in Germany. Besides room temperature, we include air quality, level of control over the system, noise reduction, and aesthetics of the dwelling as proxies for indoor comfort. Our model also accounts for monthly payments related to the implementation of the measure – and customized based on tenancy status, building type, and size of the dwelling – as well as technical energy cost savings. Econometric estimation provides significant results for most of the parameter coefficients. Findings show that thermal comfort preferences are heterogeneous: 33% of the respondents attach positive values to an increase in indoor temperature that would result from the deep retrofit, providing evidence in favor of a technical rebound effect. While environmental concern explains heterogeneity in most of the attributes, its interaction with thermal comfort is not significant. Thermal comfort turns out to be, however, the least important attribute in the analysis while air quality is the most important one.

Good Taste Tastes Good. Cultural Capital as a Determinant of Organic Food Purchase by Italian Consumers: Evidence and Policy Implications

- Ecological Economics---2017---Massimiliano Agovino, Alessandro Crociata, Davide Quaglione, Pierluigi Sacco, Alessandro Sarra

Policy actions in support of organic food chain productions have so far focused on the supply side, whereas poor attention has been paid to the demand side, despite the growing interest in consumers' attitudes toward organic food. With the prospect of a future slowing down of the demand for organic products, specific demand-side policy measures are called for. Building on interdisciplinary research on the determinants of organic food purchases, we argue that cultural capital is a relevant, so far overlooked driver of organic food purchase. We apply a Heckman two-step selection strategy approach to microdata from the latest sample annual survey by the Italian National Institute

of Statistics. We find that participation in cultural activities has a positive impact on the inclination to purchase organic products, to an extent that depends on the social orientation of each cultural activity. Some policy implications are derived.

Impacts of the Hara Biosphere Reserve on Livelihood and Welfare in Persian Gulf

- Ecological Economics---2017---Milad Dehghani Pour,Naser Motiee,Ali Akbar Barati,Fatemeh Taheri,Hossein Azadi,Kindeya Gebrehiwot,Philippe Lebailly,Steven Van Passel,Frank Witlox

Despite the importance of biosphere reserves in Iran's livelihood and welfare, the economic significance of Hara Biosphere Reserve has never been comprehensively studied. This study examines the current importance of Hara Biosphere Reserve (HBR) in local livelihood and welfare. Using a household survey, data were collected through a questionnaire, key informant interviews and direct observations. Two hundred and forty-four households were randomly selected from 10 villages through proportional sampling. Results showed that non-environmental income was the first driver of the total income, poverty alleviation and narrowing income inequality gap. Park income was the second. The results also showed that excluding park income from total income would significantly increase head-count poverty, widen the poverty gap, and raise the Gini coefficient. Wealthier households had the greatest absolute income from the environment, including forest, fishing and fodder. However, the poorest group had smallest absolute income from these sources. Thus, the study demonstrated that wealthier households are responsible for the overharvesting of environmental resources. Interestingly, the study showed that wealthier households are more dependent on profitable environmental incomes sources while the poorest are more dependent on non-profitable ones.

The Complex Relationship Between Households' Climate Change Concerns and Their Water and Energy Mitigation Behaviour

- Ecological Economics---2017---Celine Nauges,Sarah Wheeler

This study analyses household survey data on water and energy climate change mitigation behaviour from eleven OECD countries, and provides new evidence of a complex relationship between climate change concerns and mitigation behaviour. Results confirm other studies that climate change concerns positively influence specific mitigation actions. However we also find evidence that this relationship may be more complex in the sense that adoption of mitigation behaviour may negatively feedback on households' climate change concerns. This effect more likely occurs in 'environmentally-motivated' households. Conversely, economic incentives in driving energy and water mitigation work better in non-environmentally-motivated households. This highlights that a portfolio of policies is needed to drive mitigation behaviour.

Payments for ecosystem services and agricultural intensification: Evidence from a choice experiment on deforestation in Zambia

- Ecological Economics---2017---Tobias Vorlaufer,Thomas Falk,Thomas Dufhues,Michael Kirk

Agriculture is considered to be one of the major drivers of deforestation worldwide. In developing countries in particular this process is driven by small-scale agriculture. At the same time, many African governments aim to increase agricultural productivity. Empirical evidence suggests, however, that win-win relationships between agricultural intensification and forest conservation are the exception. Payments for Ecosystem Services (PES) could be linked to agriculture support programmes to simultaneously achieve both goals. Due to potentially higher profits from intensified agriculture than from pure cash transfers, potential payment recipients may prefer in-kind over conventional cash payments. Nevertheless, little scientific evidence exists

regarding the preferences of potential PES recipients for such instruments. We report from a discrete choice experiment in Zambia that elicited preferences of smallholder farmers for PES contracts. Our results suggest that potential PES recipients in Zambia value in-kind agricultural inputs more highly than cash payments (even when the monetary value of the inputs is lower than the cash payment), highlighting that PES could potentially succeed in conserving forests and intensifying smallholder agriculture. Respondents who intended to clear forest within the next three years were found to require higher payments, but could be motivated to enrol in appropriately designed PES.

Ecosystem-based Artefacts as a Source of Loyalty at the French Valley of the Monkeys

- Ecological Economics---2017---Philippe Mouillot,Pierre-Charles Pupion

This paper investigates an ecosystem as a possible source of loyalty increase. With the case of the Valley of the Monkeys in France, the only European park welcoming monkeys in total freedom, this research statistically explores emotional determinants of loyalty, satisfaction and word-of-mouth behaviour from single to family visitors in order to identify which marketing angles the park should highlight to reach a sustainable development logic. After anchoring our research in the tourism paradigm, we introduce the theoretical framework of loyalty, we define eight research hypotheses, including six sub-hypotheses, and we propose a conceptual model. Then we present our methodology, including a detailed empirical study. Results are displayed consecutively to the research hypotheses' test, which inform our suggestions for marketing directions for the park to increase its touristic performance. Results mainly highlight that in such a paradigm, satisfaction is not emotion-based but cognitive-dissonance linked, that an ecosystem-based philosophy is clearly a sustainable source of loyalty, and that the main targets for such parks are families who seek strong positive emotions such as joy and delight, the latter further supporting loyalty development.

Does Pricing Nature Reduce Monetary Support for Conservation?: Evidence From Donation Behavior in an Online Experiment

- Ecological Economics---2017---Sandra H. Goff,Timothy M. Waring,Caroline L. Noblet

Ecosystem services valuation attempts to determine the monetary value of the benefits provided by the natural world. Prior research has shown that making monetary value salient fosters self-interested behavior in experimental settings (Vohs, Mead, and Goode, 2006), reduces the intrinsic value ascribed to pro-social activities such as volunteering (Pfeffer and DeVoe, 2009), and reduces the efficacy of environmentally relevant interventions (Steinhorst, Klockner, and Matthies, 2015). These findings raise concern that ecosystem service valuation information might adversely impact individual's pro-environmental behaviors. This study uses an experimental framework to determine whether ordinary citizens' exposure to valuation information, such as one might encounter in a news article or fundraising materials, might influence an individual's contribution to a natural resource conservation fund. The study is implemented with 250 participants from across the United States. We find that participants who receive a "natural resource description plus valuation" treatment donate a statistically significant lower dollar amount of their experimental earnings on average than those who read the narrative alone. Based upon this evidence, we assert that ecosystem service valuation information has the potential to negatively impact financial support for the exact resources the information is designed to promote.

The Impact of Fairness on Side Payments and Cost-Effectiveness in Agglomeration Payments for Biodiversity Conservation

- Ecological Economics---2017---Martin Drechsler

Agglomeration payment schemes aim at increasing the spatial connectivity of conserved land. Such payments are offered by a conservation agency to landowners subject to the condition that the conserved land is sufficiently connected to other conserved land. Facing this

connectivity condition, landowners with conservation costs below the payment may need to offer some of their surplus through side payments to other landowners with high costs so that these conserve their land and the connectivity condition is met. Previous papers that modelled side payments in agglomeration payment schemes ignored that landowners may be sensitive to fairness and distributional issues. To incorporate fairness issues I relate a model of an agglomeration payment scheme to the well-known ultimatum game and show that if landowners are concerned about fairness and distribution the agency must offer higher payments and has to expect lower levels of cost-effectiveness.

Sustainability as a Fair Bequest: An Evaluation Challenge

- Ecological Economics---2017---Bernd Klauer,Bartosz Bartkowski,Reiner Manstetten,Thomas Petersen

In contrast to conventional approaches the conceptualisation of sustainability as fair bequest makes it possible to consider a finite time horizon. Valuation is necessary to determine whether the bequest package that is passed on from one generation to the next is fair. Acknowledging the merits as well as the limitations of economic price theory, this paper differentiates between three classes of valuables: the essential, the useful and the unique. It is argued that a fair bequest package should contain items from each of the classes. Because the three classes are incommensurable, fairness of the bequest cannot be expressed by a single figure like a non-declining total value of the package. We then discuss which methods are appropriate for describing a bequest package with respect to its fairness.

Farm-level Economic Analysis - Is Conservation Agriculture Helping the Poor?

- Ecological Economics---2017---Baqir Lalani,Peter Dorward,Garth Holloway

Conservation Agriculture (CA) has been widely promoted as an agro-ecological approach to sustainable production intensification. Across Sub-Saharan Africa,

however, there have been low rates of adoption with fierce debate over its attractiveness for resource-poor farmers. Farm-level economics has been a key component of this debate with several authors questioning whether short-term benefits can occur with CA and advocating the need for more sophisticated economic analysis when comparing CA and conventional agriculture. This has included the importance placed upon more detailed farm-level data gathering as opposed to on-farm/on-station research. This study uses farm-level budget data gathered from a cross-sectional survey of 197 farmers, for the 2013/2014 season, within a district situated in Cabo Delgado Mozambique, to compare the underlying economics of CA and conventional agriculture. The study is enriched by having observations reflecting each year of CA use i.e. first, second and third year. Probabilistic cash flow analysis is used to compare the net present value of CA compared to conventional cropping over the short and longer term for differing crop mixes. Benefits are found in the short-term under CA but these are largely dependent on crop mix and the opportunity cost of labour assumed. We further employ Monte-Carlo simulations to compare the poorest farmers' net returns under different crop mixes and risk tolerance levels. Contrary to previous research, which has mostly suggested that better-off farmers are more likely to find CA useful, we find evidence that for the cohort of farmers under study the poorest are likely to find CA beneficial for a variety of crop mixes and risk-levels including under extreme risk aversion with the full opportunity cost of labour and mulch accounted for. These findings suggest that CA can be an attractive option for a wide variety of resource levels and crop mixes including those of the very poor in similar farming systems elsewhere in Sub-Saharan Africa.

A structural decomposition of global Raw Material Consumption

- Ecological Economics---2017---Frank Pothén

Between 1995 and 2008, the global extraction of biomass, fossil fuels, and minerals grew from 48 to 69 billion metric tons. This study investigates how chang-

ing consumption and investment patterns affected the aforementioned increase. A series of Structural Decomposition Analyses at a global level as well as for 40 major economies is conducted. They disentangle the growth of Raw Material Consumption, which measures the extraction of materials necessary to produce a country's final demand. Data is taken from the World Input-Output Database. The results suggest that rising final demand was the predominant driver of growing Raw Material Consumption. Final demand, furthermore, shifted into countries that consume material-intensive goods, in particular due to infrastructure build-up in industrialising nations. The mix of goods in final demand slightly dematerialised. Increasing efficiency in global value chains decelerated the growth of Raw Material Consumption. The results confirm that the secular trends in structural change and technological improvements are insufficient to limit the use of materials.

Exploring Futures for Amazonia's Sierra del Divisor: An Environmental Valuation Triadics Approach to Analyzing Ecological Economic Decision Choices in the Context of Major Shifts in Boundary Conditions

- Ecological Economics---2017---Katharine N. Farrell, José Carlos Silva

This text presents a new methodological approach to ecological economic analysis, employing Georgescu-Roegen's flow-fund theory of economic process. It offers an alternative to monetary valuation based analyses and aims to contribute toward advancing work concerned with addressing complex ecological economic questions as complete wholes. The methodology is demonstrated through reference to the empirical case of a proposed rail link between Peru and Brazil, which would cut across the Sierra del Divisor of western Amazonia, connecting the Pacific and Atlantic coasts and further opening up the Amazon commodity frontier. In order to analyze the potential impacts of the rail-link, four flow-fund representations of economic process (two at the regional and two at the local level) are developed in order to juxtapose two alternative political economy contexts that might govern the rail-link's impacts in

the region: one where conservation is prioritized over cash income and one where it is not. Our results suggest that completion of the rail-link under the current political economy context, which prioritizes cash income over conservation, is likely to have substantial negative consequences for forest conservation in both Peru and Brazil and for local livelihoods throughout the region.

The Economics of Synthetic Rhino Horns

- Ecological Economics---2017---Frederick Chen

To examine the potential impact of synthetic horns to reduce rhino poaching, a formal model of the rhino horn market in which there exist firms with the capability to produce high quality synthetic horns is presented and studied. The analysis shows that whether the availability of synthetic horns would decrease the equilibrium supply of wild horns—and how much the reduction would be—depends on market structure—i.e., how competitive the synthetic horn production sector is—and on how substitutable the synthetic horns are for wild horns. The implications of these results for conservation policies are derived and discussed. Synthetic horn producers would benefit more by promoting their products as being superior to wild horns, but this could increase horn prices and lead to more rhino poaching. For conservation purposes, it may be beneficial to incentivize firms to produce inferior fakes—synthetic horns that are engineered to be undesirable in some respect but difficult for buyers to distinguish from wild horns. The analysis also shows that promoting competition in the production of synthetic horns in general is desirable from a conservation standpoint as synthetic horn producers may prefer to keep prices at a high enough level that could still encourage significant amount of poaching.

Managing Climate Change Risks in Africa - A Global Perspective

- Ecological Economics---2017---Ademola A. Adenle, James D. Ford, John Morton, Stephen Twomlow, Keith Alverson, Andrea Catta-

neo,Rafaello Cervigni,Pradeep Kurukulasuriya,Saleemul Huq,Ariella Helfgott,Jane O. Ebinger

Africa is projected to experience diverse and severe impacts of climate change. The need to adapt is increasingly recognized, from the community level to regional and national governments to the donor community, yet adaptation faces many constraints, particularly in low income settings. This study documents and examines the challenges facing adaptation in Africa, drawing upon semi-structured interviews (n=337) with stakeholders including high-level stakeholders, continent-wide and across scales: in national government and UN agencies, academia, donors, non-governmental organizations, farmers and extension officers. Four key concerns about adaptation emerge: i) Climate data, scenarios and impacts models are insufficient for supporting adaptation, particularly as they relate to food systems and rural livelihoods; ii) The adaptation response to-date has been limited, fragmented, divorced from national planning processes, and with limited engagement with local expertise; iii) Adaptation policies and programs are too narrowly focused on explicit responses to climate change rather than responses to climate variability or broader development issues; and iv) Adaptation finance is insufficient, and procedures for accessing it present challenges to governments capacities. As a response to these concerns, we propose the 4-Cs framework which places adaptation for Africa at the center of climate projections, climate education, climate governance and climate finance, with corresponding responsibilities for government and non-government actors.

Do Stormwater Basins Generate co-Benefits? Evidence from Baltimore County, Maryland

- Ecological Economics---2017---Nicholas B. Irwin,H. Allen Klaiber,Elena G. Irwin

An often-cited advantage of green infrastructure projects is the potential for “co-benefits” generated from its natural features, which depend on the generation of positive house price capitalization. Using

housing transactions data and exploiting variation in placement and design, we examine the capitalization of stormwater retention basins, a common green infrastructure project in suburban housing developments. Results show adjacency causes decreases in housing prices between 13 and 14% for the average home. Additionally this negative effect exacerbates with basin age. Rather than providing co-benefits, we find that stormwater basins generate a cost for proximate households.

Ecosystem Service Arguments Enhance Public Support for Environmental Protection - But Beware of the Numbers!

- Ecological Economics---2017---Julian Rode,Marc Le Menestrel,Gert Cornelissen

The trend in the discourse around environmental protection towards arguments based on ecosystem services and monetary valuation has prompted considerable controversy among academics and practitioners concerned with conservation. This paper informs the debate by exploring which arguments are most effective in garnering support for environmental protection. In a survey-based online experiment, participants stated their level of (dis)approval of a large-scale hydropower dam project after being presented with various kinds of arguments and information about the environmental impacts. The results show that ecosystem service arguments reduced levels of approval of the dam significantly (i.e. they increased support for environmental protection). However, moral-ecological arguments for protecting the environment proved even more effective, while a combination of both types of arguments reduced the dam approval ratings the most. Including a cost-benefit analysis (CBA) with monetary valuation of the costs of losing ecosystem services altered dam approval upwards or downwards, depending on the outcome of the CBA. The approval rates of males, of older participants and of politically right-wing participants were particularly sensitive to the outcomes of monetary valuation. More research is needed to understand the short and long term influence of different environmental discourses on peoples' judgments and

levels of environmental concern.

Fish Trade Liberalization Under 21st Century Trade Agreements: The CETA and Newfoundland and Labrador Fish and Seafood Industry

- Ecological Economics---2017---Gabriela Sabau,F. I. M. Muktadir Boksh

Both classical (Ricardo) and neo-classical (Heckscher-Ohlin) theories of international trade assume that free trade results in welfare gains for all involved. A more recent literature dedicated to liberalization of trade in renewable resources finds that welfare effects depend on certain factors, such as the country's status as importer or exporter, the state of the renewable resource stocks and the size of the country on the world market (Chichilnisky, 1993; Brander and Taylor, 1997a; Emami and Johnston, 2000, Hannesson, 2000), or remain theoretically indeterminate and require empirical analysis (Nielsen, 2009).

The Role of Strategic Behaviour in Ecosystem Service Modelling: Integrating Bayesian Networks With Game Theory

- Ecological Economics---2017---Luca Mulazani,Rosa Manrique,Giulio Malorgio

Humans fulfil an active role, through management and economic activities, in the production of ecosystem services and related benefits. Different human groups may pursue different objectives, and their actions may affect each other's well-being. Bayesian networks have gained importance in ecosystem service modelling and we show how, in recent literature, this approach has attempted to address strategic behaviour issues. Using simple simulations, we illustrate that the strategic behaviour of stakeholders could be better modelled with an integration of game theory concepts in Bayesian networks. This approach may help to understand the rationale behind stakeholders' behaviour and foresee their actions. Furthermore, the comparison of environmental results with cooperative and strategic behaviours raises questions about the role of humans in the production

of ecosystem services, and on the correct way to value their benefits.

Wind Power and Externalities

- Ecological Economics---2017---Alexander Zerrahn

This paper provides a literature review on wind power and externalities from multiple perspectives. Specifically, the economic rationale behind world-wide wind power deployment is to mitigate negative externalities of conventional electricity technologies, notably emissions from fossil fuels. However, wind power entails externalities itself. Wind turbines can lower quality of human life through noise and visual impacts, and threaten wildlife. Variable wind electricity can impose additional costs within the electricity system. Locally and nationally, employment, output, and security of electricity supply can be affected. Assembling evidence from diverse strands of research, this literature review provides a structured account of external and indirect costs, both mitigated and imposed.

Social Norms and Pro-environmental Behavior: A Review of the Evidence

- Ecological Economics---2017---Katherine Farrow,Gilles Grolleau,Lisette Ibanez

In light of the growing attention that social norm interventions have garnered as policy tools, we review the current body of evidence on their effectiveness with respect to pro-environmental behaviors. We identify the various conceptualizations of social norms currently in use and inventory the experimental economics and social psychology literature that has examined the impacts of social norm interventions on pro-environmental behavior. For each study included in this inventory, we note several contextual features, the data collection and analytical methods used, and any significant main effects attributed to the social norm intervention. We also review several theoretical models of behavior that incorporate social norms. Based on this empirical and theoretical review, we draw a number of policy implications and identify avenues for future research on the

role of social norms with respect to pro-environmental behavior.

Economic and Biological Conditions Influence the Sustainability of Harvest of Wild Animals and Plants in Developing Countries

- Ecological Economics---2017---Tarciso C.C. Leão,Diele Lobo,Lorraine Scotson

Promoting sustainable use of wild animals and plants is a global target in biodiversity conservation. However, the role of wild harvest as a conservation tool remains controversial. When unsustainable, wild harvesting leads to population decline or even extirpation of species. When sustainable, it has the potential to promote win-win solutions for conservation and development. We reviewed 87 cases of wild harvesting of vertebrates and plants in developing countries to understand the conditions influencing its sustainability. We used random forest and logistic regression to find the most important predictors among a range of biological, demographic and economic indicators, and to detail the predicted effects on sustainability of harvest. Species resilience, GDP per capita and poverty headcount ratio were the strongest predictors of sustainability. Species resilience was positively related to sustainability of harvest, whereas GDP per capita and poverty ratio were negatively related. Harvesting a species with low resilience is more likely to be unsustainable when harvested in a middle-income, high poverty ratio country than in a low-income, low poverty ratio country. This study highlights the risks of wild population harvest under the challenging economic conditions inherent in developing countries, and visualize where efforts are most needed to achieve sustainable harvest.

Preferences for variation in forest characteristics: Does diversity between stands matter?

- Ecological Economics---2017---Anna Filyushkina,Fitalew Agimass,Thomas Lundhede,Niels Strange,Jette Bredahl Jacobsen

The majority of existing studies of recreational preferences and forest characteristics focused on single stand

attributes and demonstrated that people prefer stands with visual variation. However, it may be too simple since most people experience more than one stand when visiting a forest. This study aims at evaluating the effects of variation both within and between stands on recreational values. A choice experiment (CE) was applied to elicit people's preferences for forest types on their next recreational visit. Each alternative is presented with drawings of three forest stands which differ with respect to tree species, height (age) and distance to the site, the latter representing the cost factor – willingness-to-travel. Respondents also compose their ideal recreational forest by selecting three types of stands from the catalogue of drawings. We find that mixed tree species are preferred compared to monocultures. Stands with trees of varying height (uneven-aged stands) are preferred over stands consisting of trees of the same height (even-aged ones). Variation between stands is found to contribute positively to recreational value, and in some instances, this may outweigh contribution of variation within a stand. Comparing respondents' composition of their ideal forest with elicited preferences from the CE, confirm these findings.

Scale of Production, Agglomeration and Agricultural Pollutant Treatment: Evidence From a Survey in China

- Ecological Economics---2017---Yazhou Liu,Yueqing Ji,Shuai Shao,Funing Zhong,Ning Zhang,Yishan Chen

Although some local governments in China have implemented mandatory environmental regulation policies to address severe pollution problems due to expanding pig production, whether such executive policies conform to the objective development law of pig production and are capable of effectively reducing pollution emissions is a pending issue. In this paper, we establish a theoretical model to illuminate the potential effects of the scale and agglomeration of pig production on the pollutant treatment rate and propose four theoretical hypotheses. Furthermore, we use survey data collected from Jiaxing city – the largest pig supply base

in China's Yangtze River Delta region – and employ both linear and nonlinear models to empirically test the theoretical hypotheses. The results show that the rate of faeces applied to the fields as manure decreases with the scale of pig production, while the rate of other harmless modes of pollutant treatment increases with the scale of production, resulting in a U-shaped relationship between the pollutant treatment rate and the scale of pig production. In addition, the total pollutant treatment rate increases with the agglomeration of pig production. We suggest that effective environmental regulation of pig production should differentiate between the types of pollution emissions generated by pig producers; according to their scale of production, pig producers should be classified as point or nonpoint sources of pollution.

An Input-output Economic Model Integrated Within a System Dynamics Ecological Model: Feedback Loop Methodology Applied to Fish Nursery Restoration

- Ecological Economics---2017---Mateo Cordier,Takuro Uehara,Jeffrey Weih,Bertrand Hamaide

While environmentally extended input-output (IO) models are commonly used for capturing interactions between ecosystems and economic systems, this kind of modelling cannot reflect interactions within the ecosystem. Isard's (1968) model has been the only exception. He entered interactions occurring within the ecosystem into IO. Nevertheless, given the linearity of IO, he could only analyze environmental issues in a linear fashion. We propose an alternative that reverses Isard's model types: the economic system is modelled within the ecosystem (not the contrary), as one of the ecosystem's components. To demonstrate its feasibility, we develop an ecological-economic model by integrating conventional economic IO within system dynamics (SD). After describing the methodological issues, we "test" the IO/SD model on ecological and economic data by applying it to the destruction and restoration of the Seine Estuary, France, where Common soles live. Our model brings insight into the consideration of feed-

back loops in the modelling of interactions between the ecosystem and the economic system. We believe such a tool may be of help to decision makers in mixing economic and environmental issues like, in our application case, fish habitat and harbour development.

Inconvenience cost of waste disposal behavior in South Korea

- Ecological Economics---2017---Misuk Lee,Hyunhong Choi,Yoonmo Koo

Pro-environmental activities, such as waste sorting, are considered inconveniencing; the higher the inconvenience, the more difficult it becomes to encourage active public participation. This study defines waste sorting behavior considering certain attributes and estimates the inconvenience costs associated with each attribute. The definition also considers how and when waste is disposed of as well as the hygiene of a disposal spot. We apply a conjoint analysis for data collection and latent class logit model to calculate the inconvenience costs. The model incorporates consumers' heterogeneity as a finite number of homogenous groups. The results show that the inconvenience cost for the hygiene of the disposal spot is generally higher than that of sorting itself; this tendency is strongest among young women. Moreover, older people report lower inconvenience costs than do younger ones. Further, some groups prefer manual sorting to an automated sorting service for food waste. Our findings offer policy implications considering such inconvenience costs.

Economic indicators of hydrologic drought insurance under water demand and climate change scenarios in a Brazilian context

- Ecological Economics---2017---Guilherme Samproghna Mohor,Eduardo Mario Mendiando

Developing countries face large losses to extreme natural hazards. Regarding droughts, planning instruments are important for managing water resources and diminishing the losses. Under increasing demand scenario, varied criteria should be incorporated indicating society's capacity to bear the consequences. Here we

present a Brazilian-contextualized insurance model and suggest its outputs as complementary criteria to assist water resources management and to inform the stakeholders. From the streamflow simulated using hydrologic models driven by a climate scenario, we applied the Hydrologic Risk Transfer Model (MTRH-SHS), an insurance fund simulator under a multi-year policy, to assess sustainability indicators and the premiums a community would pay to cover the expenses of water deficits. Multiple scenarios generated with MTRH-SHS link water yield and seasonality related to both premium and loss ratios. A 20% increase in water demand elevates the premium up to 0.1% of a local GDP. Even under current demand, premiums may surpass 0.5% of GDP because of changes in the hydrologic regime. Proportionally, more seasonal or varied regimes result in more heterogeneous loss events, which in turn is linked to higher insurance premiums. MTRH-SHS might raise awareness for decision-makers to cope with drought under changing water demand and climate in the Brazilian context.

Is Adaptive Co-management Delivering? Examining Relationships Between Collaboration, Learning and Outcomes in UNESCO Biosphere Reserves

- Ecological Economics---2017---Ryan Plummer, Julia Baird, Angela Dzyundzyak, Derek Armitage, Örjan Bodin, Lisen Schultz

This paper examines relationships among perceived processes and outcomes in four UNESCO biosphere reserves (BRs). BRs offer a unique opportunity to examine these relationships because they aim to foster more adaptive and collaborative forms of management, i.e. adaptive co-management (ACM). Accounting for the outcomes of ACM is a difficult task and little progress has been made to this end. However, we show here that ACM efforts in all four BRs had a myriad of positive results as well as ecological and livelihood effects. Process variables of collaboration and learning explained over half (54.6%) of the variability in results and over one third (35.1%) of the variability in effects. While the overall models for outcomes and subsequent

process were not significant, the regressions revealed predictive potential for both process variables. Our analysis highlights that a better process is associated with more positive outcomes and that collaboration and learning make unique contributions to outcomes. Opportunities for quantitative techniques to be utilized in understanding the dynamics of ACM are illustrated. Understanding relationships between process and outcomes (and vice versa) provides a sound basis to answer critiques, enhances accountability, and maximizes the potential of positive impacts for ecosystems and humans.

Multidimensional Analysis of Regional Tourism Sustainability in Spain

- Ecological Economics---2017---Marianela Carrillo, Jesús M. Jorge

In a context of expansion and development of the tourism sector worldwide, assessing the tourism sustainability performance of regions or countries becomes an important goal of strategic planning as a means to ensure an appropriate balance between present and future opportunities of areas with a tourism-based economy. Due to the multidimensional nature of the sustainability concept and the difficulties encountered in its measurement, composite indicators have increasingly been used as useful tools for the operationalization of sustainability. In this paper the study of tourism sustainability of Spanish regions is addressed by building a composite indicator that uses multicriteria decision techniques for the aggregation and weighting of the simple indicators considered. The developed index allows the representation of both the weak and strong sustainability paradigms, as well as other compromising, midway concepts between those. Moreover, the sustainability performance of the studied regions can be easily compared and a fair ranking of the regions can accordingly be obtained, which can serve as a starting point that stimulates public and private debate and promotes improvement actions to achieve sustainability.

Exploring Synergies Among Agricultural Sustainability Dimensions: An Empirical Study on Farming System in Almería (Southeast Spain)

- Ecological Economics---2017---E. Galdeano-Gómez,J.A. Aznar-Sánchez,J.C. Pérez-Mesa,L. Piedra-Muñoz

Measuring sustainability is a multi-attribute issue consisting of numerous variables that tend to be interrelated. The holistic perspective and the determination of said relationships, synergies and/or trade-offs, are aspects that have been receiving close attention in the literature on the subject. This paper aims to develop an analysis that considers these topics regarding the farming system in Almería, utilizing primary data obtained from surveys of a sampling of farmers and secondary data from the sector. A series of ecological, social and economic indicators are determined, following the framework of the Sustainability Assessment of Farming and the Environment (SAFE), and its subsequent aggregation using synthetic indexes. The estimation of interrelationships is carried out by means of a multivariate analysis, considering the endogeneity between the sustainability dimensions and the influence of several features of the agrifood system. The results reveal that the increase in the economic and social indicators reduces environmental pressures on the use of resources; in parallel, it can also be observed how social and environmental improvements reveal positive effects on the economic dimension of the farmers. Overall, this study presents an analytical study that combines indicators at farm level and the effects related to the productive activities surrounding agriculture.

Payments for Ecosystem Services: Rife With Problems and Potential—For Transformation Towards Sustainability

- Ecological Economics---2017---Kai M.A. Chan,Emily Anderson,Mollie Chapman,Kristjan Jespersen,Paige Olmsted

Payments for ecosystem services (PES) programs are one prominent strategy to address economic externalities of resource extraction and commodity production,

improving both social and ecological outcomes. But do PES and related incentive programs achieve that lofty goal? Along with considerable enthusiasm, PES has faced a wide range of substantial critiques. In this paper, we characterize seven major classes of concerns associated with common PES designs, and use these as inspiration to consider potential avenues for improvements in PES outcomes and uptake. The problems include (1) new externalities, (2) misplacement of rights and responsibilities, (3) crowding out existing motivations, (4) efficiency-equity tradeoffs, (5) monitoring costs, (6) limited applicability, and (7) top-down prescription/alienating agency. As currently practiced, many PES programs are thus of limited benefit and even potentially detrimental to sustainability. From this dire conclusion, we highlight several innovations that might be combined and extended in a novel approach to PES that may address all seven problems. Recognizing that PES necessarily articulate and even normalize values, our proposed approach entails designing these institutions intentionally to articulate rights and responsibilities conducive to sustainability—those we might collectively seek to entrench. Problems remain, and new ones may arise, but the proposed approach may offer a way to reimagine PES as a major social and economic tool for enabling sustainable relationships with nature, conserving and restoring ecosystems and their benefits for people now and in the future.

The Governance Features of Social Enterprise and Social Network Activities of Collective Food Buying Groups

- Ecological Economics---2017---Tom Dedeurwaerdere,Olivier De Schutter,Marek Hudon,Erik Mathijs,Bernd Annaert,Tessa Avermaete,Thomas Bleeckx,Charlotte de Callataÿ,Pepijn De Snijder,Paula Fernández-Wulff,Hélène Joachain,Jose-Luis Vivero

Collective food buying groups, such as community supported agriculture or self-organised citizen groups for delivery of food baskets, have emerged throughout the world as an important niche innovation for promoting

more sustainable agri-food systems. These initiatives seek to bring about societal change. They do so, however, not through protest or interest-based lobbying, but by organising a protected space for learning and experimentation with lifestyle changes for sustainable food consumption and production practices. In particular, they aim to promote social learning on a broad set of sustainability values, beyond a focus on “fresh and healthy food” only, which characterizes many of the individual consumer oriented local food chain initiatives. This paper analyses the governance features of such local food buying groups by comparing 104 groups in five cities in Belgium. We find that the social networking activities of these groups, as compared to the social enterprise activities, have led to establish specific governance mechanisms. Whereas the main focus of the social enterprise activities is the organisation of the food provisioning logistics, the focus of the social network activities is the sharing of resources with other sustainable food initiatives, dissemination of information and broader discussion on sustainability issues.

Shaded Coffee and Cocoa – Double Dividend for Biodiversity and Small-scale Farmers

- Ecological Economics---2017---Rosalien E. Jezeer,Pita A. Verweij,Maria J. Santos,René G.A. Boot

This paper compares financial and biodiversity performance of small-scale shaded coffee and cocoa plantations versus intensified conventional ones. We conduct a meta-analysis including 23 studies on coffee and cocoa plantations over a 26year period. Our results show that, contrary to common perceptions, profitability and cost-efficiency are higher for small-scale shaded systems. Despite the lower yields for shaded systems, the lower costs per area and higher price per kilogram of coffee or cocoa causes shaded systems to perform better financially. This finding shows that the traditional indicator ‘yield’ is an inaccurate measure of financial performance when studying diversified systems, and that the more detailed indicators as net revenue or benefit-cost ratio should be used instead.

Few studies specifically reported on the relationship between biodiversity and financial performance, providing divergent results, yet various papers showed a promising optimum relationship for intermediate levels of shade. Because shaded systems are known to correlate positively with biodiversity, we postulate that they can offer competitive business opportunities for small-scale farmers, while also contributing to biodiversity conservation. Still, there is a pressing need for multidisciplinary studies to quantify financial and biodiversity performance simultaneously, and to identify opportunities for scaling up shaded systems.

Freshwater for Cooling Needs: A Long-Run Approach to the Nuclear Water Footprint in Spain

- Ecological Economics---2017---Diego Sesma Martín,M^a. del Mar Rubio-Varas

From the invention of the steam engine to the present, water has represented a significant input to the energy system, although this has been mostly ignored in the literature. In Spain, the most arid country in Europe, studies about water footprint typically just consider domestic, agricultural and industrial water uses, but water requirements for the electricity sector are omitted despite our dependence on thermal power. It has been demonstrated that for each available cooling technology, nuclear needs and consumption of water tend to be larger per MWh generated. We calculate a first approximation to the Spanish nuclear water footprint from 1969 to 2014. Our results show that while water consumed by Spanish nuclear power plants are around 3 m³ per capita/year, water withdrawals per capita/year are around 70 m³. Moreover, our analysis allows extracting conclusions focusing on a River Basins approach. What is the water impact of our nuclear power plants? Will water limit our energy future? These are some of the issues at stake.

Measurement of Bequest Value Using a Non-monetary Payment in a Choice Experiment —The Case of Improving Forest Ecosystem Services for the Benefit of Local Communities in Rural Kenya

- Ecological Economics---2017---Iason Diafas,Jan Barkmann,John Mburu

This paper adds to the limited literature on the bequest value of environmental resources. A choice experiment (CE) was carried out in order to estimate the economic value of changes in ecosystem services that impact on the welfare of rural communities in the vicinity of a rainforest in Kenya. Our results demonstrate that, in addition to valuing immediate benefits, respondents were willing to pay 1750Kshs for the use of forest resources by posterity. The results also establish that the chosen non-monetary payment vehicle was not evaluated differently to a standard cash payment.

Ecosystem Services and Cultural Values as Building Blocks for ‘The Good life’ . A Case Study in the Community of Røst, Lofoten Islands, Norway

- Ecological Economics---2017---Bjørn P. Kaltenborn,John D.C. Linnell,Erik Gómez Baggethun,Henrik Lindhjem,Jørn Thomassen,Kai M. Chan

We examined the contribution of natural capital and social capital through the notion of cultural ecosystem services to shaping human well-being in the fishing community of Røst in the Lofoten Islands in Northern Norway. Through ethnographic observations, in-depth interviews, and a participatory scenario workshop we develop four narratives centering on the links of nature and ecosystem services. Benefits derived from ecosystem services are fundamental building blocks in the local vision of ‘the good life’ and emerge from a combination of satisfied preferences and struggle, hardships, and capabilities inflicted by a demanding environment and challenging work conditions. Beyond a certain level of meeting basic needs and provisioning of essential public services, simplicity in life and local control

over resources and surroundings was preferred over a multitude of other opportunities and services. Well-being was strongly linked to maintenance of identity through traditional practices for harvesting of natural resources, nurturing of skills, social cohesion, and acting meaningfully in one’s local environment. In a relational perspective, cultural ecosystem services are constituted and given meaning through interaction with nature. The main policy implication is that contributions of natural and social capital to well-being proved to be hard to meaningfully separate.

Heterogeneity in Intention to Adopt Organic Strawberry Production Practices Among Producers in the Federal District, Brazil

- Ecological Economics---2017---D.A. Andow,Moisés Resende Filho,R.G. Carneiro,D.R. Lorena,E.R. Sujii,R.T. Alves

Despite its benefits, adoption of organic farming is low in Brazil. We used the theory of planned behavior to determine factors that influenced a farmer’s decision to adopt organic production methods and identify key social psychological barriers. We focused on strawberry production as a model, and surveyed 83 conventional strawberry farmers (response rate 90.2%), and found that attitudes and perceived behavioral control (PBC) predicted intent to adopt organic production ($r^2=37.2\%$). For farmers interested in conversion, beliefs about the improved social/financial status from conversion were positively related to their attitude toward conversion, and the lack of control over informational and physical resources was negatively related to PBC. For farmers disinterested in conversion, the influence of their social norms was stronger than for interested farmers, and PBC most strongly influenced their intention to convert. These results suggest that different strategies should be pursued for encouraging conversion to organic strawberry production. For interested farmers, their interest may be enhanced by addressing their attitudinal beliefs, and allaying concerns over access to technical assistance. For disinterested producers, it may be important to raise the salience of their positive attitudinal beliefs, involve

people whose opinions they value, and enhance their perceived control over information and risks.

Personal Values, Green Self-identity and Electric Car Adoption

- Ecological Economics---2017---Camilla Bar-
barossa,Patrick De Pelsmacker,Ingrid Moons

Personal values, green self-identity and ethical motives have been widely studied as important, but mostly separate, predictors of pro-environmental behaviors. Scholars call for more research on the combined effects of these variables, to explain pro-environmental behavior. In this regard, this study presents a model of electric car adoption intention, in which personal values determine green self-identity, which in turn influences consumer intention to adopt electric cars directly and also indirectly via ethical motives of ecological care and moral obligation. Second, this work explores how personal values moderate the relationships between green self-identity, ecological care, moral obligation and electric car adoption intention.

Climate Change Constrains the Efficiency Frontier When Managing Forests to Reduce Fire Severity and Maximize Carbon Storage

- Ecological Economics---2017---Benjamin A.
Bagdon,Ching-Hsun Huang,Stephen De-
whurst,Andrew Sánchez Meador

Pareto efficiency frontiers are ideal analytical tools for evaluating likely shifts in the production of forest ecosystem services under climate change. In the context of multi-objective forest management, these frontiers, or the set of non-dominated solutions for a set of objectives at varying levels of output, provide quantitative measures of trade-offs between competing ecosystem services and changes in the best-possible management outcomes for different climate change scenarios. We used outputs from a forest growth-and-yield model that simulated wildfire and management to examine three types of Pareto frontier analyses: 1) carbon storage maximization under changing budgetary

constraints with and without wildfire effects, 2) minimization of undesirable wildfire effects under changing budgetary constraints, and 3) minimization of undesirable wildfire effects at varying constrained carbon storage levels. We found that over 45years climate change reduced the average amount of carbon stored, whether or not we simulated a wildfire on the 23,204ha study area despite our best management efforts. Climate change also adversely affected the trade-off rate, or slope of the frontiers, between carbon storage and wildfire effects. We illustrate how the application of a methodology typically used in economics can reveal insights in forest ecosystem management otherwise hidden to decision-makers.

Costs and Benefits of Rodent Eradication on Lord Howe Island, Australia

- Ecological Economics---2017---Robert Gille-
spie,Jeffrey Bennett

2017

Understanding Spatial Variation in the Drivers of Nature-based Tourism and Their Influence on the Sustainability of Private Land Conservation

- Ecological Economics---2017---Julia
Baum,Graeme S. Cumming,Alta De Vos

Protected areas connect socio-economic and ecological systems through their provision of ecosystem goods and services. Analysis of ecosystem services allows the expression of ecological benefits in economic terms. However, cultural services, such as recreation opportunities, have proved difficult to quantify. An important challenge for the analysis of cultural services is to understand the geography of service provision in relation to both human and ecological system elements. We used data on visitation rates and measures of context, content, connectivity, and location for 64 private land conservation areas (PLCAs) to better understand geographic influences on cultural service provision. Visitation to PLCAs was influenced by a combination of ecological and socio-economic drivers. Variance partitioning analysis showed that ecology explained the

largest proportion of overall variation in visitation rates (26%), followed by location (22%). In tests using generalized linear mixed models, individual factors that significantly explained visitation rates included the number of mammal species, the number of Big 5-species (ecological variables), the number of facilities provided (infrastructure) and average accommodation charges (affordability). Our analysis has important implications for the economic sustainability of PLCAs and more generally for understanding the relevance of spatial variation for analyses of cultural services.

How Sensitive Are Environmental Valuations To Economic Downturns?

- Ecological Economics---2017---Maria Loureiro, John Loomis

This paper assesses the temporal stability of willingness to pay estimates (WTP) under changing economic conditions. Specifically, two questions are addressed: a) is WTP stable over time? And b) if it is not, are the changes just driven by socio-economic effects, or something else? In order to investigate these questions, we used data from the Contingent Valuation Method (CVM) study conducted after the Prestige oil spill in Spain in 2006, and a second wave of the same survey repeated in 2009, after Spain entered a serious recession. Median WTP estimates dropped from €60.36 in 2006 to €26.92 in 2009 per household, a statistically significant reduction. To investigate the amount of the drop in WTP due to observables versus changes in preferences between 2006 and 2009, we use the 2006 logit WTP coefficient estimates with 2009 levels of the independent variables and we obtain a WTP of €46.37. This estimate is statistically different from the 2009 estimate (€26.92). In the same fashion, by using 2009 logit WTP coefficients with 2006 data, we obtain an estimate of €50.29, also different from the 2006 estimate. Implications of these findings for temporal stability of welfare measures and benefit transfer exercises are also discussed.

Ex-ante evaluation of policy measures to enhance carbon sequestration in agricultural soils

- Ecological Economics---2017---Daniel Hermann, Saramena Sauthoff, Oliver Musshoff

In the course of climate change, sequestration of soil organic carbon (SOC) has gained importance as a compensation for carbon emissions. Moreover, the promotion of SOC is increasingly advocated as a measure to sustainably increase crop yields and reduce agricultural production risks. Applying an incentivized extra-laboratory experiment, we evaluate the factors and policy measures that affect the decision to promote SOC using a sample of German farmers. Our results reveal that farmers were highly motivated to promote SOC. Political fostering through subsidy payments increased farmers' efforts to build SOC. Efforts remained constant if economically equal payments were designated as certificates rather than subsidies. Surprisingly, certificates with uncertain payments increased farmers' efforts to enhance SOC to a similar degree as subsidy and certificate scenarios, which provided fixed and therefore certain payments. Thus, these results contribute valuable information regarding the effectiveness of market-based policy measures which aim to include farmers in climate protection strategies.

Multi-Product Category Choices Labeled for Ecological Footprints: Exploring Psychographics and Evolved Psychological Biases for Characterizing Latent Consumer Classes

- Ecological Economics---2017---B.E. Steiner, A.O. Peschel, C. Grebitus

This paper explores psychographics and evolved psychological biases to characterize consumer segments regarding pro-environmental choices. Based on survey-evidence from Germany, we analyze consumer preferences for two product categories, a food-staple and a non-food staple, labeled for carbon and water footprints. Latent class analysis is employed to identify

and characterize distinct consumer segments as a function of consumers' 'ecological worldview', consumer involvement, motivation to attend to product label information, personal values, as well as consumers' environmental group membership and donation behavior. Results suggest that latent segments of ecologically-oriented consumers can be differentiated from price-sensitive segments, with the former appearing less prone to certain evolved psychological biases compared to the latter segments. In contrast to previous work on self-reported ecologically conscious behavior, our results highlight the role of personal values, in particular that of personal health. This is found to be valued less by ecologically-oriented consumers, indicating that such individuals may have a strong communal focus in their value orientation. In terms of policy implications, our findings suggest that sustainability labels can provide valuable and interpretable information to consumers, yet more effective intervention efforts may require a stronger focus on targeted information provision with regard to carbon rather than water footprints.

Economic Growth and the Evolution of Material Cycles: An Analytical Framework Integrating Material Flow and Stock Indicators

- Ecological Economics---2017---Chao Zhang,Wei-Qiang Chen,Gang Liu,Da-Jian Zhu

Understanding the relationship between material cycles and economic growth is essential for relieving environmental pressures associated with material extraction, production, and consumption. We developed an integrated analytical framework of dematerialization analysis incorporating both material flow and stock indicators. A four-quadrant diagram is designed to classify different stages of dematerialization based on the elasticity of material flow/stock to economic output or well-being. We then conducted a case study on the long-term evolution of aluminum cycle in the U.S., and found that different material flow and stock indicators decoupled from gross domestic product (GDP) growth in a clear sequential pattern. Flows closer to the beginning of the aluminum cycle (e.g., primary

aluminum production) decoupled from GDP earlier than flows closer to the final consumption stage (e.g., consumption of final products). In-use stock of aluminum decoupled from GDP much more slowly than any flow indicator, and had just reached the status of relative decoupling around 2000. This phenomenon is determined by the fact that different causes of dematerialization, such as import substitution and secondary material recycling, take effect at different stages of economic development. Comprehensive understanding of dematerialization depends on in-depth analysis on material-economy relationships from an integrated stock and flow perspective.

Modeling the Contribution of Existing and Potential Measures to Urban Sustainability Using the Urban Biophysical Sustainability Index (UBSI)

- Ecological Economics---2017---Zeev Stossel,Meidad Kissinger,Avinoam Meir

Advancing urban sustainability requires an implementation of various measures such as environmental policy, behavioral change, and technological developments, which have to be taken at various spatial scales. However, choosing the right measures demands considering their potential contribution in reducing the environmental impact and advancing urban sustainability. In recent years, some attempts to assess the contribution of implementing various measures have been advanced by various researchers focusing on different components of urban environmental interactions. While these studies make a significant contribution towards the understanding of the impact of various measures taken for a specific environmental issue, they mostly ignore the diversity and complexity of the urban interface with the environment at different spatial scales, as well as the ecological economics perspective, which approaches the city as a system. This paper uses the UBSI index published recently in this journal, to evaluate the urban biophysical sustainability of the city of Tel Aviv-Jaffa (Israel) in 2014. Based on this data, future scenarios are developed, which examine the potential contribution of various policy measures and different technological

processes to the city's sustainability. This examination is conducted while considering population growth and changes of consumption patterns as they are expected to occur until 2030.

Investigating the Impact of Agricultural Land Losses on Deforestation: Evidence From a Peri-urban Area in Canada

- Ecological Economics---2017---Haoluan Wang,Feng Qiu

Although deforestation has been studied extensively in tropical regions and developing countries, research focusing on developed countries in a peri-urban setting is scarce. This study helps to fill this gap in the literature by investigating the drivers of forest-to-agriculture conversion in one of the largest metropolitan areas and its surrounding peri-urban regions in Canada, focusing on the effect of farmland losses to development. A unique contribution of this study is that we take into account the heterogeneous forestland availability in the empirical investigation, which makes the estimation more realistic and accurate. Generalized spatial two-stage least square (GS2SLS) models are adopted to control for spillover effects from deforestation activities in neighboring areas and also to solve the potential endogeneity problem resulted from simultaneous land-use changes. Key findings include the following: agricultural land losses are an important driver for deforestation, and the magnitude of impact increases as the availability of forest-cover increases; population growth hinders the process of deforestation; high road density encourages forestland conversion to agriculture. Future policy-design shall find it helpful to incorporate the agricultural land expansion onto forestland due to land development when evaluating the social, economic, and environmental consequences of urbanization.

Waste Performance of NUTS 2-regions in the EU: A Conditional Directional Distance Benefit-of-the-Doubt Model

- Ecological Economics---2017---Nicky Rogge,Simon De Jaeger,Carolien Lavigne

This paper attempts to benchmark the municipal solid waste (MSW) management performance of the NUTS 2-regions in the EU by constructing a composite indicator. In order to account for commensurability, weighting and aggregation issues of the performance indicators in regional waste and materials' management, this paper advocates a conditional directional distance version of the Benefit-of-the-Doubt weighting technique. In addition, the waste management hierarchy defined by the EU is strongly embedded in the construction of our composite indicator. The results reveal considerable differences in the aggregate performance of the regions, even within Member States. In general, waste sectors of the NUTS 2-regions in Austria, Belgium, and Germany generally do well in terms of MSW management. Our results also reveal that some differences in the operating environment of the regions, such as the number of tourist overnight stays, are related to the aggregate performance of the regions. However, the observation that other conditions are not significantly related to the performance on a regional level is interesting as many policy makers frequently argue that the level of performance in their regions cannot be compared to that in other regions precisely due to this difference in operating conditions.

International Trade and Energy Intensity During European Industrialization, 1870–1935

- Ecological Economics---2017---Astrid Kander,Paul Warde,Sofia Teives Henriques,Hana Nielsen,Viktoras Kulionis,Sven Hagen

Previous research suggests that there is an inverted U-shape curve for energy intensity in the long-run for Western Europe with a peak in the early 20th century. This paper tests the hypothesis that the increase of German and British energy intensity was an effect from the concentration of heavy industrial production to these countries, although the consumption of a significant share of these goods took place elsewhere. We use an entirely new database that we have constructed (TEG: Trade, Energy, Growth) to test whether these countries exported more energy-demanding goods than they imported, thus providing other countries with

means to industrialize and to consume cheap-energy demanding goods.

Dancing With Storks: The Role of Power Relations in Payments for Ecosystem Services

- Ecological Economics---2017---Hiroe Ishihara, Unai Pascual, Ian Hodge

The institutional change induced by payments for ecosystem services (PES) schemes is a ‘messy’ process. The uptake and outcomes of PES schemes cannot be fully explained from a rational choice perspective. The notion of ‘institutional bricolage’ is needed to analyse how actors assemble or reshape their actions by combining new institutions such as a PES scheme within other locally embedded institutions. A case study from Japan is used to illustrate how a PES scheme designed to conserve the habitat of a charismatic and endangered flagship species, the Oriental White Stork, has been reshaped by social actors to fit the locally dominant ‘institutional logic’. We also show how the resulting institutional change is not only able to subvert policy makers’ original assumptions, for instance about how to target and distribute the payments, but can also contribute to the reproduction of unequal power relations.

The Development of Industrial Symbiosis in Existing Contexts. Experiences From Three Italian Clusters

- Ecological Economics---2017---Raffaella Taddeo, Alberto Simboli, Anna Morgante, Suren Erkman

It is acknowledged that Industrial Symbiosis (IS) is not only a technical phenomenon; socio-relational, organizational, and cultural issues come to light in its development as well. This is much more evident when an IS relies on existing contexts. Industrial networks and clusters have been proven to be one of the best models of local industrial development, and they can be considered also a favorable starting context for IS projects. The relations between traditional and symbiotic networks have been deeply investigated, but the

complexity and the scientific and practical implications of the topic render the discussion still open. The present article contributes to this debate by clarifying the dynamics of the IS development in connection with the features of existing industrial clusters. The study proposed uses the results and the experiences gained by the authors in three case studies previously conducted, in order to develop an interpretative framework for assessing the potential and the limits for the development of IS-based scenarios. Empirical evidences show both the role of significant technical factors in designing the IS and the role played by non-technical factors in promoting and preventing its potential implementation.

Good for the Economy? An Ecological Economics Approach to Analyzing Alberta’s Bitumen Industry

- Ecological Economics---2017---Gerda J. Kits

Competing claims about the economic, social and environmental impacts of bitumen projects make Alberta’s oilsands industry highly contentious. This paper uses a case study of a major bitumen project, Shell Canada’s Jackpine mine expansion, to examine the evidence considered by government decision-makers in the project approval process. The project was determined to be “in the public interest” based primarily on its economic benefits, despite significant adverse environmental and social impacts. The paper evaluates the evidence that was presented to support this decision, using three criteria drawn from ecological economics: efficient allocation, just distribution, and sustainable macroeconomic scale. It finds that the evidence presented is, in fact, insufficient to justify the project on any of the three criteria. Furthermore, other studies of the bitumen industry cast doubt on the likelihood that the project would satisfy these criteria if further analysis were conducted. It concludes by recommending several measures that could help to improve decision-making on bitumen projects in the future.

Cost-effective Land Use Planning: Optimizing Land Use and Land Management Patterns to Maximize Social Benefits

- Ecological Economics---2017---Derric N. Pennington,Brent Dalzell,Erik Nelson,David Mulla,Steve Taff,Peter Hawthorne,Stephen Polasky

Improving water quality and other ecosystem services in agriculturally dominated watersheds is an important policy objective in many regions of the world. A major challenge is overcoming the associated costs to agricultural producers. We integrate spatially-explicit models of ecosystem processes with agricultural commodity production models to analyze the biophysical and economic consequences of alternative land use and land management patterns to achieve Total Maximum Daily Loads targets in a proto-typical agricultural watershed. We apply these models to find patterns that maximize water quality objectives for given levels of foregone agricultural profit. We find it is possible to reduce baseline watershed phosphorus loads by ~20% and sediment loads by ~18% without any reduction in agricultural profits. Our results indicate that meeting more stringent targets will result in substantial economic loss. However, when we add the social benefits from water quality improvement and carbon sequestration to private agricultural net returns we find that water quality improvements up to 50% can be obtained at no loss to societal returns. The cost of meeting water quality targets will vary over time as commodity and ecosystem service prices fluctuate. If crop prices drop or the value of ecosystem services increase, then achieving higher water quality goals will be less costly.

How Funding Source Influences the Form of REDD+ Initiatives: The Case of Market Versus Public Funds in Brazil

- Ecological Economics---2017---Guilherme Piffer Salles,Delhi Teresa Paiva Salinas,Sônia Regina Paulino

The Mechanism to Reduce Emissions from Deforestation and Forest Degradation (REDD+), which is being implemented by the United Nations Framework

Convention on Climate Change, is considered essential to provide economic incentives for the adoption of forest-based mitigation measures against global climate change. This article analyses the key characteristics of REDD+ pilot initiatives in Brazil from different perspectives concerning the concept of payment for environmental services, while exploring how these characteristics relate to the funding models adopted, regardless of whether they are sourced from public funds or via the carbon market. Data collected from publicly available databases are analysed using hypothesis tests. Ten variables from 89 pilot initiatives approved by the Voluntary Carbon Market or the Fundo Amazônia (Amazon Fund) are examined. Findings show that initiatives under each funding model have distinct characteristics in terms of stakeholders, criteria for incentive concession, time frames, geographical reach, as well as Measurement, Report and Verification (MRV) practices. Differences are consistent with distinct theoretical conceptions on incentive-based economic instruments.

The Impact on Global Greenhouse Gas Emissions of Geographic Shifts in Global Supply Chains

- Ecological Economics---2017---Xuemei Jiang,Christopher Green

During the past two decades there has been a shift in the geography of Global Supply Chains (GSCs) from developed countries to China, and more recently from China to successor developing countries in South Asia, Africa and Latin America. The shift in GSC geography influences global greenhouse gas (GHG) emissions because of an energy efficiency and low-carbon technology gap between developed and developing economies. Our simulations indicate that changing GSC geography toward China positively contributed, on average (2001–2008), 919 Mt CO₂ equivalents to global GHG emissions annually. In addition, there are potentially even larger indirect effects, including import-related and transportation-related emissions that are attributable to GSC shift-related improvements in developing world consumption and infrastructure. We

then investigate the emission impact of a further GSCs shift toward South Asia, Africa and Latin America. Although the direct impact of such a shift is likely negative due to a lower dependency on coal as well as lower carbon intensities in South Asia, Africa and Latin America relative to China, it is likely that the direct effects are more than offset by the indirect shift-related effects associated with improvements in consumption and infrastructure. Our results have policy implications for future climate change mitigation.

Rethinking Monitoring in Smallholder Carbon Payments for Ecosystem Service Schemes: Devolve Monitoring, Understand Accuracy and Identify Co-benefits

- Ecological Economics---2017---Geoff Wells,Janet A. Fisher,Ina Porras,Sam Staddon,Casey Ryan

Monitoring is a key aspect of payments for ecosystem services (PES) schemes, providing a basis for payments. PES monitoring however presents challenges, including in balancing technical accuracy with cost, local equity and legitimacy. This is particularly true in smallholder carbon PES, where managers have limited resources and capacity. Here we explore ways to improve monitoring in smallholder projects. We looked at two well-established projects in Uganda and Mexico, and appraised five monitoring methodologies: two remote sensing and three field measurement approaches. Each methodology varied in data resolution, methodological complexity and degree of local participation. We collected quantitative and qualitative information on four aspects of performance: accuracy; costs; local equity; and local legitimacy. We show that methodologies with greater data resolution and local participation performed better in all four aspects, while greater methodological complexity was not associated with significantly improved performance. We conclude that monitoring in smallholder and other types of PES may be improved through: 1) devolving analyses to the local level; 2) communicating to stakeholders a distinction between ‘applied’ and ‘scientific’ accuracy; and 3) documenting and communicating the diverse functions of monitoring, referred to here as co-benefits

– a contrast to simple ‘monitor and pay’ conceptions of PES.

The Impact of Aquatic Salinization on Fish Habitats and Poor Communities in a Changing Climate: Evidence from Southwest Coastal Bangladesh

- Ecological Economics---2017---Susmita Dasgupta,Mainul Huq,Md. Golam Mustafa,Md. Istiak Sobhan,David Wheeler

Fisheries constitute an important source of livelihoods for tens of thousands of poor people in the southwest coastal region of Bangladesh, and they supply a significant portion of protein for millions. Among the various threats fisheries in the southwest coastal region will face because of climate change, adverse impacts from increased aquatic salinity caused by sea level rise will be one of the greatest challenges. This paper investigates possible impacts of climate change on aquatic salinity, fish species habitats, and poor communities using the salinity tolerance ranges of 83 fish species consumed in the region and aquatic salinity in 27 alternative scenarios of climate change in 2050. The results provide striking evidence that projected aquatic salinization may have an especially negative impact on poor households in the region. The estimates indicate that areas with poor populations that lose species are about six times more prevalent than areas gaining species.

Simulated exchange values and ecosystem accounting: Theory and application to free access recreation

- Ecological Economics---2017---Alejandro Caparrós,José L. Oviedo,Alejandro Álvarez,Pablo Campos

This paper discusses the Simulated Exchange Value method, a practical method to estimate values for goods and services currently outside of the market in a manner consistent with the market-based figures considered in national accounts. The method proposes to simulate, in a partial equilibrium context, the price that would occur if a good or service outside of the

market, such as free access recreation in forests, were internalized. The method takes into account the demand, estimated using non-market valuation techniques, the supply and the market structure. The discussion covers the case of a linear demand and the case in which the demand is estimated using discrete choice methods. This paper applies the method to free access recreation in the forests of Andalusia, in the south of Spain, and compares the results to those obtained using Hicksian variations.

Buen Vivir vs Development (II): The Limits of (Neo-)Extractivism

- Ecological Economics---2017---C. Unai Villalba-Eguiluz,Iker Etxano

Like the entire Andean region, Ecuador has an economic structure that is dependent on primary exports. During the last boom in commodity prices the (neo-)extractivist development strategy generated economic growth and simultaneously reduced inequality. However, this bonanza was not used to advance in economic diversification or for transition towards Buen Vivir (Sumak Kawsay –Good Living) as postulated in the Constitution and the National Development Plans. We establish that (neo-)extractivism is not compatible with Buen Vivir, analysing three concrete aspects to this end: the failure to fulfill the rights of nature and ecological sustainability; the lack of advances in transforming the productive matrix; insufficient results in matters of redistributive social policies.

Eco-efficiency of Virgin Resources: A Measure at the Interface Between Micro and Macro Levels

- Ecological Economics---2017---Frank Figge,Philippe Givry,Louise Canning,Elizabeth Franklin-Johnson,Andrea Thorpe

Eco-efficiency is often considered an adequate response to the problem of the scarcity of non-renewable resources. Even if a more eco-efficient use of natural resources cannot guarantee lower resource consumption, it can allow a better combination of desirable economic activity with undesirable resource use. However,

more eco-efficient use of resources at the micro-level does not always lead to higher eco-efficiency at the macro-level. This is due to resource flows between actors at the micro-level. They use both virgin resources and resources that have been previously used. Virgin resources represent the relevant scarcity at the macro-level, while eco-efficiency at the micro-level typically does not discriminate between virgin and used resources. We develop an eco-efficiency formula that closes this gap. Our formula not only allows the measurement of the eco-efficiency of virgin resource use at the micro-level, but also helps to identify the drivers of the eco-efficiency of virgin resource use. Application of the formula to the case of gold in smartphones points to the very limited potential of technical improvements and shows that behavioural and collaborative endeavours promise dramatically higher improvements in eco-efficiency. This calls for a reconsideration of the focus of efforts to increase eco-efficiency for sustainable development.

A Multi-regional Economic Impact Analysis of Alaska Salmon Fishery Failures

- Ecological Economics---2017---Chang K. Seung

Recently, the harvest of Chinook salmon (*Oncorhynchus tshawytscha*) in some areas of Alaska was severely curtailed due to a significant reduction in the salmon runs. This generated adverse economic impacts in the areas. Unlike previous studies of impacts of changes in fisheries, which often rely on single-region economic impact models, this study uses a multi-regional social accounting matrix (MRSAM) model of three US regions – Alaska, West Coast, and the rest of US – to calculate the multi-regional economic impacts of the Chinook salmon fishery failures, considering the countervailing effects of federal disaster funds paid to commercial salmon fishermen. To estimate the negative effects of the reduced salmon harvest, this study uses “adjusted demand-driven MRSAM model”, which avoids the double-counting problem encountered when a demand-driven model is used to compute the effects of exogenous output change, and overcomes the weakness of Ghosh (1958) approach in estimating the

forward-linkage effects. To calculate the positive effects of federal relief payments, this study uses a Leontief demand-driven MRSAM model. Results indicate that the salmon fishery failures have significant adverse economic impacts including both intra-regional (Alaska) and inter-regional (West Coast and the rest of US) impacts, and that the disaster relief mitigates only a small portion of the adverse impacts.

Managing Forests for Carbon and Timber: A Markov Decision Model of Uneven-aged Forest Management With Risk

- Ecological Economics---2017---Craig Johnston,Patrick Withey

This paper calculates steady state management decisions that, if followed indefinitely, provide an adaptive strategy that maximizes the value from timber and carbon sequestration when risk is present. By including carbon offsets directly in the objective function of a Markov decision process (MDP) model, we find long-term trade-offs exist between economic and ecological outcomes. An economic supply schedule is provided, which shows an exponential increase in the cost of sequestration. Moderate carbon prices effectively sequester additional CO₂ from the atmosphere while having a positive impact on ecological indicators such as size and species diversity. In contrast, high carbon prices promote more of a monoculture in order to maximize expected forest value in the long run from carbon sequestration. This study finds evidence that the optimal adaptive decisions are sensitive to the magnitude of carbon prices, and consequently, so too are ecological outcomes. While some governments acknowledge the influence carbon markets have on the ecological integrity of the forest, fluctuations in carbon prices within a cap-and-trade market likely influence the optimal decision making of the forest manager, and thus, the ecological landscape of the forest itself.

Clarifying the Epistemology of Corporate Sustainability

- Ecological Economics---2017---Sigurd Sagen Vildåsen,Martina Keitsch,Annik Magerholm Fet

Business research is placing increasing focus on the relationship between the natural environment and the political concept of sustainable development. Within this nexus, one area, labelled ‘Corporate Sustainability’, emphasizes the interactions between economic, environmental and social values. The need to consider multiple values has contributed to a blur in the conceptual landscape. This is partly due to the fact that authors often address epistemological challenges on an implicit level. Moreover, hidden ideologies, e.g. the profit maximization paradigm, can explain the conceptual obscurity.

Applying a ‘Value Landscapes Approach’ to Conflicts in Water Governance: The Case of the Paraguay-Paraná Waterway

- Ecological Economics---2017---Christopher Schulz,Julia Martin-Ortega,Antonio A.R. Ioris,Klaus Glenk

Values have been identified as important factors to estimate preferences within water governance and to assess the political legitimacy of water governance in a given time and location. The present study applies an interdisciplinary ‘value landscapes approach’ to water governance in the state of Mato Grosso, Brazil, using conflicts around the construction of the Paraguay-Paraná Waterway as a case study. Using material from interviews with major stakeholders in the region, the results demonstrate that supporters of the waterway hold similar ‘value landscapes’ around economic values of water, efficiency, order, and economic development, while opponents’ ‘value landscapes’ centre on cultural and non-economic values of water, social justice, solidarity, conservation and tradition. This suggests that persistent conflicts around the Paraguay-Paraná Waterway are only an expression of much deeper value conflicts that are also relevant to other water governance issues. Moreover, values expressed through the planned construction of the Paraguay-Paraná Waterway disproportionately reflect values of powerful stakeholder groups such as the agribusiness sector, which significantly undermines its political legitimacy.

Environmental Valuation With Periodical Payments in High-inflation Economies. An Argentinean Case Study

- Ecological Economics---2017---Verónica Ferreras,Pere Riera,Pablo Salvador

Stated preference valuation surveys often ask respondents for periodical payments, sometimes for the remaining life of the individuals. Questionnaires do not usually specify whether those payments would vary according to inflation. This may be less important in low-inflation economies, but results could differ significantly in high-inflation countries. A contingent choice exercise was conducted to explore the severity of this effect in Argentina. The empirical application focused on an anthropogenic-pressure mitigation program for the basins of the Mendoza region. A comparison of willingness-to-pay results from a scenario where annual payments were to be increased according to inflation with another of fixed annuities, found inflation to be significantly influential on respondents' stated values. Furthermore, a test on the robustness of the estimated values found results to be consistent with prior expectations.

Stability of Willingness-to-Pay for Coastal Management: A Choice Experiment Across Three Time Periods

- Ecological Economics---2017---Yvonne Matthews,Riccardo Scarpa,Dan Marsh

A key assumption of stated preference methods is that individuals have well-formed preferences that are robust over time. Both the discovered and constructed preference perspectives imply this is not necessarily the case. There can be a large situational component to expressed preferences that add to the uncertainty of sampling error. Most non-market valuation studies only collect data from one point in time so the degree of temporal variability cannot be tested. Test-retest studies that provide data from two points in time generally find significant differences in preference structure and willingness-to-pay (WTP). In this study we test stability of WTP for beach erosion management using

a fully ranked discrete choice experiment survey with not one but two retests over a six month period. We find that stability does not improve with the additional repetition as the preference discovery hypothesis implies it might. WTP confidence intervals overlap but the models are significantly different at each point in time, even after allowing for variation in choice error. Either the survey did not facilitate sufficient preference discovery or preferences were reconstructed. However, respondents with high scores of self-reported certainty in their choices in the first survey had significantly more stable WTP estimates.

Shifting Priorities in Degrowth Research: An Argument for the Centrality of Human Needs

- Ecological Economics---2017---Max Koch,Hubert Buch-Hansen,Martin Fritz

We present an argument for the deprioritization of subjective well-being and a prioritization of human needs within degrowth research. First, we discuss empirical evidence, methodological problems and theoretical shortcomings of subjective well-being concepts. While data for one country over time suggest a flattening of the happiness curve relative to GDP growth, cross country comparisons reveal that the richest and most environmentally unsustainable countries are also the 'happiest'. Methodologically, we point to the issue of adaptability. A limitation in the use of 'positional goods' is unlikely to be accompanied by short-term increases in subjective well-being. Theoretically, we question 'happiness', where it helps promote growth and disguise structural relationships of inequality. Secondly, we sketch out an alternative degrowth research agenda oriented at the satisfaction of human needs. Here, Doyal and Gough's theory of human needs is especially useful due to its systematic account of environmental limits and the 'policy-auditing' approach that follows from it. Finally, we illustrate such a needs-based research agenda at the example of food by reviewing recent research on the environmental impacts of different diets and kinds of food production and on how these forms compare in terms of scale and land-use.

The impact of air pollution and noise on the real estate market. The case of the 2013 European Green Capital: Nantes, France

- Ecological Economics---2017---Rémy Le Boennec,Frédéric Salladarré

In this paper, we aim to demonstrate the way air pollution and noise may affect the well-being of the inhabitants of Nantes, France, designated the European Green Capital in 2013. We use a database compiling certain attributes of the houses that exchanged hands and their price. In order to understand the complex relationships that can exist between explanatory variables and housing price, we consider not only the direct effects of air pollution and noise on the price of around 3000 houses sold in Nantes and its metropolitan area from 2002 to 2008, but also the way some location attributes of the dwellings may affect air pollution and noise. We demonstrate that even if air pollution may be affected by some location characteristics of the house, this variable has no significant impact on the price, in the end. Noise is affected by the location of the house and exerts some significant effect on housing price. However, whilst air pollution does not impact at a global level, people who have lived in an air polluted county before coming to Nantes are sensitive to air quality, whereas those who come from a low air polluted county tend to choose low noise exposure dwellings.

Balancing Risks from Climate Policy Uncertainties: The Role of Options and Reduced Emissions from Deforestation and Forest Degradation

- Ecological Economics---2017---Alexander Golub,Ruben Lubowski,Pedro Piris-Cabezas

Progressively adjusting climate policies will entail adjustment costs for society. This paper develops a conceptual model and numerical example that illustrate the risk associated with exposure to the high costs of complying with future emissions controls and how this risks trades off against that from potentially premature investment into abatement. We then highlight

the potentially unique role of tropical forest protection in helping to manage these risks by providing a cost-effective “buffer” of near term emissions reductions at a globally significant scale. This buffer would provide insurance against the risk of suddenly tightening targets, as well as providing other critical environmental benefits. We further examine how a version of a private finance instrument in the form of long-dated ‘call’ options on verified reductions in emissions from deforestation and forest degradation (i.e. REDD+) can help to operationalize this risk-hedging buffer creation. Options on REDD+ could aid both regulated businesses and tropical nations to manage their respective risks. REDD+ options could deliver sufficient abatement to significantly hedge exposure of regulated entities to potential corrections in climate policy while channeling financial resources to defer deforestation even as climate policies continue to evolve.

Gender Differences in Climate Change Adaptation Strategies and Participation in Group-based Approaches: An Intra-household Analysis From Rural Kenya

- Ecological Economics---2017---Marther W. Ngigi,Ulrike Mueller,Regina Birner

Existing studies on adaptation to climate change mainly focus on a comparison of male-headed and female-headed households. Aiming at a more nuanced gender analysis, this study examines how husbands and wives within the same household perceive climate risks and use group-based approaches as coping strategies. The data stem from a unique intra-household survey involving 156 couples in rural Kenya. The findings indicate that options for adapting to climate change closely interplay with husbands’ and wives’ roles and responsibilities, social norms, risk perceptions and access to resources. A higher percentage of wives were found to adopt crop-related strategies, whereas husbands employ livestock- and agroforestry-related strategies. Besides, there are gender-specific climate information needs, trust in information and preferred channels of information dissemination. Further, it turned out that group-based approaches benefit husbands and wives

differently. Policy interventions that rely on group-based approaches should reflect the gender reality on the ground in order to amplify men's and women's specific abilities to manage risks and improve well-being outcomes in the face of accelerating climate change.

Is the Gasoline Tax Regressive in the Twenty-First Century? Taking Wealth into Account

- Ecological Economics---2017---Jordi J. Teixidó, Stefano F. Verde

Poterba (1991a) has much influenced the literature on the distributional effects of carbon pricing. Poterba argues that the incidence of energy/environmental taxes across households is better appreciated if the relative tax burdens are measured against total expenditure, interpreted as a proxy for lifetime income, instead of annual income. This way, however, since the distribution of total expenditure is structurally more uniform, the incidence of energy price increases is always less regressive than when annual income is used. This outcome is often taken to lessen the relevance of equity concerns regarding carbon pricing. Almost twenty-five years after Poterba (1991a), Piketty (2014) revived the idea that wealth is a dimension of economic welfare constituting an increasingly important source of inequality. We show that omitting wealth in measuring ability to pay means underestimating the regressivity of carbon pricing and its inequity towards younger people. Using household-level data and statistical matching, we revisit Poterba's application and compare the distributional incidence of the US gasoline tax for different measures of ability to pay: total expenditure, income and wealth-adjusted income. Regressivity is not a reason to forgo carbon pricing as a cost-effective approach to climate mitigation, but calls for consideration and compensation of the distributional effects.

Local Environmental Non-Profit Organizations and the Green Investment Strategies of Family Firms

- Ecological Economics---2017---Daniela Maggioni, Grazia Santangelo

We add to the debate on the determinants of firms' green investment strategies (GIS) by looking at societal stakeholders and explicitly testing the role of local environmental non-profit organizations (ENPOs) in GIS engagement by family and non-family firms. We argue that ENPOs favor GIS engagement only by family firms, which, due to their resource constraints, risk aversion and local embeddedness, are more sensitive to ENPOs normative pressure. We also suggest that the role of ENPOs is especially important for family firms' GIS in those sectors with less stringent regulations, where ENPOs may act as a substitute for the coercive pressure of regulation, and promote firms' self-regulatory behaviors. We test and find support for our arguments on a sample of about 2000 Italian manufacturing firms over the period 2001–2003. Our results are robust to the control of observable omitted variables, reverse causality and to alternative model specifications.

Understanding and Overcoming the Barriers for Cost-effective Conservation

- Ecological Economics---2017---Linda Grand, Kent D. Messer, William Allen

Despite extensive research demonstrating the benefits of applying cost-effective conservation techniques, such as optimization, a large gap remains between the evidence from research and the actions of professions as they design and implement conservation programs. This study examines this gap through an international survey of conservation professionals who are familiar with cost-effective conservation techniques. The primary results of this study, replicate previous results from a smaller sample of agricultural preservation professionals, and show that the vast majority of survey respondents viewed cost-effectiveness as a virtue, but ultimately do not consider it as important as other program design criteria. These results reinforce the idea that advocates of cost-effective conservation need to address concerns about fairness and transparency and remedy gaps in the knowledge and expertise of professionals involved. Finally, the lack of incentive to conservation professionals to change their practices is a

challenge that calls for public pressure and encouragement for experimentation and evidence-based policy to improve the cost effectiveness of conservation.

Long-Term Estimates of the Energy-Return-on-Investment (EROI) of Coal, Oil, and Gas Global Productions

- Ecological Economics---2017---Victor Court, Florian Fizaine

We use a price-based methodology to assess the global energy-return-on-investment (EROI) of coal, oil, and gas, from the beginning of their reported production (respectively 1800, 1860, and 1890) to 2012. It appears that the EROI of global oil and gas productions reached their maximum values in the 1930s–40s, respectively around 50:1 and 150:1, and have declined subsequently. Furthermore, we suggest that the EROI of global coal production has not yet reached its maximum value. Based on the original work of Dale et al. (2011), we then present a new theoretical dynamic expression of the EROI. Modifications of the original model were needed in order to perform calibrations on each of our price-based historical estimates of coal, oil, and gas global EROI. Theoretical models replicate the fact that maximum EROIs of global oil and gas productions have both already been reached while this is not the case for coal. In a prospective exercise, the models show the pace of the expected EROIs decrease for oil and gas in the coming century. Regarding coal, models are helpful to estimate the value and date of the EROI peak, which will most likely occur between 2025 and 2045, around a value of $95(\pm 15):1$.

Quantifying Market and Non-market Benefits and Costs of Hydraulic Fracturing in the United States: A Summary of the Literature

- Ecological Economics---2017---John Loomis, Michelle Haefele

We quantify the monetary market and non-market environmental benefits and costs of hydraulic fracturing in the 14 U.S. states whose oil and gas production is dominated by hydraulic fracturing. By far the largest mar-

ket benefit is \$75 billion (\$46–\$95 billion) in consumer surplus from lower natural gas prices to residential, commercial, and industrial consumers. There are also environmental benefits resulting from the switch by some electric utilities from coal to natural gas (\$13.25 billion, range \$3.9–\$21.9 billion). However, there are also substantial environmental costs associated with hydraulic fracturing. These are dominated by \$27.2 billion (\$12.5–\$41.95 billion) health damages from air pollution. Costs also include \$3.8 billion (\$1.15–\$5.89 billion) in greenhouse gas emissions, \$4 billion (\$3.5–\$4.45 billion) in wildlife habitat fragmentation, and \$1 billion (\$0.5–\$1.6 billion) in pollution of private drinking water wells. Opportunity costs of water usage and property value losses are less than one-quarter of a billion dollars. The market and non-market benefits of hydraulic fracturing are widespread geographically but many of the non-market costs are concentrated in the areas of drilling, creating a distributional disconnect that we believe drives much of the controversy over hydraulic fracturing.

When to Pay? Adjusting the Timing of Payments in PES Design to the Needs of Poor Land-users

- Ecological Economics---2017---Henintsoa Randrianarison, Jeannot Ramiamanana, Frank Wätzold

A neglected issue in the design of payments for ecosystem services (PES) is the timing of payments to ecosystem service providers over the course of the year. We hypothesise that timing should matter to poor land-users with limited options to save money in regions dominated by subsistence farming, seasonal fluctuations of food supply, and peaks in expenses during the year due to cultural events such as circumcisions and funeral ceremonies that occur in specific months. If land-users value payments differently at different time points throughout the year, the provision of ecosystem services can be increased for the given financial resources if payments are made at a point in time when land-users need those most. We conducted a choice experiment in the Mahafaly plateau in Southwestern Madagascar, an area which meets the aforementioned criteria, to test the importance of the time of receipt

of payments. We found that respondents are willing to accept less money if they receive it in months of food shortage unlike if they receive it at the time of cultural events. We conclude that the cost-effectiveness of PES in regions with the above-mentioned characteristics can be increased by selecting the appropriate timing to pay ecosystem service providers.

An Economic Impact Report of Shale Gas Extraction in Pennsylvania with Stricter Assumptions

- Ecological Economics---2017---Kyle A. Hoy,Timothy W. Kelsey,Martin Shields

During the onset of shale gas development, a variety of economic impact studies were released through the ‘gray literature’ without formal peer review. In a review of six such impact reports, Kinnaman (2011) speculates about several major issues worth scrutiny arising with analysis using input-output models. His central critique focuses on the assumptions of how industry spending is represented and how leasing and royalty dollars are spent. In this study, we use detailed county records and results from a survey to directly address these assumptions, and compare our results to the findings in an economic impact study of Marcellus Shale development in Pennsylvania which Kinnaman critiqued. Our results, which are only about 52% of the prior study, confirm his supposition that some ex ante studies use unrealistic assumptions which lead to gross overestimates of the impacts.

Projected Increases in Hurricane Damage in the United States: The Role of Climate Change and Coastal Development

- Ecological Economics---2017---Terry Dinan

The combined forces of climate change and coastal development are anticipated to increase hurricane damage around the globe. Estimating the magnitude of those increases is challenging due to substantial uncertainties about the amount by which climate change will alter the formation of hurricanes and increase sea levels in various locations; and the fact that future

increases in property exposure are uncertain, reflecting local, regional and national trends as well as unforeseen circumstances. This paper assesses the potential increase in wind and storm surge damage caused by hurricanes making landfall in the U.S. between now and 2075 using a framework that addresses those challenges. We find that, in combination, climate change and coastal development will cause hurricane damage to increase faster than the U.S. economy is expected to grow. In addition, we find that the number of people facing substantial expected damage will, on average, increase more than eight-fold over the next 60 years. Understanding the concentration of damage may be particularly important in countries that lack policies or programs to provide federal support to hard-hit localities.

Policy instruments to control Amazon fires: A simulation approach

- Ecological Economics---2017---Thiago Fonseca Morello,Luke Parry,Nils Markusson,Jos Barlow

Agricultural fires are a double-edged sword that allow for cost-efficient land management in the tropics but also cause accidental fires and emissions of carbon and pollutants. To control fires in Amazon, it is currently unclear whether policy-makers should prioritize command-and-control or incentive-based instruments such as REDD+. Aiming to generate knowledge about the relative merits of the two policy approaches, this paper presents a spatially-explicit agent-based model that simulates the causal effects of four policy instruments on intended and unintended fires. All instruments proved effective in overturning the predominance of highly profitable but risky fire-use and decreasing accidental fires, but none were free from imperfections. The performance of command-and-control proved highly sensitive to the spatial and social reach of enforcement. Side-effects of incentive-based instruments included a disproportionate increase in controlled fires and a reduced acceptance of conservation subsidies, caused by the prohibition of reckless fires, and also indirect deforestation. The instruments that were most effective in reducing deforestation were not the most effective

in reducing fires and vice-versa, which suggests that the two goals cannot be achieved with a single policy intervention.

Can Personality Traits Explain Where and With Whom You Recreate? A Latent-Class Site-Choice Model Informed by Estimates From Mixed-Mode LC Cluster Models With Latent-Personality Traits

- Ecological Economics---2017---Edward R. Morey, Mara Thiene

We test and find that personality traits interact with site characteristics and the ability of a potential companion to determine where, and with whom you recreate. 4605 mountain bikers chose between multiple pairs of hypothetical mountain-bike rides, and, in addition, answered Likert-scale questions on sensation-seeking, competitiveness and extroversion. For each personality trait, a mixed-mode latent-class cluster model was estimated, accounting for that fact that the indicators can have ordinal, cardinal or nominal meaning. Most LC models ignore these distinctions. Our model also allows the scores on questions to be correlated, even after conditioning on class (typically assumed away). Then, a latent-class choice model of trail attributes and companion's ability was estimated using the choice-pair data, with the estimated latent personality-traits as covariates. Three choice classes are identified and the odds of being in each varies by personality: estimated choice probabilities and WTP estimates vary significantly and substantially by class and personality type.

Complexity and the Economics of Climate Change: A Survey and a Look Forward

- Ecological Economics---2017---T. Balint, Francesco Lamperti, Antoine Mandel, Mauro Napoletano, Andrea Roventini, A. Sapio

Climate change is one of the most daunting challenges human kind has ever faced. In the paper, we provide a survey of the micro and macro economics of climate change from a complexity science perspective and we discuss the challenges ahead for this line of research.

We identify four areas of the literature where complex system models have already produced valuable insights: (i) coalition formation and climate negotiations, (ii) macroeconomic impacts of climate-related events, (iii) energy markets and (iv) diffusion of climate-friendly technologies. On each of these issues, accounting for heterogeneity, interactions and disequilibrium dynamics provides a complementary and novel perspective to the one of standard equilibrium models. Furthermore, it highlights the potential economic benefits of mitigation and adaptation policies and the risk of under-estimating systemic climate change-related risks.

The Non-market Value of Birding Sites and the Marginal Value of Additional Species: Biodiversity in a Random Utility Model of Site Choice by eBird Members

- Ecological Economics---2017---Sonja Kolstoe, Trudy Cameron

The eBird database is the product of a huge citizen science project at the Cornell University Laboratory of Ornithology. Members report their birding excursions both their destinations and the numbers and types of birds they observe on each trip. Based on home address information, we calculate travel costs for each birder for trips to alternative birding hotspots. We focus on the Pacific Northwest U.S. (Washington and Oregon states). Many birders are "listers" who seek to maximize the cumulative number of species they have been able to see, and each hotspot is characterized by the number of bird species expected to be present. In a random utility model of destination site choice, we allow for seasonal as well as random heterogeneity in the marginal utility per bird species. For this population of birders, marginal WTP for an additional bird species is highest in June when birds are in their mating-season plumage (at more than \$3 per species per trip). Total WTP for a birding outing also depends on other site attributes (including ecological management regime, the possible presence of endangered bird species, urban/rural location, ecological region and relative congestion/popularity). Evidence of variety-seeking can also be discerned in birders' destination

choices.

Optimal Phosphorus Abatement Redefined: Insights From Coupled Element Cycles

- Ecological Economics---2017---Antti Iho,Lassi Ahlvik,Petri Ekholm,Jouni Lehtoranta,Pirkko Kortelainen

To successfully combat eutrophication caused by agricultural P loads, we need to understand how various forms of P respond to mitigation measures and thus how they contribute to algal growth. Failure to balance mitigation measures targeting dissolved inorganic P (DIP) and P in eroded soil (PP) may lead to economically inefficient measures at best, and to aggravated eutrophication at worst. We model dynamically optimal eutrophication management in a P-limited and SO₄-containing water body by taking into account the O₂ available and the coupling between the C, Fe, S and P cycles. We show that optimal management would put more weight on mitigating DIP than PP, and that the emphasis on DIP should be particularly strong in eutrophic water bodies. To foster influential and cost-efficient policies, we urge defining water body-specific multipliers to commensurate the main P forms into eutrophying phosphorus, much as greenhouse gases are converted to their CO₂ equivalents.

The Case of Legume-Cereal Crop Mixtures in Modern Agriculture and the Transtheoretical Model of Gradual Adoption

- Ecological Economics---2017---Dominic Lemken,Achim Spiller,Marie von Meyer-Höfer

Mixed cropping (MC), the growing of two or more co-existing crops in one field, specifically the mix of cereal and grain legumes, can contribute to a more sustainable agricultural land use. Despite a variety of ecological benefits and promising grain productivity, applications are scarce among farmers in developed countries. In consideration of MC's potential this study interviews farm managers to profile characteristics of adopters. The transtheoretical model (TTM) is applied to capture adoption and adoption tendencies. The results

point to a significant positive role of land owned vs. leased, adoption of reduced tillage and adoption intensity of legumes in general. The perception of technical barriers and the perception of MC's usefulness are also major drivers that proponents need to address. In general, the TTM provides a gradual measure of farmer's willingness to adopt, leading to more variance than binary classifications, which makes TTM especially useful to adoption research of marginalized ecological practices.

Valuing Air Quality Using Happiness Data: The Case of China

- Ecological Economics---2017---Xin Zhang,Xiaobo Zhang,Xi Chen

This paper estimates the monetary value of cutting PM_{2.5}, a dominant source of air pollution in China. By matching hedonic happiness in a nationally representative survey with daily air quality data according to the dates and counties of interviews in China, we are able to estimate the relationship between local concentration of particulate matter and individual happiness. By holding happiness constant, we calculate the tradeoff between the reduction in particulate matter and income, essentially a happiness-based measure of willingness-to-pay for mitigating air pollution. We find that people on average are willing to pay ¥258 (\$42, or 1.8% of annual household per capita income) per year per person for a 1% reduction in PM_{2.5}.

The Implications of Industrial Development for Diversification of Fuels

- Ecological Economics---2017---Karolina Safarzynska

The central role of energy in economic growth and development is substantiated by both theory and data. Much of the analysis of energy in economics has focused on the study of the aggregate output. Here, we deviate from this approach and study the role of fuel diversification in industrial development. We build the energy space describing the space of energy technologies, which a country can use in the production of

manufacturing goods. As countries grow, they diversify their industries, producing more diverse products over time. We show that the process is accompanied by diversification of fuels, which countries use in the manufacturing sector. In particular, countries move in the energy space by adopting novel fuels, while their movements can be linked to structural changes in the industry. Over time, countries build unique production capabilities, which drives divergence in fuel diversity between countries. Our results provide insight into the limits of fuel substitution in the manufacturing sector, as well as they carry important implications for the assessment of potential reductions in CO₂ emissions in the future.

Respondent Uncertainty and Ordering Effect on Willingness to Pay for Salt Marsh Conservation in the Brest Roadstead (France)

- Ecological Economics---2017---Louinord Voltaire,Hermann Donfouet,Claudio Pirrone,Agathe Larzillière

This paper explores the potential link between the sensitivity of willingness to pay (WTP) to the order of presenting bid amounts in contingent valuation questions (ordering effect) and respondent uncertainty. The resource being valued is a public project to protect salt marshes against the spread of an invasive aquatic plant in the Brest roadstead (France). Valuation uncertainty is captured through a variant of payment card format where respondents are given the opportunity to report their WTP as either a single value (Option A) or an interval of values (Option B). The ordering effect is tested using both parametric models that ignore and control for the potential sample selection bias related to the choice between Option A and Option B, as well as non-parametric models. The results suggest that (1) respondents place substantial WTP values on salt marsh conservation, and (2) the ordering effect is linked to respondent uncertainty since only uncertain respondents react differently to changes in the order of presenting bid amounts. Specifically, for uncertain respondents, putting bid amounts in ascending order yields lower welfare estimates than putting bid

amounts in descending order or random order. Policy recommendations and options to deal with ordering effect are discussed.

Exploring Citizen Support for Different Types of Climate Policy

- Ecological Economics---2017---Ekaterina Rhodes,Jonn Axsen,Mark Jaccard

Citizen support for climate policies is considered an important criterion in climate policy-making. While there is a growing body of literature exploring factors of citizen support, most studies tend to use climate policy support as an aggregate variable, overlooking differences in support for different climate policy types. This study examines citizen support for several market-based, regulatory, and voluntary climate policies using survey data collected from a representative sample of Canadian citizens (n=1306). Specifically, the research objectives are to (1) assess citizen support for different types of climate policies, (2) identify the key factors associated with citizen support for different policy types, and (3) explore heterogeneity across respondents based on policy support patterns. Results indicate that most regulatory and voluntary policies receive high levels of support (83–90% of respondents), while a carbon tax receives the highest levels of opposition (47%). Regression analysis identifies several factors associated with citizen support, including values, trust, and household features. However, only a few factors are consistently associated with support across policy types, including being concerned about climate change, having trust in scientists, and being female. Other significant factors are unique to different policy types. Cluster analysis identifies four distinct respondent clusters based on policy support.

Assessing Impacts From Climate Change on Local Social-ecological Systems in Contexts Where Information is Lacking: An Expert Elicitation in the Bolivian Altiplano

- Ecological Economics---2017---Adan Martinez-Cruz,Miriam Juarez,Santiago Guerrero

Assessment of the expected impacts from climate change is an essential input for agencies engaged in fostering adaptation of local social-ecological systems. However, data is seldom available at the required scale. This study overcomes this hurdle by gathering data via an expert elicitation protocol. We report experts' judgements about two topics: i) the impacts from climate change on crop yields in three communities located in the Bolivian Altiplano; and ii) the effectiveness of specific irrigation techniques in mitigating the impacts from climate change in the communities under study. Our gathered data allow us to document heterogeneity of expected impacts across communities –with one community expected to experience an increase in yields under wet climate change scenarios. Experts judge irrigation as an effective mitigation tool under most of the dry climate change scenarios presented to them. We believe that our data collection strategy represents a promising decision support tool for a wide range of public policy issues. Particularly, when monetary and time constraints converge with the lack of scientific information. In addition, the information gathered with this methodology can be incorporated into participatory methodologies gathering information from local social-ecological systems.

Expert Elicitation, Uncertainty, and the Value of Information in Controlling Invasive Species

- Ecological Economics---2017---Fred A. Johnson,Brian J. Smith,Mathieu Bonneau,Julien Martin,Christina Romagosa,Frank Mazzotti,Hardin Waddle,Robert N. Reed,Jennifer Kettevrlin Eckles,Laurie J. Vitt

We illustrate the utility of expert elicitation, explicit recognition of uncertainty, and the value of information for directing management and research efforts for invasive species, using tegu lizards (*Salvator merianae*) in southern Florida as a case study. We posited a post-birth pulse, matrix model in which four age classes of tegus are recognized: hatchlings, 1year-old, 2year-olds, and 3+year-olds. This matrix model was parameterized using a 3-point process to elicit estimates of tegu demographic rates in southern Florida from 10 her-

petology experts. We fit statistical distributions for each parameter and for each expert, then drew and pooled a large number of replicate samples from these to form a distribution for each demographic parameter. Using these distributions, as well as the observed correlations among elicited values, we generated a large sample of matrix population models to infer how the tegu population would respond to control efforts. We used the concepts of Pareto efficiency and stochastic dominance to conclude that targeting older age classes at relatively high rates appears to have the best chance of minimizing tegu abundance and control costs. We conclude that expert opinion combined with an explicit consideration of uncertainty can be valuable in conducting an initial assessment of what control strategy, effort, and monetary resources are needed to reduce and eventually eliminate the invader. Scientists, in turn, can use the value of information to focus research in a way that not only increases the efficacy of control, but minimizes costs as well.

Supply, Demand, and Uncertainty: Implications for Prelisting Conservation Policy

- Ecological Economics---2017---Christopher S. Galik,David McAdams

The Endangered Species Act (ESA) faces a shortage of incentives to motivate the scale of conservation activities necessary to address and reverse the decline of at-risk species. A recent policy proposal attempts to change this by allowing landowners to generate credits for voluntary prelisting conservation activities. We explore the proposed policy from the perspective of potential participants. We find that uncertainty present in species listing processes complicates the decision to undertake conservation activities, leading to less conservation being supplied than when a listing decision is certain, while also delaying implementation until late in the listing determination process. Incentives created by the prelisting policy may likewise push species status closer to a listing threshold and thus exacerbate uncertainty in the listing process. To counter this tendency and encourage a more efficient allocation of conservation activity, early-actor bonuses, weighted

credits, or limited windows of eligibility could be used to target or place increased premiums on early conservation activity. Though these findings are most directly applicable to the specific prelisting policy considered here, they are nonetheless relevant to a wider array of conservation policies that seek to encourage voluntary early action in advance of a regulatory alternative.

Feeding the Household, Growing the Business, or Just Showing Off? Farmers' Motivations for Crop Diversity Choices in Papua New Guinea

- Ecological Economics---2017---Stella Nordhagen, Unai Pascual, Adam G. Drucker

Understanding farmers' reasons for growing diverse crop portfolios is essential for supporting the conservation of agricultural biodiversity to foster social-ecological resilience and conserve crop genetic resources. In this paper, Q methodology is applied to examine the motivations for growing diverse crops among semi-subsistence rural farmers in Papua New Guinea. Various types of farmers are identified including so-called 'marketer-consumers,' who are highly motivated by crop sale, and 'exhibitionists,' who prioritize the 'show' values of crops. This approach can be applied to better target programs seeking to conserve crop diversity and promote new crop varieties in regions undergoing rapid transformation.

Climate change mitigation and agricultural development models: Primary commodity exports or local consumption production?

- Ecological Economics---2017---Alassane Drabo

The increasing demand for agricultural products partly due to the high population growth requires agriculture to struggle for productivity improvement. However, productivity search is constrained by environmental preoccupations, raising the question of agricultural development models to be adopted to increase productivity while limiting environmental consequences. This paper examines the role of market orientation by assessing the effect of agricultural commodity export on greenhouse gas emissions relatively to local market

oriented agricultural production model. Using panel data from 1986 to 2010 for 136 countries around the world, and accurate instrumental variables technique, the findings suggest that the proportion of primary commodity export in agricultural production increases greenhouse gas emissions. These results are robust to different sources of agricultural export and environmental data, and to the inclusion of additional control variables.

Common Patrimony: A Concept to Analyze Collective Natural Resource Management. The Case of Water Management in France

- Ecological Economics---2017---Iratxe Calvo-Mendieta, Olivier Petit, Franck-Dominique Vivien

The objective of this article is to show that, along with the concepts of common property and common-pool resources, the concept of common patrimony can be relevant for analyzing collective natural resource management. We proceed in three steps. First, we present the concept of common patrimony and we distinguish it from common property and common-pool resources. We show that the notion of common patrimony allows identity, historical, territorial and institutional dimensions to be taken into account as it places social dimension at the center of the analysis. Second, we illustrate the common patrimony concept by using the case of water management policy in France. Third, we place common patrimony within the framework of social ecological economics and we identify links with other approaches addressing institutional dimensions of water resource management. We outline some research questions that can be developed to contribute to a better understanding of collective natural resource management.

Picking Winners: Modelling the Costs of Technology-specific Climate Policy in the U.S. Passenger Vehicle Sector

- Ecological Economics---2017---Jacob Fox, Jonn Axsen, Mark Jaccard

Researchers debate the cost-effectiveness of technology-specific versus technology-neutral climate policies, but few quantify the differences. Using the case of low-carbon vehicle technologies in the US passenger vehicle sector (ethanol, plug-in electric and hydrogen), we develop a technology adoption simulation model that represents increasing returns to adoption in both financial costs and consumer preferences, representing uncertainty through Monte Carlo analysis. We compare the policy costs (\$/tonne CO₂ out to 2050) of: i) a technology-neutral carbon tax, ii) a somewhat neutral vehicle standard requiring low carbon vehicle sales, but allowing competition among technologies, and iii) technology-specific vehicle standards requiring sales of just one technology. On average across simulations, the carbon tax is twice as cost-effective as the best vehicle standard, in part because the tax more substantially affects vehicle use rates. Among the vehicle standards, a technology-specific standard that selects the right “winner” (plug-in electric vehicles) is more cost-effective than the neutral standard, as it more quickly stimulates technology improvement. However, there is risk in a technology-specific approach; mistakenly forcing a “loser” technology (hydrogen) results in policy costs that are 2 to 5 times higher than other policies. Results can help policymakers trade-off the costs and risks of different climate policy options.

Rethinking Resilience in Industrial Symbiosis: Conceptualization and Measurements

- Ecological Economics---2017---Luca Fraccascia, Ilaria Giannoccaro, Vito Albino

Resilience has become the new imperative of industrial symbiosis research, since its recognition as a fundamental factor in the development of sustainable Industrial Symbiosis Networks (ISNs). We offer a contribution to this topic by providing a wider conceptualization of resilience and an innovative method of measuring it, borrowing from studies in other disciplines such as ecology, complexity science, and engineering. We focus on two important antecedents of ISN resilience, i.e., diversity at system and firm level and the ubiquity of wastes, on the basis of which we design a new

method of measuring ISN resilience. This captures the extent to which the removal of a firm is critical for the ISN's survival. We test our resilience index on two real ISNs and compare it against other network-based measurement methods commonly adopted in the literature. Finally, we discuss the advantages of the new measurement procedure.

Exploring the links between community-based governance and sustainable energy use: Quantitative evidence from Flanders

- Ecological Economics---2017---Thomas Bauwens, Nick Eyre

Community-based energy organizations have been said to influence their members' energy-related behavior by activating social norms and by providing trustworthy information about sustainable energy investments and behaviors. However, little is known yet about members' actual energy use and how it differs from that of individuals who do not participate in such projects. In particular, selection effects are likely to arise, i.e. community-based energy projects may attract people that are different from the underlying population in terms of energy use. This article empirically addresses the question of the selection into community-based energy projects in terms of energy use, focusing on the case of renewable energy cooperatives. Based on quantitative data from an original survey conducted with one renewable energy cooperative in Flanders and using probit regression analyses, it contrasts a sample of cooperative members with an appropriate comparison group in terms of electricity usage. The results show that electricity consumption is positively related with cooperative membership, suggesting that high use consumers have greater incentives to join a community-based organization which provides assistance and advice on the adoption of green technologies and energy efficiency measures. These findings contribute to an understanding of the relationship between community-based governance and sustainable energy practices.

Risk Perception of Climate Change: Empirical Evidence for Germany

- Ecological Economics---2017---Manuel Frondel,Michael Simora,Stephan Sommer

The perception of risks associated with climate change appears to be a key factor for the support of climate policy measures. Using a generalized ordered logit approach and drawing on a unique data set originating from two surveys conducted in 2012 and 2014, each among more than 6000 German households, we analyze the determinants of individual risk perception associated with three kinds of natural hazards: heat waves, storms, and floods. Our focus is on the role of objective risk measures and experience with these natural hazards, whose frequency is likely to be affected by climate change. In line with the received literature, the results suggest that personal experience with adverse events and personal damage therefrom are strong drivers of individual risk perception.

A Global Meta-Analysis of the Value of Ecosystem Services Provided by Lakes

- Ecological Economics---2017---Arnaud Reynaud,Denis Lanza

This study presents the first meta-analysis on the economic value of ecosystem services delivered by lakes. A worldwide data set of 699 observations drawn from 133 studies combines information reported in primary studies with geospatial data. The meta-analysis explores antagonisms and synergies between ecosystem services. This is the first meta-analysis to incorporate simultaneously external geospatial data and ecosystem service interactions. We first show that it is possible to reliably predict the value of ecosystem services provided by lakes based on their physical and geographic characteristics. Second, we demonstrate that interactions between ecosystem services appear to be significant for explaining lake ecosystem service values. Third, we provide an estimation of the average value of ecosystem services provided by lakes: between 106 and 140 USD\$2010 per respondent per year for non-hedonic

price studies and between 169 and 403 USD\$2010 per property per year for hedonic price studies.

Understanding the Amenity Impacts of Wind Development on an International Border

- Ecological Economics---2017---Martin D. Heintzelman,Richard Vyn,Sarah Guth

Wind energy developments are often controversial. Concerns are often raised about negative impacts on local communities, including impacts on property values. Some of these negative impacts may be offset by compensatory payments made by wind developers. Community involvement in the planning and development process may also reduce negative perceptions associated with wind facilities. However, if the development is near a border between municipalities, states, or even countries, it is often the case that one or more jurisdictions will not be involved in the process or receive compensation, but will, nonetheless, face some costs or impacts from the development. We explore exactly this situation at the border between Canada and the United States in the Thousand Islands region where a wind farm is currently operating on the Canadian border island of Wolfe Island. Using a parcel-level hedonic analysis of property sales transactions, we find that properties in New York with a view of and/or in close proximity to the turbines significantly depreciated in value after construction of the turbines while no negative impacts were observed on properties in Ontario. We highlight a number of factors that could contribute to these differences in impacts on property values, which may also explain the variation in results that currently exists in the literature.

Measuring Localisation Nationally to Form a Global Index

- Ecological Economics---2017---Michelle M. Olivier,Ben P. Wilson,Johnathon L. Howard

Localisation is an important sustainability strategy that may reduce the harmful socio-ecological effects of economic globalisation. This article describes the development of a localisation metric set, and the formation

of a composite, multi-criteria global localisation index (GLI). The index comprises 103 countries from across the global North and South, for which the required data was available. In forming the GLI, secondary source data was gathered according to localisation-expert determined metrics, which were then weighted, standardised, scored and ranked. Bhutan, which tops the GLI, may do so due to the prioritisation of socio-ecological health and participative democracy there, as in many Latin American countries that also achieve high localisation scores whilst minimally compromising sustainability thresholds. The GLI may assist those seeking to strategise localisation as it identifies the most localised places, which may serve case study purposes.

Degrowth – Taking Stock and Reviewing an Emerging Academic Paradigm

- Ecological Economics---2017---Martin Weiss,Claudio Cattaneo

Degrowth has evolved within a decade from an activist movement into a multi-disciplinary academic paradigm. However, an overview taking stock of the peer-refereed degrowth literature is yet missing. Here, we review 91 articles that were published between 2006 and 2015. We find that the academic degrowth discourse occupies a small but expanding niche at the intersection of social and applied environmental sciences. The discourse is shaped by authors from high-income, mainly Mediterranean, countries. Until 2012, articles largely constitute conceptual essays endorsed by normative claims. More recently, degrowth has branched out into modelling, empirical assessments, and the study of concrete implementations. Authors tend to agree in that economic growth cannot be sustained ad infinitum on a resource constraint planet and that degrowth requires far reaching societal change. Whether degrowth should be considered as a collectively consented choice or an environmentally-imposed inevitability constitutes a major debate among degrowth thinkers. We argue that the academic discourse could benefit from rigid hypotheses testing through input-output modelling, material flow analysis, life-cycle assessments, or social surveys. By analyzing the potentials for non-market

value creation and identifying concrete well-being benefits, the degrowth discourse could receive wider public support and contribute to a paradigmatic change in the social sciences.

Bridging the Gap Between Revealed and Stated Preferences in Flood-prone Housing Markets

- Ecological Economics---2017---Koen de Koning,Tatiana Filatova,Okmyung Bin

2017

Quantifying Spatial Variation in Ecosystem Services Demand: A Global Mapping Approach

- Ecological Economics---2017---S. Wolff,C.J.E. Schulp,T Kastner,P.H. Verburg

Understanding the spatial-temporal variability in ecosystem services (ES) demand can help anticipate externalities of land use change. This study presents new operational approaches to quantify and map demand for three non-commodity ES on a global scale: animal pollination, wild medicinal plants and outdoor recreation. We show how the demand for these ES differs between beneficiaries and world regions. While the demand for animal pollination is accounted for via the consumption preferences for pollinator-dependent crop products, the demand for wild medicinal plants is quantified by the direct reliance on wild medicinal plants for basic healthcare needs. The demand for outdoor recreation is represented by the possibility and interest to participate in related activities. For animal pollination and outdoor recreation, demand is highest in industrial countries; demand for wild medicinal plants is highest in least developed countries, given their direct reliance on this ES for healthcare. Spatial demand-supply mismatches can cause trade-offs between ES in distant provisioning areas and can lead to unintended impacts on human well-being. The study reveals that quantifying and mapping spatial patterns of ES demand on a global scale requires clear conceptualization and operationalization of specific ES to select the most appropriate methods and arrive at meaningful results.

Decentralized Land Use Zoning Reduces Large-scale Deforestation in a Major Agricultural Frontier

- Ecological Economics---2017---Christoph Nolte, Beatriz Gobbi, Yann le Polain de Waroux, María Piquer-Rodríguez, Van Butsic, Eric F. Lambin

Reducing large-scale deforestation is a key objective of global efforts to mitigate climate change. An important debate concerns the levels of governance at which deforestation can be reduced effectively. Political economic theory and evidence suggests that national governments are more likely than subnational governments in agricultural frontiers to adopt restrictive forest conservation policies, due to differences in political constituencies and capacity. Here we examine the validity of this claim using an impact study of provincial-level land use planning in Argentina's main deforestation frontier, the Dry Chaco. In 2007, Argentina's provinces were obliged to define land use zoning for their native forests, but had considerable leeway in its implementation. We use data from 30,126 properties in the provinces of Salta, Santiago del Estero, and Chaco, and a rigorous counterfactual estimation strategy to quantify the extent to which adopted zoning plans affected deforestation. We find evidence that provincial-level land use zoning reduced deforestation in all three provinces, but not in all zones and periods. Differences in impact are associated with differences in the location of zones and the timing of planning. Our findings suggest that subnational governments can make important contributions to reducing large-scale deforestation in agricultural frontiers.

Beach Recreationalists' Willingness to Pay and Economic Implications of Coastal Water Quality Problems in Hawaii

- Ecological Economics---2017---Marcus Peng, Kirsten L.L. Oleson

The economic value of water quality is poorly understood in Hawaii. Quantifying the economic value of coastal water quality would inform policy decisions that

impact the coast and help justify expenditures in water quality improvements. We conducted a non-market valuation of beach recreationalists' preferences and willingness to pay for water quality and associated attributes at Oahu beaches. Using a discrete choice experiment analyzed by a conditional logit model, results suggest individuals were willing to pay \$11.43 per day at the beach to reduce days of bacterial exceedance from 11 to 5 per year, a further \$30.72 to reduce it to no bacterial exceedances at all. WTP to move from 15 ft to 30 ft of underwater visibility was \$35.71, a further \$14.80 to increase from 30 ft to 60 ft. Respondents were also willing to pay \$15.33 to improve coral reef cover from 10% to 25%, a further \$4.89 to improve to 45% cover. WTP for moving from 9 fish species to 18 species was \$7.14, a further \$2.47 to increase that to 27 fish species. These environmental improvements can improve Oahu recreationalists' welfare by \$205 million, \$550 million, \$639 million, \$265 million, \$274 million, \$88 million, \$128 million, and \$44 million per year, respectively. Welfare gains may justify increased spending in management and restoration of coastal ecosystems.

Brazil's National Environmental Registry of Rural Properties: Implications for Livelihoods

- Ecological Economics---2017---Suhyun Jung, Laura Vang Rasmussen, Cristy Watkins, Peter Newton, Arun Agrawal

In Brazil, the Cadastro Ambiental Rural (CAR) is currently being implemented. This policy aims to georeference all properties and promote monitoring of, and compliance with, natural vegetation conservation requirements. Scholarly efforts and policy attention have so far concentrated on possible environmental impacts hereof, while the attention devoted to how the CAR might affect farmers' livelihoods has been limited. In this paper, we evaluate potential livelihood impacts of the CAR and programs that facilitate CAR registration. We do so by developing a conceptual framework and using evidence from semi-structured interviews with key stakeholders including farmers, governments, and funding agencies. We find that while the CAR and

programs facilitating CAR do not have explicit livelihood impact goals, they nonetheless affect livelihoods, both positively and negatively, depending on the initial amount of natural vegetation on farmers' properties, farmers' access to credit and infrastructure, and changing market conditions. We argue that environmental interventions and policies need to consider potential livelihood impacts, especially if the policy intervention area has high poverty rates.

The Carbon Footprint of European Households and Income Distribution

- Ecological Economics---2017---Mark Sommer,Kurt Kratena

This paper calculates the carbon footprint of private consumption in the EU27 by five groups of household income, using a fully fledged macroeconomic input-output model covering 59 industries and five groups of household income for the EU27. Due to macroeconomic feedback mechanisms, this methodology – besides induced intermediate demand – also quantifies: (i) private consumption induced in the other household groups, (ii) impacts on other endogenous final demand components, and (iii) negative feedback effects due to output price effects of household demand. The carbon footprint is calculated separately for the consumption vector of each of the five income groups. The simulation results yield a non-linear income elasticity of direct and indirect emissions at each income level: the value of the direct footprint income elasticity decreases from 1.32 (first quintile) to 0.69 (fourth quintile). The value of the indirect footprint income elasticity is always below unity and decreases from 0.89 to 0.62. The results in general reveal a relative decoupling effect: the share of the top income group in income (45%) is much larger than its share in the carbon footprint (37%) and vice versa for the bottom income group (6% in income and 8% in footprint).

Global Climate Policy Will Have Net Benefits Larger Than Anyone Thinks (and Welfare Gains, Strangely, Are Likely To Be Much Larger Yet)

- Ecological Economics---2017---Philip Graves

As with other public goods lacking strong special interest support, global climate policy suffers from two serious theoretical flaws. The first is failure to endogenize the labor-leisure decision when conducting benefit-cost analysis. Recognition that income generated will not remain the same pre-and-post policy results in downward bias in benefit estimation. Much more importantly, there will generally be free riding in input markets in addition to the well-known output demand revelation problem. Since even households with very high marginal values cannot individually increment public goods, too little income will be generated and too much of the income that is generated will be spent on relatively low value ordinary private goods. The ungenerated income would have all been spent on the public good, apart from general equilibrium considerations, resulting in additional—and perhaps large—downward bias in benefits of global climate policy. The reallocation of spending from relatively low value private goods to higher value public goods may further greatly increase willingness-to-pay for policies stabilizing global climate.

The Choice of the Sustainability Assessment Tool Matters: Differences in Thematic Scope and Assessment Results

- Ecological Economics---2017---Evelien M. de Olde,Eddie A.M. Bokkers,Imke J.M. de Boer

While the number of farm-level sustainability assessment tools is growing rapidly, concerns are raised on whether the assessment results of different tools present similar and valid conclusions about the sustainability performance of farms. In this paper we analysed the thematic scope of sustainability assessment tools, and compared assessment results from sustainability assessment tools. A coverage analysis of four tools (RISE, SAFA, PG and IDEA) demonstrated the diversity in approaches to assess sustainability at farm level. Tool developers select different (sub)themes and indicators, and apply different methods for measurement and aggregation of scores. This variability in approaches results not only in different tools, but can also result in different conclusions on the sustainability perfor-

mance of farms. Decisions made in the development of a sustainability assessment tool need to be transparent to understand and explain the results of a tool and support farmers in a sustainable development of their farm. To improve the transparency in sustainability assessment tools we presented a framework describing decisions made in the development of a tool. An increased transparency in sustainability assessment tools can reduce the risk on distorted assessment results and actions, and contribute to the trust and relevance of future sustainability assessments.

The Impact of Technological Green New Product Introductions on Firm Profitability

- Ecological Economics---2017---Mark Palmer,Yann Truong

With changing customer preferences and volatile economic-technological environments, firms have accelerated the rate of new product introductions (NPIs) to sustain corporate growth. However, NPIs have adverse impacts on the environment. But what do we know about the impact of technological green NPIs on firm profitability? Can technological green products help limit or off-set the negative impact of NPIs on the environment? Accelerating the number of NPIs imposes additional costs for firms as well as environmental costs, particularly with greater resource depletion and waste generation. A well-supported solution to reconcile the economic-environmental preservation imperative is to create incentives for firms to use green technologies to offset the negative impact of new products on the environment. Using data on 1020 technological green products which were introduced between 2007 and 2012 by 79 global firms, we investigate whether there are any win-win situations in terms of financial advantages for firms, while reducing the adverse impacts of NPIs on the environment. The results show that the relationship between technological green NPIs and firm profitability is positive. The findings point to the financial incentives for firms to leverage on green technologies to limit the environmental impact of new product introductions.

Generous Sustainability

- Ecological Economics---2017---Reyer Gerlagh

I define “generous sustainability” as a combination of two conditions: neither instantaneous maximin utility nor attainable maximin utility should decrease over time. I provide a formal definition and study applications to a Climate Economy with bounded and with unbounded growth. Generosity is shown to require that GHG emissions are limited to levels that do not cause irreversible system damages if some group of people systematically value these systems.

Smallholder Farmers and the Dynamics of Degradation of Peatland Ecosystems in Central Kalimantan, Indonesia

- Ecological Economics---2017---Medrilzam Medrilzam,Carl Smith,Ammar Abdul Aziz,John Herbohn,Paul Dargusch

2017

Consistency and stability analysis of models of a monetary growth imperative

- Ecological Economics---2017---Oliver Richters,Andreas Siemoneit

Is fostering economic growth ‘only’ a question of political will or ‘unavoidable’ to maintain economic stability? It is disputed whether such a ‘growth imperative’ is located within the current monetary system, creating conflicts with sustainability. To examine the claim that compound interest compels economies to grow, we present five post-Keynesian models and show how to perform a stability analysis in the parameter space. A stationary state with zero net saving and investment can be reached with positive interest rates, if the parameter ‘consumption out of wealth’ is above a threshold that rises with the interest rate. The other claim that retained profits from the interest revenues of banks create an imperative is based on circuitist models that we consider refutable. Their accounting is inconsistent, and a modeling assumption central for a growth imperative is not underpinned theoretically:

Bank's equity capital has to increase even if debt does not. This is a discrepancy between the authors' intentions in their texts and their actual models. We conclude that a monetary system based on interest-bearing debt-money with private banks does not lead to an 'inherent' growth imperative. If the stationary state is unstable, it is caused by agents' decisions, not by structural inevitableness.

What are Households Willing to Pay for Improved Water Access? Results from a Meta-Analysis

- Ecological Economics---2017---George L. Van Houtven, Subhrendu K. Pattanayak, Faraz Usmani, Jui-Chen Yang

Although several factors contribute to low rates of access to improved water and sanitation in the developing world, it is especially important to understand and measure household demand for these services. One valuable source of information regarding demand is the growing empirical literature that has applied stated preference methods to estimate households' willingness to pay (WTP). Because it is difficult to generalize and support planning based on this scattered literature, we conduct a meta-analysis to take stock of the worldwide sample of household WTP for improved drinking water services. Using 171 WTP estimates drawn from 60 studies, we first describe this sample and then examine the potential factors that explain variation in WTP estimates. Our results suggest that households are willing to pay between approximately \$3 and \$30 per month for improvements in water access. Specifically, in line with economic theory and intuition, WTP is sensitive to scope (the magnitude of improvement in drinking water services), as well as household income, and stated-preference elicitation method. We demonstrate how our results can be used to predict household-level WTP for selected improvements in drinking water access in regions with low coverage, and find that private benefits exceed the cost of provision.

Impact Fees Coupled With Conservation Payments to Sustain Ecosystem Structure: A Conceptual and Numerical Application at the Urban-Rural Fringe

- Ecological Economics---2017---Yong Jiang, Stephen Swallow

Communities in exurban areas increasingly rely on land preservation as a strategy to balance sprawling land development with maintaining environmental amenities. Based on a review of existing approaches for preserving land, we consider a conceptual model of environmental impact fees (EIFs) coupled with conservation payments for managing private land of ecosystem value. In this framework, conservation payments are intended to cost-effectively target fair market value compensation for heterogeneous land for preservation that sustains ecosystem health. EIFs serve as a financial instrument to augment conservation payments and to allow flexibility for landowners with private information to pursue development opportunities while accounting for environmental impacts. Using a bioeconomic model of nature-reserve design, we develop an empirical illustration of how to estimate the EIF of development damage to critical habitat in southern Rhode Island in an effort to preserve land as an environmental infrastructure that maintains ecosystem health.

Addressing Contextual and Location Biases in the Assessment of Protected Areas Effectiveness on Deforestation in the Brazilian Amazônia

- Ecological Economics---2017---Eric Kere, Johanna Choumert Nkolo, Pascale Combes Motel, Pascale Motel Combes, Olivier Santoni, Sonia Schwartz

Using a remotely sensed pixel data set, we develop a multilevel model and propensity score weighting with multilevel data to assess the impact of protected areas on deforestation in the Brazilian Amazon. These techniques allow taking into account location bias, contextual bias and the dependence of spatial units. Our results show that the hierarchical structure of the

database matters and should be considered in the assessment of protected areas effectiveness. Our results also suggest that protected areas have slowed down deforestation between 2005 and 2009, whatever the type of governance. The effectiveness of protected areas differs according to socioeconomic and environmental variables measured at municipal level. For instance, indigenous protected areas are found to be marginally more efficient than sustainable use areas and integral use areas. Protected Areas that were more recently implemented are also found to avoid more deforestation than older ones. This corroborates the idea that recently created protected areas in the Brazilian Amazon have a greater agricultural potential.

The Displacement Effect of Convenience: The Case of Recycling

- Ecological Economics---2017---Andrew Abbott, Shasikanta Nandeibam, Lucy O'Shea

In light of increasingly ambitious recycling targets it is important to analyse the potential displacement effect of improving access to kerbside provision on other forms of recycling. Do households view the different modes of recycling as substitutes or complements of each other? Does this perceived relationship depend on the type of material recycled? Using data for all of the UK's local governments from 2004Q2 to 2013Q3 we analyse the nature of the relationship between the two main channels of recycling. In the case of dry recycling, the empirical findings are ambiguous on the tradeoff between kerbside and non-kerbside recycling. On the one hand, the findings suggest that there is no trade-off when considering the effect of expanding kerbside provision. On the other hand, the findings also suggest that there is a trade-off when we focus on the effect of expanding nonkerbside provision. However, putting together the empirical findings with theory (in particular, the symmetry property of the Hicksian substitution effect) suggests that there is a trade-off irrespective of whether we consider expansion of kerbside or non-kerbside provision. In the case of green (compost) recycling the empirical findings on their own or together with theory unambiguously suggest that

there is a trade-off.

Piketty and the Growth Dilemma Revisited in the Context of Ecological Economics

- Ecological Economics---2017---Jamie Morgan

Piketty's Capital has provoked considerable debate regarding inequality. The existence of increasing inequality creates a challenge for ecological economics. In this paper we set out some of the problems inherent in Piketty's approach and how they are addressed from the point of view of ecological economics. We use Jackson and Victor's response as a point of departure to make several points. Piketty's work involves an unreconciled inconsistency between his laws and the institutional context, which becomes problematic when one starts to think about 'inevitability'. He simply assumes away ecological problems to make future forecasts for inequality. As such, his forecasts are undermined, since ecological issues are fundamental to any viable future economy. Furthermore, Piketty effectively reproduces (rather than contests) the mainstream practice of delegating ecological issues to a sub-discipline. Jackson and Victor, meanwhile, focus on the mainstream economic aspect of Piketty's work, and construct a model to contest a model. In so doing, they provide an ideational response to what is also a problem of ideological frameworks. Though it can be important to contest an idea, they inadvertently, through family resemblance, contribute to the reproduction of the problematic position of ecological concerns within dominant ways of conceiving economics.

Allocating Environmental Water and Impact on Basin Unemployment: Role of A Diversified Economy

- Ecological Economics---2017---M. Roobavannan, J. Kandasamy, S. Pande, S. Vigneswaran, M. Sivapalan

Water diversion for environmental purposes threatens many agricultural communities. This paper focuses on the water-agriculture-environment nexus in the Murrumbidgee River Basin, Australia, and attempts to

explain how reduced water allocation to agriculture aimed at protecting the environment in turn impacted the wider economy and the community. Predictably reduced water allocation saw declines in agriculture production and employment. Despite this, paradoxically, the basin unemployment rate declined and basin median household income increased. To understand and interpret this, we first analyze available labour, economic and hydrology data, and then develop a simple dynamic model to interpret the observed pattern of basin employment and unemployment. Data analysis revealed the likely causes behind the paradox as (a) out-migration of people from the basin, and (b) absorption of the labour force in the fast growing non-agricultural sectors of the diversified basin economy. The model simulations reinforced this interpretation. Further model simulations under alternative realities of out-migration and sectoral transformation indicated that basins embedded in faster growing national economies, and are more diversified to begin with, are likely to be more conducive to agriculture sector reform (e.g., reduced water allocation) and environmental regeneration. This is a sobering message for other regions experiencing environmental degradation due to extensive agricultural development.

Relationship between Consumer Behavior and Success of Urban Agriculture

- Ecological Economics---2017---Carola Grebittus,Iryna Printezis,Antonios Printezis

Consumers prefer locally grown food products. One source that provides local food is urban agriculture, the farming in and around cities. A number of urban farmers are selling their products directly to consumers. In addition, consumers have the option to grow their own food on certain urban farms. Given this, we investigate how likely consumers are to purchase or grow their own food at urban farms and what determines this likelihood. Given that millennials are a key stakeholder of sustainable consumption and those with the greatest increase in numbers of food gardeners, we conducted an online survey with over 300 Generation Y respondents. We investigate whether young consumers perceive the

health impacts and environmental benefits provided by urban agriculture, and what attitudes they hold towards this source of produce. Empirical results show that both psychological and personal factors affect consumer intentions to participate in urban agriculture. Among others, subjective knowledge regarding urban agriculture and a generally favorable attitude towards urban farms increases the likelihood to buy and grow produce at urban farms. Female and older consumers are more likely to grow their own produce. These findings can be used by stakeholders in urban agriculture to design target-oriented marketing activities.

Green Space and Adult Obesity in the United States

- Ecological Economics---2017---Ramesh Ghimire,Susana Ferreira,Gary T. Green,Neelam C. Poudyal,H. Ken Cordell,Janani R. Thapa

This paper estimates the relationship between green space and body mass index (BMI) in the U.S. We find that accounting for the heterogeneity of green space matters: BMI is significantly lower in counties with larger forestland per-capita, but not in those more abundant in rangeland, pastureland or cropland. This is after controlling for state-specific heterogeneity, and a range of environmental and natural amenities, including the presence of state parks, proximity to national parks, and outdoor recreation resources in the county, all of which have the expected negative correlation with BMI. Hence, the findings suggest that forests, public recreation lands, along with publicly available outdoor recreation resources can be valuable resources to help reduce obesity and associated public health problems.

Public Willingness to Pay and Policy Preferences for Tidal Energy Research and Development: A Study of Households in Washington State

- Ecological Economics---2017---Hilary Jacqueline Polis,Stacia Jeanne Dreyer,Lekelia Danielle Jenkins

Puget Sound in Washington State (WA) has significant

tidal energy resources, but the industry is at a nascent stage of development. At this stage, the availability of research and development (R&D) funding plays a critical role in the success or failure of renewable energy schemes. However, information about public interest in developing marine renewable energy technology, including tidal energy technology, in WA and the U.S. has been limited. Responses to a dichotomous choice referendum question on a mail survey sent to a representative sample of WA households were used to estimate residents' Willingness to Pay (WTP) for tidal energy R&D. Public preferences for policies to support tidal energy R&D were also assessed. WA households are WTP between \$29M and \$127M annually for tidal energy R&D, indicating public preference for an increase in government spending on tidal energy R&D over current levels. Public perceptions of potential social, environmental, and economic risks and benefits of developing tidal energy emerged as highly significant predictors of WTP.

Economic Opportunities and Trade-Offs in Collaborative Forest Landscape Restoration

- Ecological Economics---2017---Alan A. Ager, Kevin C. Vogler, Michelle A. Day, John D. Bailey

We modeled forest restoration scenarios to examine socioeconomic and ecological trade-offs associated with alternative prioritization scenarios. The study examined four US national forests designated as priorities for investments to restore fire resiliency and generate economic opportunities to support local industry. We were particularly interested in economic trade-offs that would result from prioritization of management activities to address forest departure and wildfire risk to the adjacent urban interface. The results showed strong trade-offs and scale effects on production possibility frontiers, and substantial variation among planning areas and national forests. The results pointed to spatially explicit priorities and opportunities to achieve restoration goals within the study area. However, optimizing revenue to help finance restoration projects led to a sharp reduction in the attainment of other

socioecological objectives, especially reducing forest departure from historical conditions. The analytical framework and results can inform ongoing collaborative restoration planning to help stakeholders understand the opportunity cost of specific restoration objectives. This work represents one of the first spatially explicit, economic trade-off analyses of national forest restoration programs, and reveals the relative cost of different restoration strategies, as well scale-related changes in production frontiers associated with restoration investments.

Adoption of Energy Efficiency Measures for Non-residential Buildings: Technological and Organizational Heterogeneity in the Trade, Commerce and Services Sector

- Ecological Economics---2017---Mark Olsthorn, Joachim Schleich, Simon Hirzel

Drawing on agency theory and absorptive capacity literature, this paper empirically analyzes factors of adoption and barriers to adoption of four crosscutting, ancillary energy efficiency measures (EEMs) for non-residential buildings (efficient lighting, building insulation, heating system replacement, and optimization of heating system operations). The empirical analysis employs a large representative sample of organizations in the German trade, commerce and services sector. Results from econometric analyses provide evidence for a negative effect of principal-agent relationships (landlord-tenant; owner-user of energy supply equipment; parent-subsidiary) and for a positive effect of organizational attributes that contribute to absorptive capacity (energy manager in place; energy audit conducted; experience with decentralized low carbon energy). However, the significance of these effects varies by measure. For non-adopters, heterogeneity of crosscutting ancillary EEMs has little impact on the ranking of barriers to adoption. The most relevant barriers for all EEMs are rented spaces, high investment costs, and other priorities; least relevant are technical risk to production and risk to product quality. Finally, we find little evidence for differences in the factors of adoption and barriers to adoption between manufac-

turing and non-manufacturing organizations. These findings are robust to alternative model specifications.

Identifying Five Different Perspectives on the Ecosystem Services Concept Using Q Methodology

- Ecological Economics---2017---Verena Hermelingmeier, Kimberly A. Nicholas

The objective of this paper is to recognize and categorize the various ways that ecosystem services researchers perceive the concept and purpose of ecosystem services (ES). To do so, we employed the discourse analysis approach of Q methodology, where 33 researchers ranked 39 statements on ES derived from the literature. Factor analysis of the Q sorts allowed for the interpretation of five main perspectives on ES: a pragmatic view on nature conservation, seeing ES as useful tool (“Non-Economic Utilitarian”), a strongly value-focused perspective with a skeptical view on ES (“Critical Idealist”), an opposition to a utilitarian approach to nature conservation but seeing ES as more encompassing approach (“Anti-Utilitarian”), a focus on a methodological rather than a critical approach to ES (“Methodologist”), and a rather economic approach to environmental decision-making, in which ES is a useful tool (“Moderate Economist”). We see this plurality as illustrating both the potential of the ES concept to serve as a boundary object for collaboration, but also the threat of ineffective collaboration due to the lack of a common conceptual ground. However, as pluralism can be fruitful if handled transparently, we suggest the need for open dialogue about underlying assumptions when using a value-laden concept like ES.

Optimal Versus Sustainable Degrowth Policies

- Ecological Economics---2017---Marc Germain

This paper introduces a natural resource and pollution in a Ramsey growth model which relies on the postulates of ecological economics. It studies the impact of voluntary degrowth policies on production and welfare. The instrument of these policies is a tax on the natural resource. These public policies are implemented after

the downturn of the households' welfare following from the increased pollution.

How Do Multi-criteria Assessments Address Landscape-level Problems? A Review of Studies and Practices

- Ecological Economics---2017---Sandrine Allain, Gaël Plumecocq, Delphine Leenhardt

Viewing the landscape as a spatialized social-ecological system allows identification of specific management challenges: integration of multiple views, multiple levels of organization, complex spatial-temporal patterns and uncertainties. Multi-criteria assessments (MCAs), which allow the comparison of alternative actions when multiple interests collide, are considered adequate to support landscape management. However, there is no consensus about how they should be applied and can integrate both multiple views and spatial dimension. We conducted an extensive quantitative and qualitative literature review targeting MCAs with a participatory and spatial approach. Our results suggest that (1) for sustainability assessments, participatory and spatial approaches endorse different rationales and hybrid methods are not so common; (2) within those methods, only scenario-selection methods (as opposed to design methods) can integrate spatially-explicit, spatially-implicit, place-specific, and overall values; and (3) current applications, which aggregate values ignoring their spatial and social distribution, do not coincide with the nature of landscape-management challenges. In addition, they give little importance to the structuration of information and to collective deliberation. We conclude that, in the absence of a good match between spatiality and participation, MCAs should, for now, be handled as insightful but distorted tools to explore and structure landscape-level management problems.

Using neuroeconomics to understand environmental valuation

- Ecological Economics---2017---Nik Sawe

Contingent valuation, choice experiments, and other stated preference methods are frequently used to cap-

ture the nonmarket valuation of natural resources and ecosystem services. The emerging field of neuroeconomics, which assesses the neuroscience underlying decision-making, plots a promising course to explore the mechanisms underlying complex environmental valuation decisions. Neuroeconomic methods offer a unique capacity to isolate value components that contribute to willingness-to-pay (WTP), separating an individual's response to natural resource attributes that are of interest to economists from other attributes or influences on the decision process. Neuroimaging data can also aid in understanding differences in response between preference elicitation techniques and identifying the use of different decision processes and heuristics during valuation. This article surveys the benefits and limitations of using neuroeconomics methods to assess the value of environmental goods, and focuses on three examples where neuroeconomics may inform environmental valuation: protest responses, comparison of hypothetical and consequential choice contexts, and the evaluation of environmental attributes and optimization of study design in stated choice experiments. Neuroeconomics methods offer a foundation for positive collaboration between environmental economists and cognitive neuroscientists, yielding metrics that complement and augment current stated preference methods of determining environmental valuation.

Business Strategy Under Institutional Constraints: Evidence From China's Energy Efficiency Regulations

- Ecological Economics---2017---Junming Zhu, Marian R. Chertow

This paper links theoretical perspectives from energy efficiency economics with those observed from corporate environmental strategy to develop a framework for explaining energy efficiency strategies by firms in response to national policies and local regulations in China. The framework is refined through analytic generalization of 20 cases from four industries and four cities in Jiangsu Province, and reveals two strategies: 1) firms with moderate institutional pressure seek incremental competitiveness by adopting energy-saving

technologies, which is reinforced by their informational, organizational, and financing capabilities, and facilitated by voluntary policies and industrial competition; 2) firms with survival risk or development constraints under regulation seek a position favored by local governments by replacing old plant and equipment with larger, more efficient ones and contributing to the local community. The Chinese case studies reveal a strong institutional impact on firms' choice of business strategies and particularly the positioning strategy. The identified business strategies shed additional light on the effectiveness and implications of different policy instruments for energy efficiency.

A Cost-effectiveness Analysis for Incineration or Recycling of Dutch Household Plastic Waste

- Ecological Economics---2017---Raymond Gradus, Paul H.L. Nillesen, Elbert Dijkgraaf, Rick J. van Koppen

The cost-effectiveness of two different plastic waste treatment options is compared. This paper evaluates the recycling of plastic waste with the more conventional incineration of plastic waste, using data for the Netherlands. Both options have specific revenues and costs. The main benefit from plastic recycling is the avoidance of CO₂ emissions that otherwise would occur during incineration and from the production of virgin (new) plastic material. At the same time, there are significant costs involved, such as collection, separation, sorting, and recycling. The benefit from plastic waste incineration is the energy that can be recovered, which reduces emissions in the regular energy production sector by displacing production. The main cost associated with incineration is that this requires a waste-to-energy plant with the associated capital investments. Summing the costs and revenues from both plastic waste treatment options and comparing the results, leads to an implicit CO₂ abatement price of 178€/t of CO₂ in case of plastic recycling. In general, this implicit price is much higher than current (or historic) ETS prices, the estimated external costs of CO₂ emissions, or alternatives to reduce CO₂ emissions (e.g. renewable energy). A sensitivity analysis shows that this

conclusion is robust.

Using Game Theory to Resolve the “Chicken and Egg” Situation in Promoting Cellulosic Bioenergy Development

- Ecological Economics---2017---Yi Luo,Shelie A. Miller

The Renewable Fuel Standard (RFS) requires production of cellulosic biofuel, such as ethanol produced from switchgrass. However, the bioenergy industry faces a well-established “chicken and egg” conundrum where biorefineries cannot be built until adequate farmers’ participation in cellulosic biomass production is ensured; on the other hand, farmers will not commit to growing cellulosic biomass until a market is established. We assume that individual farmers in a future biofuel market are boundedly rational, and will endure the risk of growing switchgrass if they are likely to receive a better payoff in the future. After the number of switchgrass farmers reaches a certain threshold, sufficient biomass can be procured to build an economically viable biorefinery. If a biorefinery is built in a region, the reductions of logistics costs and economies of scale lead to the realization of a public good, and all farmers can be benefited from it; otherwise, the efforts of early switchgrass adopters could be unsuccessful. In this paper, an appropriate biorefinery capacity and the corresponding incentives provided to the farmers are determined by balancing the impact and the risk of the public good. Our incentive model is more efficient than a program that incentivizes all switchgrass growers equally.

Multiple Policy Instruments for Sustainable Water Management in Crop Production - A Modeling Study for the Chinese Aksu-Tarim Region

- Ecological Economics---2017---Til Feike,Martin Henseler

China’s crop production sector faces severe water scarcity issues. Previous research has shown that effective water conservation policies exert strongly negative

impacts on agricultural production and farmers’ income, which make them politically unfeasible under Chinese conditions. To highlight ways out of this dilemma, the present study tests three alternative water policies complemented by supportive agricultural policies to reduce the trade-offs between water conservation and rural development policy goals. Using the case of the extremely arid Aksu-Tarim Region in north-west China, a regional supply model is developed which serves as the analysis framework. Applied as stand-alone water policies, irrigated area tax, water quota and water pricing differ clearly in effectiveness and efficiency. Combined with agricultural policies (subsidies) into multiple policy instruments, the price-based and quota-based instruments mitigate the negative impacts on rural development goals. Targeting a water conservation rate of 20%, the tested multiple policies perform alike on the level of the entire study region; cotton production decreases by 15%, cereals production remains stable, and regional income decreases by 13%. However, at the sub-regional level, the impacts on water conservation, production and income differ significantly between the alternative policy instruments and sub-regions, constituting a crucial challenge for practical water policy implementation.

How Social Footprints of Nations Can Assist in Achieving the Sustainable Development Goals

- Ecological Economics---2017---Yanyan Xiao,Catherine Benoît Norris,Manfred Lenzen,Gregory Norris,Joy Murray

Our study illustrates how consumer social risk footprints can assist in achieving the Sustainable Development Goals (SDGs). Combining the Social Hotspots Database (SHDB) and the Eora global multi-regional input-output table, we use input-output analysis to calculate a consumer social risk footprint (SF) of nations’ imports. For our SFs, we select four indicators related to five of the UN’s SDGs: gender equality (SDG 5 also 8.5 & 8.8); mother and child health (SDG 3, especially 3.1 & 3.2); governance (SDG 16, especially 16.5 & 16.6); and access to clean water (SDG 6, especially 6.1 & 6.2). After examining results for all four indicators

we focus on gender equality to fully convey the value and limitations of using this method of analysis.

Pricing Future Nature Reserves Through Contingent Valuation Data

- Ecological Economics---2017---Louinord Voltaire
- We explore the possibility of generating revenue from nature-based tourism for future nature reserves.
- We investigate different pricing systems.
- The appropriate system depends on the managers' purpose.
- Economic impact assessment on the tourism businesses is required prior adopting a system.

Modelling Land Use, Deforestation, and Policy: A Hybrid Optimisation-Heterogeneous Agent Model with Application to the Bolivian Amazon

- Ecological Economics---2017---Lykke Andersen,Ben Groom,Evan Killick,Juan Carlos Ledezma,Charles Palmer,Diana Weinhold

We introduce a hybrid simulation model (‘SimPachamama’) designed to explore the complex socio-environmental trade-offs of alternative policy bundles and policy sequencing options for stemming deforestation and reducing poverty in tropical countries. Designed and calibrated to the initial conditions of a small forest village in rural Bolivia, the model consists of: (a) an optimising agricultural household module of heterogeneous agents that make individually optimal land-use decisions based on factor endowments and market conditions; (b) an encompassing general equilibrium ‘shell’ module that endogenously determines wages and links the agricultural labour market and rural-urban migration rates; and (c) a novel user-controlled policy-maker module that allows the user to make ‘real time’ choices over a variety of public and environmental policies that in turn impact land use, welfare, and migration. Over a 20-year simulation period the results highlight trade-offs between reductions in deforestation and improvements in household welfare that can only be overcome either when international REDD payments are offered or when decentralized

deforestation taxes are implemented. The sequencing of policies plays a critical role in the determination of these results.

Green Public Procurement of Certified Wood: Spatial Leverage Effect and Welfare Implications

- Ecological Economics---2017---Jan Brusse-laers,Guido Van Huylenbroeck,Jeroen Buysse
- Certified and conventional products are not traditional substitute goods.
- Green public procurement stimulates certification globally, but not in each region.
- Public procurement of the cheaper unsustainable product does not maximise welfare.
- Increasing the price premium for certified wood creates a trade barrier.
- The high costs of forest certification exclude vulnerable producers.

Modeling the Property Price Impact of Water Quality in 14 Chesapeake Bay Counties

- Ecological Economics---2017---Patrick Walsh,Charles Griffiths,Dennis Guignet,Heather Klemick

The Chesapeake Bay and its tributaries provide a range of recreational and aesthetic amenities, such as swimming, fishing, boating, wildlife viewing, and scenic vistas. Living in close proximity to the Bay improves access to these amenities and should be capitalized into local housing markets. We investigate these impacts in the largest hedonic analysis of water quality ever completed, with over 200,000 property sales across 14 Maryland counties. We use a spatially explicit water quality dataset, along with a wealth of landscape, economic, geographic, and demographic variables. These data allow a comprehensive exploration of the value of water quality, while controlling for a multitude of other influences. We also estimate several variants of the models most popular in current literature, with a focus on the temporal average of water quality. In comparing 1year and 3year averages, the 3year averages generally have a larger implicit price. Overall, results indicate that water quality improvements in the Bay, such as those required by EPA's Total Maximum Daily

Load, could yield significant benefits to waterfront and near-waterfront homeowners.

The Impact of Land Use Change on Carbon Stored in Mountain Grasslands and Shrublands

- Ecological Economics---2017---Adrian Ward,Kwong-sang Yin,Paul Dargusch,Elizabeth A. Fulton,Ammar Abdul Aziz

Impacts of Land Change on Ecosystem Services in the San Antonio River Basin, Texas, from 1984 to 2010

- Ecological Economics---2017---Hoonchong Yi,Burak Güneralp,Anthony M. Filippi,Urs P. Kreuter,İnci Güneralp

The San Antonio River Basin (SARB) is an ecologically diverse region in South Texas. The city of San Antonio is located within the basin and is the hub of the North American Free Trade Agreement (NAFTA). San Antonio, together with other major metropolitan centers in Texas, has experienced rapid population and economic growth over the last thirty years, which accelerated after the implementation of NAFTA in 1994. To assess the environmental implications of this growth in the SARB, we first conducted a land-change analysis using Landsat images from 1984, 1995, and 2010. Then, we analyzed spatiotemporal changes in ecosystem services across the SARB and within three watersheds in Bexar County where the city of San Antonio is located. To estimate changes in ecosystem service values (ESV) during this period, we combined the results of the land-change analysis with a benefit transfer approach using two sets of widely cited ecosystem-service valuation coefficients published in 1997 and 2014 but we modified the urban coefficient from the 2014 publication for low-density and high-density urban areas. When 1997 coefficients were applied, the ESV in the SARB decreased, on average, by \$1.2million/year during 1984–1995 and by \$1.8million/year during 1995–2010. The ESV in Bexar County decreased, on average, by \$0.5million/year and \$0.7million/year during the first and second periods, respectively. When the 2014 coefficients and modified urban

value coefficients were applied, the ESV in the SARB decreased, on average, by a 27% more during the first period than when the 1997 coefficients were applied, while, ESV increased during the second period by an average of \$2.2million/year. This temporally opposite trend in ESV change did not occur in Bexar County, however. Using the 2014 coefficients, ESV in Bexar County decreased 5 times more during the first period and decreased 2.5 times more during the second period than when 1997 coefficients were applied. The differences in ESV trends resulting from the two sets of coefficients can be explained primarily by the different coefficients assigned to urban spaces (\$0/ha/year in the 1997 study and \$7005/ha/year in the 2014 study). Our results suggest that the value placed on urban areas in the 2014 publication, taken from a single case study and intended primarily for large urban parks, substantially overestimates the ESV of urban space. In our study areas, applying this value, even only to urban green space, led to the improbable conclusion that urbanization had a positive overall effect on the delivery of ecosystem services. While open spaces in urban areas do provide valuable ecosystem services, it is highly unlikely that their value exceeds those provided by less modified ecosystems. The ability to confidently use value coefficients when applying benefit transfer methods to estimate ESVs demands rigorous assessments of their broad applicability.

Should We Be Wary of Mitigation Banking? Evidence Regarding the Risks Associated with this Wetland Offset Arrangement in Florida

- Ecological Economics---2017---Harold Levrel,Pierre Scemama,Anne-Charlotte Vaissière

This paper describes and analyzes the risks associated with using mitigation banking for the conservation of wetlands in Florida in the United States. First, we attempt to identify and summarize the main ecological and socio-economic risks regarding mitigation banking that have been discussed in previous studies. Then we analyze the institutional responses adopted by US regulators to limit these risks. We have used empirical evidence including interviews and data analysis

to assess the effectiveness of these responses. Our main findings are that the recent regulatory responses adopted to face risks associated with mitigation banking seem to be more effective than what is often assumed. These responses are underpinned by the emergence of a hybrid mode of governance that combines market characteristics and regulatory constraints, and which contributes to enforcing wetland compensation in Florida. However, we also observed some risks inherent in this system, in particular the redistribution of ecosystem services, as the distance between impact sites and compensation sites seems to have increased in Florida in the last several years. In addition, the question is still pending regarding whether or not No Net Loss of wetlands is really achieved through mitigation banking.

Reviewing, Reforming, and Rethinking Global Energy Subsidies: Towards a Political Economy Research Agenda

- Ecological Economics---2017---Benjamin K. Sovacool

This article provides a review of global energy subsidies—of definitions and estimation techniques, their type and scope, their drawbacks, and effective ways to reform them. Based on an assessment of both policy reports and peer-reviewed studies, this article presents evidence that energy subsidies could reach into the trillions of dollars each year. It also highlights how most subsidies appear to offer net costs to society, rather than benefits, in the form of government deficits, increased waste, shortages of energy fuels, and aggravated environmental impacts, among others. The review then talks about how tools such as best practices in measurement and estimation, subsidy elimination, impact studies, and adjustment packages can dramatically reorient subsidies so that they become more socially and environmentally sustainable. It also argues that such efforts need to explicitly learn from previous successes and recognize the importance of political economy, the possible winners and losers to subsidy reform. The final part proposes a future research agenda.

Whose Equity Matters? National to Local Equity Perceptions in Vietnam's Payments for Forest Ecosystem Services Scheme

- Ecological Economics---2017---Lasse Loft,Dung Ngoc Le,Thuy Thu Pham,Anastasia Lucy Yang,Januarti Sinarra Tjajadi,Grace Yee Wong

This paper focuses on the assessment of legislative considerations and local perceptions of equity in Vietnam's Payments for Forest Ecosystem Services scheme (PFES). Equity perceptions are powerful determinants of human behaviour and, consequently, many environmental conflicts arise from contested visions of what constitutes as 'equitable' environmental management. Therefore, equity can play an instrumental role in shaping outcomes of PFES schemes. This paper analyzes how contextual, procedural and distributive equity considerations are reflected in national PFES legislation and implementation, how equity outcomes are perceived locally, and whether local perceptions match legislative considerations. We reviewed national legislation and government reports, conducted expert interviews on the national and provincial level, as well as surveys, focus group discussions, and in-depth interviews on the local level. Our findings reveal that equity outcomes are very much affected by contextual factors, such as how the Forest Land Allocation regulation determines the distribution of use rights. In the implementation of PFES national aspirations and rationales of equity as outlined in legislation were not met due to technical constraints, financial costs, and social and institutional conflicts. The implementation on the ground contrasts with local interests. Our results show that on the local level the preference for a distributive equity principle is very much influenced by the degree of transparency of the payment distribution process. The prevailing perceptions of equitable benefit distribution by local PFES participants correspond to a merit-based principle of compensation for the effort of forest protection.

Tenure Security, Human Capital and Soil Conservation in an Overlapping Generation Rural Economy

- Ecological Economics---2017---Shaikh Eskan-der,Edward Barbier

We develop an overlapping generation model of rural agricultural households to examine whether tenure security and subsistence needs influence the choice between unexploited topsoil and investment in children's human capital as the mode of transfer of wealth. A unique dataset from Bangladesh finds that tenure security is associated with greater topsoil conservation and lower human capital investment. Therefore, there exists a tradeoff between these two modes of transfer. We suggest that increased public expenditure on schooling, which substitutes private expenditure, may lower the pressure on land and soil resources.

Culture, Conservation and Crime: Regulating Ivory Markets for Antiques and Crafts

- Ecological Economics---2017---Alan Collins,Caroline Cox,Nick Pamment

Elephant population numbers are seriously declining due to poaching activity to provide illegal ivory for crafted items, sculpture and jewellery. Despite seemingly robust legislation controlling legal ivory sales (including export permit requirements for UK sales abroad) and the fact that synthetic ivory can now be created to the same diagnostic standards as genuine ivory, selling at a fraction of the cost, the demand for the 'real thing' continues to rise in craft and antique markets with very few prosecutions in the UK. Moreover, there is evidence to suggest that "ghost ivory" (post 1947 worked ivory being sold as pre-1947 worked ivory) is being sold by traders to the unsuspecting and uneducated buyer. Two key illegal sub-markets are identified and a socio-legal and economic analysis of the regulatory options available is presented.

Regional Net Impacts and Social Distribution Effects of Promoting Renewable Energies in Germany

- Ecological Economics---2017---Johannes Többen

This paper concerns the net effects of promoting renewable energies on value added and disposable income in Germany, as well as their distribution among regions and income brackets. Since its entry into force, the German Renewable Energy Sources Act (EEG) has stimulated tremendous investments in renewable energy capacities by guaranteeing investors a fixed price per kWh as well as a preferred feed into the grid over electricity from conventional sources. The policy measures are financed by a surcharge on electricity prices. In recent years, a controversy has arisen about potentially negative regional and social distribution effects. In this paper, multiregional price and quantity input-output models with endogenous heterogeneous households are used to trace the indirect impacts of the EEG on value added and disposable income through the complex network of regional value chains. Our findings suggest that the generation of electricity from renewable sources itself leads to small positive impacts on industries, but leads to a significant drain on household income and has regressive distributive effects. However, investment in new capacities may possibly transform these negative impacts into a positive direction for the majority of households.

Bloom and bust: Toxic algae's impact on nearby property values

- Ecological Economics---2017---David Wolf,Henry Klaiber

Over the past decade harmful algal blooms (HABs) have become a nationwide environmental concern. HABs are likely to increase in frequency and intensity due to rising summer temperatures caused by climate change and higher nutrient enrichment from increased urbanization. Policymakers need information on the economic costs of HABs to design optimal management policies in the face of limited budgets. Using a detailed, multi-lake hedonic analysis across 6 Ohio

counties between 2009 and 2015 we show capitalization losses associated with near lake homes between 11% and 17% rising to above 22% for lake adjacent homes. In the case of Grand Lake Saint Marys, we find one-time capitalization losses exceeding \$51 million for near lake homes which dwarfs the State of Ohio's cleanup expenditure of \$26 million.

Economic implications of agricultural reuse of treated wastewater in Israel: A statewide long-term perspective

- Ecological Economics---2017---Ami Reznik,Eli Feinerman,Israel Finkelshtain,Franklin Fisher,Annette Huber-Lee,Brian Joyce,Iddo Kan

We develop an Israeli version of the Multi-Year Water Allocation System (MYWAS) mathematical programming model to conduct statewide, long-term analyses of three topics associated with agricultural reuse of wastewater. We find that: (1) enabling agricultural irrigation with treated wastewater significantly reduces the optimal capacity levels of seawater and brackish-water desalination over the simulated 3-decade period, and increases Israel's welfare by 3.3 billion USD in terms of present values; (2) a policy requiring desalination of treated wastewater pre-agricultural reuse, as a method to prevent long-run damage to the soil and groundwater, reduces welfare by 2.7 billion USD; hence, such a policy is warranted only if the avoided damages exceed this welfare loss; (3) desalination of treated wastewater in order to increase freshwater availability for agricultural irrigation is not optimal, since the costs overwhelm the generated agricultural benefits. We also find the results associated with these three topics to be sensitive to the natural recharge of Israel's freshwater aquifers, and to the rate at which domestic-water demand evolves due to population and income growth.

Payments for Pioneers? Revisiting the Role of External Rewards for Sustainable Innovation under Heterogeneous Motivations

- Ecological Economics---2017---Aiora Zabala,Unai Pascual,Luis García-Barrios

Acknowledging the diversity of preferences, goals and motivations of individuals is key to promote the effectiveness of incentive-based conservation interventions. This paper analyses the heterogeneity of motivations to adopt silvopastoral practices, a social-ecological innovation for soil conservation and carbon emission reduction. We use Q methodology to identify smallholders' views with regard to these practices in a community in the forest frontier in Chiapas (Mexico). The analysis uncovers three main perspectives: self-sufficient pioneers, environmentally-conscious followers and payment-dependent conservatives. We discuss these perspectives around three topics: smallholders' predisposition to adopt silvopastoral practices, their views about needing external payments to sustain their livelihood and the diffusion of innovative sustainable practices. We relate these perspectives with livelihood characteristics and with observed adoption levels under a pilot programme to promote silvopasture. Our findings suggest that incentives other than payments may be more appropriate for those more likely to adopt, and that payments could encourage rent-seeking strategies and not necessarily promote permanent behavioural change. We suggest ways for designing more effective and adaptive environmental conservation programmes to foster adoption and continuation of social-ecological innovations.

Using Adaptation Insurance to Incentivize Climate-change Mitigation

- Ecological Economics---2017---C. Patrick Doncaster,Alessandro Tavoni,James G. Dyke

Effective responses to climate change may demand a radical shift in human lifestyles away from self-interest for material gain, towards self-restraint for the public good. The challenge then lies in sustaining cooperative mitigation against the temptation to free-ride on others' contributions, which can undermine public endeavours. When all possible future scenarios entail costs, however, the rationale for contributing to a public good changes from altruistic sacrifice of personal profit to necessary investment in minimizing personal debt. Here we demonstrate analytically how an economic

framework of costly adaptation to climate change can sustain cooperative mitigation to reduce greenhouse gas emissions. We develop game-theoretic scenarios from existing examples of insurance for adaptation to natural hazards exacerbated by climate-change that bring the debt burden from future climate events into the present. We model the as-yet untried potential for leveraging public contributions to mitigation from personal costs of adaptation insurance, by discounting the insurance premium in proportion to progress towards a mitigation target. We show that collective mitigation targets are feasible for individuals as well as nations, provided that the premium for adaptation insurance in the event of no mitigation is at least four times larger than the mitigation target per player. This prediction is robust to players having unequal vulnerabilities, wealth, and abilities to pay. We enumerate the effects of these inequalities on payoffs to players under various sub-optimal conditions. We conclude that progress in mitigation is hindered by its current association with a social dilemma, which disappears upon confronting the bleak consequences of inaction.

The Importance of Learning for Achieving the UK's Targets for Offshore Wind

- Ecological Economics---2017---Patrizio Lecca,Peter McGregor,Kim J. Swales,Marie Tamba

Using a purpose-built, multi-sectoral energy-economy-environmental model we evaluate the economic and environmental impact of a reduction in the levelized costs of offshore wind energy generation in the UK. Our modelling approach suggests that in order to significantly increase the offshore wind capacity in the UK the required fall in the generation cost should be larger than expected and certainly bigger than that implied by the most recent cost projections developed by the UK Department of Energy and Climate Change (DECC). Potential expansion of the offshore wind sector in the UK crucially depends on the price sensitivity of the energy supply sector and on agent's expectations. Only in our more optimistic scenario do we reach DECC's ambitious challenge of 22 GW offshore wind

deployment in 2030 through a constant learning rate alone.

Carbon Dioxide Emissions and Economic Growth: An Assessment Based on Production and Consumption Emission Inventories

- Ecological Economics---2017---Octavio Fernández-Amador,Joseph Francois,Doris Oberdabernig,Patrick Tomberger

Working with a new dataset on comparable global CO₂ production and consumption inventories spanning the 1997–2011 period, we investigate the relationship between real gross domestic product (GDP) per capita and CO₂ emissions per capita associated with both production and consumption activities. By including linkages between production-based emissions in one country and final consumption in another (via cross-border value chains), we focus on the entire carbon chain. We estimate polynomial and threshold models, accounting for reverse causality and identification problems. We find that the income-elasticity for both inventories is regime-dependent and reflects small carbon efficiency gains from economic development. Carbon footprints show larger income-elasticities, while national policy instruments targeting production can clearly be circumvented by carbon embodied in intermediate trade. This implies problems of environmental sustainability that may require consumption-based policy instruments.

Urban commons service generation, delivery, and management: A conceptual framework

- Ecological Economics---2017---Arpit Shah,Amit Garg

Urban commons are currently not studied holistically under the rationale used by the ecosystem cascade framework. In this paper, we build on the ecosystem cascade framework to present a conceptual model that provides a comprehensive view of urban common resources and allows decision-makers to develop suitable interventions to meet objectives of sustainability and equity. The model looks at the role of and explains the

linkages between urban commons' biophysical structures, user population characteristics, power dynamics, use behavior, benefits generated, and management strategies. The model adds to existing literature by focusing on direct benefits and equity and by elaborating on the role of transaction costs and management strategies in governing urban commons. Considering direct benefits allows for a complete picture of overall benefits while making governance decisions, as opposed to considering benefits received only through human effort. Focusing on power asymmetries between stakeholders highlights the inequities created in accessing benefits from urban commons. Elaborating on management strategies provides greater insight into the complexities of managing urban commons and the impacts that governance decisions can have. Finally, including transaction costs highlights the factors that influence costs of managing resources. We illustrate the use of the model with literature from urban India.

Causes and Impacts of Deficient Liability for Climate Change Damage, and an Economic Conception for Climate Change Liability That Supports Appropriate Action: DRaCULA

- Ecological Economics---2017---Sacha Rene Meckler

To gain an understanding of the issues with environmental liability attribution, both international law and the implicit liability under the UNFCCC are reviewed, and found to be ineffective. This stems from a neoliberal marginalisation of international law and tendency to externalise liability resulting in accountability gaps, which pose major challenges for the climate regime. A socially efficient economic reframing of liability into a Dynamically Relative, and Comparatively Universal Liability Attribution (DRaCULA) framework is proposed. The attribution of liability for climate change damages under DRaCULA is algebraically developed into a conceptual model, the operation of the conceptual model is discussed and together with the framework found to be robust. Through its embodiment of the dynamic challenges inherent in climate change, DRaCULA strategically facilitates the climate nego-

tiations and provides credible solutions to stumbling blocks, including the N-S divide.

Payment Vs. Compensation For Ecosystem Services: Do Words Have A Voice In The Design of Environmental Conservation Programs?

- Ecological Economics---2017---Sophie Clot,Gilles Grolleau,Philippe Méral

We examine whether and how word choice can affect individual perceptions about a proposed Payments for Ecosystem Services (PES) program when objective outcomes are similar. From a traditional economic perspective, this type of manipulation would be considered unlikely to affect perceptions and behaviour, especially in the presence of pecuniary incentives and repeated decisions among sophisticated agents. From a behaviourally informed perspective, however, psychological and political theories of wording argue that word choice can have a significant impact on economic behaviour. To substantiate this discussion, we conduct a survey experiment that tests the impact of the words 'payment' and 'compensation' on favorability ratings of a proposed PES program. These preliminary findings suggest that the words used to describe public policies can be influential non-pecuniary interventions.

How Countries' Resource Use History Matters for Human Well-being – An Investigation of Global Patterns in Cumulative Material Flows from 1950 to 2010

- Ecological Economics---2017---Andreas Mayer,Willi Haas,Dominik Wiedenhofer

Global resource use has been expanding rapidly after 1950 and improved material living conditions and human well-being of large parts of the global population. We here apply a cumulative long-term perspective to gain broader insights into the material requirements of human well-being, the role of trade and the history of environmental pressures than the usual perspective of annual or most recent flows would reveal. Furthermore, we investigate environmental pressures expressed as cumulative extraction per area over the last 60years.

To both ends, we utilize cumulative data on material flows on domestic material inputs (DMI) and domestic extraction (DE) for 148 countries from 1950 - to 2010 and the Social Progress Index. We find that a high level of well-being required at least 460t/cap of cumulative material inputs from 1950- to 2010. An analysis of the relation between cumulative flows and current human well-being shows statistically significant that at similar levels of cumulative material inputs, biophysical export-orientation of a country has a weak negative influence on well-being. When the Sustainable Development Goals are to be achieved, the scientific community and policy makers have to consider the history of development of resource use to better understand the future challenges ahead.

Transferability of Policies to Control Agricultural Nonpoint Pollution in Relatively Similar Catchments

- Ecological Economics---2017---Ashar Aftab,Nick Hanley,Giovanni Baiocchi

The EU's WFD requires cost-effective compliance with good ecological and chemical status across EU surface waters. Previous studies have modelled single catchments or been limited by their realism when investigating multiple catchments. We investigate whether the cost-effectiveness ranking of policy instruments to control agricultural nonpoint nitrate pollution (NP) is consistent across two relatively similar catchments. Transferability may interest regulators seeking to identify policies implementable in relatively similar catchments, rather than setting high transaction cost catchment specific policies. Detailed nonlinear stochastic biophysical economic optimisation models of two catchments are constructed. We estimate the distribution of daily river pollution for 10years in each catchment without assuming an underlying pollutant distribution that is likely to distort policy ranking. We report consistency of policy rankings and outperformance in distinct regulatory target ranges in both catchments as well as pollution swapping. The transferability evidence may not be as robust as policymakers would like. Mixed instruments are cost-effective at higher regulatory targets

and display characteristics suited to uniform application across catchments. Our study would benefit from improved modelling of farming heterogeneity, groundwater hydrology and policy transaction costs. Further research is required to identify catchment characteristics that determine transferability across a broader set of catchments.

Economic Water Productivities Along the Dairy Value Chain in South Africa: Implications for Sustainable and Economically Efficient Water-use Policies in the Dairy Industry

- Ecological Economics---2017---Enoch Owusu-Sekyere,Morné Erwin Scheepers,Henry Jordaan

The global water scarcity situation is a major issue of concern to sustainable development and requires detailed assessment of water footprints and water productivities in all sectors of the economy. This paper has analysed economic water productivities along the dairy value chain in South Africa. The findings reveal that the value added to milk and water as it moves along the value chain varies from stage to stage; with the highest value being attained at the processing level, followed by the retail and farm gate levels, respectively. Milk production in South Africa is economically efficient in terms of water use. Feed production accounts for about 98.02% of the total water footprint of milk with 3.3% protein and 4% fat. Feed production is economically efficient in terms of cost and water use. Value addition to milk and economic productivity of water are influenced by packaging design. Not all economically water productive feed products are significant contributors to milk yield. Future ecological footprint assessments should take into account the value added to output products and economic water productivities along the products' value chain, rather than relying only on water footprint estimates.

Crop Production and Crop Diversity in France: A Spatial Analysis

- Ecological Economics---2017---Hermann Dönfouet,Aleksandra Barczak,Cecile Detang-Dessendre,Elise Maigné

This paper aims to provide empirical evidence of the effect of crop diversity on crop production and spillover effect. Based on the estimation of production functions with spatial concerns on an original and rich dataset, results of the study suggest that crop diversity has a positive and significant effect on crop production. Its marginal contribution is substantial when rainfall is low in the agroecosystem. Furthermore, spatial dependence is a major issue and could be explained by topographic, climatic and agronomic constraints.

Income Inequality and Carbon Emissions in the United States: A State-level Analysis, 1997–2012

- Ecological Economics---2017---Andrew Jorgenson,Juliet Schor,Xiaorui Huang

This study investigates the relationship between U.S. state-level CO₂ emissions and two measures of income inequality: the income share of the top 10% and the Gini coefficient. Each of the inequality measures, which focus on unique characteristics of income distributions, is used to evaluate the arguments of different analytical approaches. Results of the longitudinal analysis for the 1997 to 2012 period indicate that state-level emissions are positively associated with the income share of the top 10%, while the effect of the Gini coefficient on emissions is non-significant. The statistically significant relationship between CO₂ emissions and the concentration of income among the top 10% is consistent with analytical approaches that focus on political economy dynamics and Veblen effects, which highlight the potential political and economic power and emulative influence of the wealthy. The null effect of the Gini coefficient is generally inconsistent with the marginal propensity to emit approach, which posits that when incomes become more equally distributed, the poor will increase their consumption of energy and other carbon-intensive products as they move into the middle class.

Performance of Input- and Output-based Payments for the Conservation of Mobile Species

- Ecological Economics---2017---Martin Drechsler

A conceptual model is presented for the comparison of input-based payments (where conservation measures are rewarded) and output-based payments (where conservation outcomes are rewarded) in a spatially structured landscape. The landscape consists of a grid of land parcels, each managed by a land user. The objective of the conservation agency is the survival of an endangered mobile species in the landscape. The comparison of the two payment schemes is made with regard to cost-effectiveness (maximizing species survival for given total conservation costs) and budget-effectiveness (maximizing species survival for given conservation budget). The model is a grid-based dynamic stochastic ecological-economic simulation model. In the model analysis it is found that within the considered model parameter ranges the output-based payment outperforms the input-based payment, except for the cases of risk-averse land users and spatial spill-overs. The comparative advantage of the output-based payment increases with increasing viability and decreasing dispersal range of the species, and with decreasing spatial variation of the conservation costs. In the light of these results, output-based payments appear as a promising policy option even for mobile species where the local outcome (presence of the species in the land parcel) of a local conservation measure is uncertain.

Potential Consequences on the Economy of Low or No Growth - Short and Long Term Perspectives

- Ecological Economics---2017---J. Mikael Malmmaeus,Eva C. Alfredsson

2017

The State-contingent Approach to the Noah's Ark Problem

- Ecological Economics---2017---Neil Perry,Sriram Shankar

Biodiversity outcomes arising from conservation programs depend on the future state of nature, yet standard economic models of biodiversity conservation are not state contingent. We develop a state-contingent

approach to the Noah's Ark problem – the problem of efficiently allocating limited funds to conserve biodiversity – and model conservation actions under uncertainty. Under the state-contingent approach, Noah will prepare for unfavorable and unexpected states of nature ex ante rather than relieving suffering ex post. Different species will be chosen for the Ark and particularly species that underpin the foundations of ecosystems. More generally, the state-contingent ranking equation justifies conservation policy that treats the cause rather than the symptom of biodiversity loss, and recommends strategies that focus on ecosystem resilience and integrity. In comparison to the standard model, the state-contingent approach leads to a more detailed and explicit allocation of resources. (JEL: Q54, Q57, Q58).

Estimating a Total Demand Function for Sea Angling Pursuits

- Ecological Economics---2017---Stephen Hynes,Rainey Gaeven,O'Reilly, Paul

Sea angling is often over-looked in debates related to the sustainability of commercial fisheries, tourism and impacts on marine ecosystem service provision from coastal developments. This paper presents the estimation of a sea angling demand function for Irish waters. The negative binomial models also account for truncation and endogenous stratification; two issues that need to be controlled for when dealing with on-site sampled populations. Given the dispersed nature of sea angling activity, the chosen model does not focus on one specific site as is common in the literature for count data travel cost models but rather estimates the total demand for sea angling in the season, no matter where the angling takes place along the Irish coast. We use this empirical work to discuss the more general debate surrounding resource allocation between commercial fisheries and recreational anglers. The results indicate the high value of the Irish marine environment as a recreational angling resource.

Payment for multiple forest benefits alters the effect of tree disease on optimal forest rotation length

- Ecological Economics---2017---Morag F. Macpherson,Adam Kleczkowski,John R. Healey,Nick Hanley

Forests deliver multiple benefits both to their owners and to wider society. However, a wave of forest pests and pathogens is threatening this worldwide. In this paper we examine the effect of disease on the optimal rotation length of a single-aged, single rotation forest when a payment for non-timber benefits, which is offered to private forest owners to partly internalise the social values of forest management, is included. Using a generalisable bioeconomic framework we show how this payment counteracts the negative economic effect of disease by increasing the optimal rotation length, and under some restrictive conditions, even makes it optimal to never harvest the forest. The analysis shows a range of complex interactions between factors including the rate of spread of infection and the impact of disease on the value of harvested timber and non-timber benefits. A key result is that the effect of disease on the optimal rotation length is dependent on whether the disease affects the timber benefit only compared to when it affects both timber and non-timber benefits. Our framework can be extended to incorporate multiple ecosystem services delivered by forests and details of how disease can affect their production, thus facilitating a wide range of applications.

Governmentality, Development and the Violence of Natural Resource Extraction in Peru

- Ecological Economics---2017---Diego Andreucci,Giorgos Kallis

2017

Choosing a Functional Form for an International Benefit Transfer: Evidence from a Nine-country Valuation Experiment

- Ecological Economics---2017---Mikolaj Czakowski,Heini Ahtiainen,Janne Artell,Jürgen

This paper investigates the performance of common approaches in international benefit transfer using data from identical and simultaneous contingent valuation studies on marine water quality in nine European countries. The environmental good is shared by the study countries, but the countries differ substantially in their income levels and other characteristics. We compare the performance of value transfers (with or without income elasticity of willingness to pay adjustments) and function transfers that include only core variables supported by economic theory. Our results point to a new source of uncertainty associated with function transfer – choosing a particular functional form. Even if only theoretically relevant explanatory variables are used, the theory offers no insights with respect to a functional relationship of the dependence (e.g., linear, log-linear, exponential, polynomial). We show that while different functional forms may offer improvements in model fit, this does not necessarily translate to improvements in transfer errors or minimum tolerance levels. In our case, the value transfer with constant (unit) income elasticity adjustment, corresponding to the log-log functional relationship between willingness to pay and income, performs the best. Including additional explanatory variables or using other functional forms worsens the quality of transfers. Overall, our study questions the rationale for using more complicated function transfers in international benefit transfers, as the relationships observed within a country or a group of countries does not necessarily translate to dependencies between countries.

Determinants of Consumers' Green Purchase Behavior in a Developing Nation: Applying and Extending the Theory of Planned Behavior

- Ecological Economics---2017---Rambalak Yadav, Govind S. Pathak

The green consumption among individuals can be an effective way to minimize the negative impact of consumption on the environment. The research related to green consumption behavior in developing nations

such as India is few and far between. Considering this, researchers in the present study have attempted to understand the consumer behavior to buy green products in context of a developing nation; India. The study has used the Theory of Planned Behavior (TPB) and further extended the TPB including additional constructs namely; perceived value and willingness to pay premium (WPP) and measured its appropriateness in determining consumer green purchase intention and behavior. A total of 620 usable responses were collected with the help of a questionnaire survey using the convenience sampling approach. Structural Equation Modeling (SEM) was used to evaluate the strength of relationships among constructs. The findings reported that TPB fully supported the consumers' intention to buy green products which in turn influences their green purchase behavior. Inclusion of additional constructs was supported in the TPB as it has improved the predicted power of the TPB framework in predicting consumer green purchase intention and behavior. At the end, discussion and implications have been discussed.

Competitive Lobbying over Common Pool Resource Regulations

- Ecological Economics---2017---Matthew A. Freeman, Christopher M. Anderson

Common-pool resource regulations are developed through a combination of resource assessment, economic analysis, and politics. We investigate a management institution wherein users can influence a proposed common extraction cap through costly effort, or lobbying. Our model incorporates two user types: a few harvesters who efficiently handle extraction externalities, and a larger number who do not. Without regulation, we observe the efficient harvesters extracting more than the social optimum, consistent with Nash equilibrium. Given the opportunity to lobby, we observe harvesters contributing to move inefficient proposed caps toward more efficient levels. However, lobbying is a public good and, consistent with Nash equilibrium, the user type with weaker preference free rides on the type with stronger preferences leading to

insufficient lobbying and inefficient regulations, especially when the cap must be lowered. This highlights an important limitation to participatory governance mechanisms when participation is costly.

Equity-based Natural Resource Allocation for Infrastructure Development: Evidence From Large Hydropower Dams in Africa and Asia

- Ecological Economics---2017---Giuseppina Siciliano,Frauke Urban

Large hydropower infrastructure development is a key energy priority in low and middle income countries as a means to increase energy access and promote national development. Nevertheless hydropower dams can also negatively impact people's livelihoods by reducing access to local natural resources such as land, water and food. This paper analyses equity-based resource allocation from an ecological economics perspective, by looking at local resource use competition between different uses (food, energy, livelihoods) and users (villagers, urban settlers, local government and dam builders) in selected case studies in Asia and Africa. It also illustrates from a political ecology approach divergences between national priorities of energy production and growth and local development needs.

Caloric unequal exchange in Latin America and the Caribbean

- Ecological Economics---2017---Fander Falconí,Jesus Ramos-Martin,Pedro Cango

The existence of an unequal exchange between rich and poor countries has been well studied in the literature, explained by differences in labour costs that were reflected in the prices of traded goods. Research has also demonstrated that the failure to include environmental impacts in prices of traded goods concealed an ecologically unequal exchange. This paper contributes to the discussion with the newly coined concept of caloric unequal exchange that defines the deterioration of terms of trade in food in units of calories. Exports and imports to and from Latin America and the Caribbean are analysed for the period 1961 through 2011 in volume,

value, and calories, for different groups of products. The study concludes that although calories exported by the region to the rest of the world are more expensive than those imported, the ratio is deteriorating over time. This trend is found to be dependent of the trading partner involved. The region is helping the rest of the world in supplying their diets at a lower cost. A side result is that globalisation is homogenising diets over time, concentrating most food consumption in a reduced number of products, and therefore increasing interdependency among countries and affecting food security.

The Panda's Pawprint: The Environmental Impact of the China-led Re-primarization in Latin America and the Caribbean

- Ecological Economics---2017---Rebecca Ray
- 2017

Monetary Valuation of Natural Predators for Biological Pest Control in Pear Production

- Ecological Economics---2017---Silvie Daniels,Nele Witters,Tim Beliën,Kristof Vrancken,Jaco Vangronsveld,Steven Van Passel

In spite of global actions, biodiversity is declining at an alarming rate. Despite the need for objectively comparable monetary standards to include biodiversity arguments in policymaking, research on the relationship between species diversity and its valuation from a societal perspective is still scarce.

The inequality-emissions nexus in the context of trade and development: A quantile regression approach

- Ecological Economics---2017---Michael Hübler

If the emissions attributed to households' consumption rise in their income in a concave way, higher within-country inequality will reduce emissions. To test this negative nexus, the article utilizes simultaneous-quantile regressions with per capita CO2 emissions (or energy intensities of GDP) as the dependent variable

and draws on country-level panel data. Overall, the estimates vary considerably across quantiles. Regressions with pooled data support the negative inequality-emissions (energy) nexus, whereas regressions with fixed-effects question it. International trade and international investments are mostly positively related to emissions (energy).

Is It Possible to Make Rubber Extraction Ecologically and Economically Viable in the Amazon? The Southern Acre and Chico Mendes Reserve Case Study

- Ecological Economics---2017---Carolina Jaramillo-Giraldo,Britaldo Soares Filho,Sônia M. Carvalho Ribeiro,Rivadalve Coelho Gonçalves

Rubber extraction in the Amazon faces enormous ecological and economic challenges. We modeled the ecology (tree density and forest yields) and the production chain, including rents of the three major rubber products: Pressed Virgin Rubber (PVR), Liquid Latex (LL), and Liquid Smoked Sheet (LSS) from native forests and from plantations in Southern Acre, including the emblematic Chico Mendes Reserve. Our estimates show that, in native forests, tree density ranges from 0 to 4trees/ha (average=1.67trees/ha), while productivity varies from 1 to 3l/tree/year (average=2.26l/tree/year) with yields between 1 and 6l/ha/year. Our model estimates a potential annual production of 890tons of dry rubber in the 2.5millionha of forests of Southern Acre (average=0.36kg/ha/year). Rubber extraction in native forests is not economically viable without government subsidies. Mean Equivalent Annual Annuity (EAA) for LL is US\$ 3.24ha/year in a scenario with subsidies and of 75% of potential annual harvest. LSS from plantations reaches an EAA of US\$ 270ha/year if costs of formation are subsidized. Public subsidies or Payments for Ecosystem Services are essential to sustain, at least temporally, rubber tapper identity – an important Cultural Ecosystem Service of the Amazon.

Ecological Macroeconomic Models: Assessing Current Developments

- Ecological Economics---2017---Lukas Hardt,O'Neill, Daniel W.

Our society faces a dilemma. While continued economic growth is ecologically unsustainable, low or negative rates of economic growth are accompanied by adverse social impacts. Hence there is a need for macroeconomic tools that can help identify socially sustainable post-growth pathways. The emerging field of ecological macroeconomics aims to address this need and features a number of new macroeconomic modelling approaches. This article provides (1) a review of modelling developments in ecological macroeconomics, based on the literature and interviews with researchers, and (2) an analysis of how the different models incorporate policy themes from the post-growth literature. Twenty-two ecological macroeconomic models were analysed and compared to eight policy themes. It was found that environmental interactions and the monetary system were treated most comprehensively. Themes of income inequality, work patterns, indicators of well-being, and disaggregated production were addressed with less detail, while alternative business models and cross-scale interactions were hardly addressed. Overall, the combination of input-output analysis with stock-flow consistent modelling was identified as a promising avenue for developing macroeconomic models for a post-growth economy. However, due to the wide interpretation of what “the economy” entails, future research will benefit from employing a range of approaches.

When Does Public Information Undermine the Efficiency of Reverse Auctions for the Purchase of Ecosystem Services?

- Ecological Economics---2017---Kent D. Messer,Joshua Duke,Lori Lynch,Tongzhe Li

Government agencies that conduct reverse auctions related to the Payment of Ecosystem Services (PES) traditionally provide a significant amount of public information about past auction results. This information

includes not only the amount of money spent by the government but also can include various information about the accepted bids. This research uses induced-value experiments to evaluate the effect of past auction information on seller (landholder) rent seeking. Results suggest that sellers use this public information and learn how to secure higher rents. However, when sellers are given information only about the buyer's (government agency's) budget, they secure lower rents. Results also suggest that relative budget size affects rents and that budget stochastic variability in the presence of market information diminishes the effect. Thus, in the presence of public information and equivalent total outlays, variable budgets are more likely than stationary budgets to achieve auction fiscal efficiency—the measure of whether the auction achieves the greatest PES benefits given its limited budget. Finally, this research finds that auctions with greater heterogeneity in seller opportunity costs are likely to be less fiscally efficient than when the distribution is more homogeneous.

Determinants of Motives for Land Use Decisions at the Margins of the Corn Belt

- Ecological Economics---2017---Tong Wang,Moses Luri,Larry Janssen,David Hennessy,Hongli Feng,Michael C. Wimberly,Gaurav Arora

The extent of United States Great Plains grass agriculture has ebbed and flowed over decades in response to market incentives, government policies, technological innovations and weather patterns. Our thesis is that the land most responsive to these drivers is at the economic margin between grass-based production and cropping. Much of the eastern Dakotas is such an area, primarily under crop-based agriculture although grass remains an important land use. We surveyed land operators in the area on their views about motivators for land use choices. Their views are largely consistent with the economic margin viewpoint. The importance of crop output prices, crop input prices, innovations in cropping equipment and weather patterns on land use decisions grow as one moves north toward the economic margin. Land in more highly sloped ar-

eas is more sensitive to crop prices and crop insurance policies. Consistent with human capital theory, older operators are generally less responsive to factors that affect land use. Those renting more land, being more exposed to market forces, are more responsive. As farm size increases, respondents declared higher land use sensitivity to policy issues and technological innovations, suggesting that scale effects render land units more sensitive to land use change drivers.

Evaluating Revealed Preferences for Street Tree Cover Targets: A Business Case for Collaborative Investment in Leafier Streetscapes in Brisbane, Australia

- Ecological Economics---2017---Lyndal Plant,Alicia Rambaldi,Neil Sipe

Many cities are seeking to optimise the ecosystem service benefits of urban trees by incorporating goals for increasing tree canopy cover into strategies that promote liveability and urban sustainability. We adapt revealed preference valuation techniques as a combined policy evaluation and business case tool with broader application to urban forest planning and investment. We use spatial hedonic price modelling of 2,299 house sales across 80 sample sites in 52 residential Brisbane suburbs, to reveal home-buyers willingness to pay 3.73% more for houses in streets with target levels of footpath tree cover (50% tree canopy coverage of the footpath zone by 2031) nearby (within 100m). An estimate of the contribution of 2010 levels of footpath tree cover (35%) to the prices of houses sold in 2010 (\$US15.03 – 15.91 million) far exceeded annual costs to those home owners in local property taxes. Associated annual rates revenues (\$US 0.51 – 0.53 million) to local government and stamp duty revenues (\$US 0.53 – 0.60 million) to state government help justify ongoing collaborative investment to achieve target levels of footpath tree cover.

Invasive Species Impacts on Human Well-being Using the Life Satisfaction Index

- Ecological Economics---2017---Benjamin Jones

Invasive alien species are known to be disruptive to the natural environment and can lead to sharp reductions in environmental quality, thereby affecting social welfare. However, little is known about how subjective well-being, in particular, is impacted by invasive species. This is troubling because it precludes credible empirical considerations of the full-range of social externalities when setting invasive species management policy. To address this knowledge gap, this paper provides the first estimates of invasive species impacts on subjective well-being using the life satisfaction (“happiness”) index. The approach is applied to the invasive emerald ash borer (EAB), a particularly virulent ash tree attacking pest in North America. Using a repeated cross-sectional fixed effects design, the impact of EAB detection on life satisfaction (LS) is estimated for individuals living in 189 counties in 15 US states over 2005–2011. Results suggest that after EAB detection, LS is reduced by 0.127 on a 4-point scale [95% CI: 0.002, 0.252]. The magnitude of impacts are greatest after a 5-year lag and are largest among young adults (18–24years).

Behavioral Insights for the Analysis of Green Tips

- Ecological Economics---2017---Gilles Grolleau, Estelle Midler, Naoufel Mzoughi

People in several countries are overwhelmed with green tips in order to encourage them protecting the environment. The effectiveness of these tips, however, highly depends on the context and the person targeted by the tips. In particular, we contend that some green tips may do more harm than good when individuals have cognitive and behavioral biases. Without purporting to be exhaustive, we explain some of these biases and mechanisms by which green tips may lead to a net environmental degradation. We also emphasize that it is possible to complement green tips with debiasing strategies to guarantee their performance. We present some of these strategies, notably the foot-in-the-door technique, commitment strategies, the strategic use of small changes and individuals’ pursuit of identity. Finally, several policy implications are developed.

Revisiting Pesticide Taxation Schemes

- Ecological Economics---2017---Robert Finger, Niklas Möhring, Tobias Dalhaus, Thomas Böcker

The risks caused by pesticide use for human health and nature are one of the major challenges for agricultural policies. Despite their high potential to contribute to better policies, economic instruments such as pesticide taxes are rarely used in the current policy mix. In this essay, we combine current discussion on pesticide policies in European countries with new insights from recent economic research to provide an outline for better pesticide policies to policy makers and stakeholders. We show that differentiated taxation schemes have a high potential to reduce risks caused by pesticide use and that the targeted re-distribution of tax revenues in the agricultural sector is crucial to create leverage effects on pesticide use and to increase the acceptability of pesticide taxes.

Dealing with Cultural Differences in Environmental Management: Exploring the CEP-CFP Relationship

- Ecological Economics---2017---Vincenzo Vastola, Angeloantonio Russo, Clodia Vurro

Despite numerous attempts to agree on the nature of the relationship between environmental and financial performance, controversial results still exist in the literature. This discrepancy suggests that we must enlarge the spectrum of analysis to understand when it pays to be green. The way in which society takes a stance on environmental responsibility is deeply bounded to the cultural lenses through which it sets its priorities. A cultural perspective can help explain the capacity for social phenomena to shape behaviour. We consider how the contextual environment of culture, thus far neglected, might moderate the corporate environmental performance–corporate financial performance relationship and thus influence firms’ capacity to offset the costs of environmental management. By using a sample of 954 companies, we contribute to the long-running debate, showing how the effect of cultural influence can

overcome the hurdle of contrasting results and offer novel insights for both academia and practitioners.

A Global Survey and Review of the Determinants of Transaction Costs of Forestry Carbon Projects

- Ecological Economics---2017---Thu-Ha Dang Phan,Roy Brouwer,Marc David Davidson

Reducing carbon emissions in the forestry sector by means of market-based schemes is considered a cost-effective measure for tackling climate change impacts. However, the transaction costs (TCs) involved are typically unknown or unquantified and therefore often neglected. In this study three types of TCs (search, design and negotiation costs) were measured in person-days and monetary terms based on a global survey of forestry carbon projects implemented across Latin-America, Asia and Africa. Cost estimates vary between zero and 1.201/tCO₂ for person-days and from zero to US\$ 1.738/tCO₂ for monetary costs. Key drivers of TCs are identified based on the characteristics of the project in general, the transaction, the transactors involved and institutional design. The latter type of characteristic is shown to have a particularly large impact on TCs.

The Emergy Perspective of Sustainable Trends in Puerto Rico From 1960 to 2013

- Ecological Economics---2017---Alejandra M. González-Mejía, Ma, Xin (Cissy)

Emergy analysis quantifies the direct and indirect contributions of nature to human systems providing a sustainability assessment framework, which couples economic growth within biophysical constraints. In this study, Puerto Rico's sustainability was assessed with emergy flow dynamics from 1960 to 2013. During this period, the island shifted from an agriculture-based economy to an industrial base of manufacture and services (1960–1970). The emergy analysis indicated an exponential decline in sustainability during this period. From 1975 to 1992, the island became more industrialized and imported more goods and services. Since 1998,

although more renewable production such as forest regeneration occurred, the rapid industrialization heavily relied on imported fossil fuels, goods, and services, resulting in a system that has not been self-sufficient, nor sustainable. The latest economic crisis and the most recently passed financial rescue bill represent an opportunity to redirect Puerto Rico towards a sustainable path with policies that decrease the ratio of imported y to exported emergy, and strategies that encourage efficient use of resources and local production based on the utilization of renewable sources within this U.S. territory.

Using inclusive wealth for policy evaluation: Application to electricity infrastructure planning in oil-exporting countries

- Ecological Economics---2017---Ross D. Collins,Noelle E. Selin,Olivier L. de Weck,William C. Clark

Decision-makers often seek to design policies that support sustainable development. Prospective evaluations of how effectively such policies are likely to meet sustainability goals have nonetheless remained challenging. Evaluating policies against sustainability goals can be facilitated through the inclusive wealth framework, which characterizes development in terms of the value to society of its underlying capital assets, and defines development to be potentially sustainable if that value does not decline over time. The inclusive wealth approach has been developed at a theoretical level and applied to retrospective evaluations. Here, we apply inclusive wealth theory to prospective policy evaluation coupled with dynamic simulation modeling, using a case of electricity infrastructure policies in oil-exporting countries. To demonstrate the prospective evaluation, we analyze investment policies in non-fossil electricity capacity in terms of their forecast impact on several dimensions of inclusive wealth. Illustrative results show that investing in non-fossil capacity in Saudi Arabia and Kuwait can increase components of the countries' inclusive wealth, though the impacts depend on future uncertainties. In contrast, comparable components of the UAE's net inclusive wealth decline

under similar investment policies. Finally, including human capital improvements in estimates of inclusive wealth substantially increases its value, though the amount varies across the countries.

The Hotelling Rule for Entropy-constrained Economic Growth

- Ecological Economics---2017---Gabriel A. Lozada

Lozada, Gabriel A. (1995), “xxx” , Ecological Economics, ? : ???–???. The entropy change of the solar system between now and its final heat death is fixed. The time to the heat death is determined by the rate of entropy increase between now and then. If this rate of entropy increase is itself increased by economic activity, then economic activity is generating a negative externality. By internalizing this, a social planner treats the fixed amount of entropy change remaining until the heat death like the stock of an exhaustible resource. This leads to an analysis along the same lines as Hotelling’s neoclassical economics of exhaustible resources, forming a partial synthesis between neoclassical economics and Nicholas Georgescu-Roegen’s “ecological economics” work on the entropy law.

Social Cost of Forcing: A Basis for Pricing All Forcing Agents

- Ecological Economics---2017---Aapo Rautiainen, Jussi Lintunen

An efficient climate policy is based on cost-benefit analysis (CBA) and equates marginal abatement costs across all forcing agents affecting climate change. In CBA, the agents’ contributions to radiative forcing (RF) must be consistently priced (i.e. the social cost of RF, occurring at a specific time, must be the same regardless of the agent causing it). We present a concept that enables doing so. The Social Cost of Forcing (SCF) is the monetary value of the social damage caused by marginal RF at a given instant ($W_m - 2$). Any forcing agent whose temporal decay profile and radiative efficiency are known can be priced based on it. Prices obtained for distinct agents are consistent in CBA, as long as the same SCF and discounting assumptions

are applied. Hence, the SCF is a concise way to communicate social cost information: mutually consistent prices for any set of forcing agents can be obtained based on a single Integrated Assessment Model output, the SCF. We explain the theoretical foundations of the concept and illustrate its practical applications with two examples: (1) we derive SCF-based prices for CO₂ and CH₄, and (2) we estimate the social cost of albedo changes in a boreal forest stand.

The Neoclassical Trojan Horse of Steady-State Economics

- Ecological Economics---2017---Elke Pirgmaier

The vision of a steady-state economy elaborated by Herman Daly describes an economy that uses materials and energy within the regenerative and assimilative limits of the planet’s ecosystems. Sustainable scale, just distribution, and efficient allocation are its constitutive theoretical goals. This paper is a critique of the theoretical foundations of steady-state economics. It argues that steady-state economics consists in an attempt to squeeze neoclassical economics into a biophysical and ethical corset. As a result, many fundamental flaws and criticisms of neoclassical economics remain. As a consequence, steady-state economics does not lead to a radical departure from, or improvement upon, neoclassical theory but rather to fundamental internal inconsistencies between the ‘old’ economics paradigm and ‘new’ progressive ecological economic thinking. Contradictions appear at various levels ranging from ontology and methodology to theory and values. As Daly has pioneered the foundations of ecological economics with his thinking, these ambiguities are not only problematic for steady-state economics but ecological economics as a field more generally. The paper concludes that ecological economics has to let go of neoclassical foundations as they contradict its core values and ambitions. A new and consistent theory of political economy of the environment along heterodox lines is needed.

Commercial and biophysical deficits in South America, 1990–2013

- Ecological Economics---2017---Pablo Samaniego, María Cristina Vallejo, Joan Martínez-Alier

This article analyses the Physical Trade Balances (PTB) of five South American economies since 1990. Both exports and imports (measured in tonnes) increased but exports were consistently much larger than imports. Such large Physical Trade Deficits (PTD) persisted throughout the 1990s and 2000s. Export prices of primary goods increased but by 2013, export prices had declined and the exports could no longer pay for imports. Countries started to show commercial trade deficits (in money terms). These findings hold for all the South American countries analysed and they show that the optimism generated by the improving terms of trade in South America at the beginning of the 21st century was premature. First, there were PTDs even in the boom years; second, the deterioration in the terms of trade after 2012 was accompanied by a counterproductive deficit in the monetary trade balance. It is counterproductive because, in principle, it leads to greater external debts or to outflows of currency reserves. It can also create pressure to increase physical exports. We argue that deficits in the monetary trade balances tend to be compensated by increasing the deficit in the PTB, which can lead to enhanced environmental pressures and therefore to local protests.

Threshold Effects in Meta-Analyses With Application to Benefit Transfer for Coral Reef Valuation

- Ecological Economics---2017---Luke Fitzpatrick, Christopher Parmeter, Juan Agar

Policymakers and advocates often use benefit transfers to estimate the economic value of environmental amenities when primary valuation studies are infeasible. Benefit transfers based on meta-analyses, which synthesize site and methodological characteristics from valuation studies of similar underlying amenities, generally outperform traditional site-to-site transfers. We build on

earlier meta-analyses of willingness-to-pay for tropical coral reef recreation by introducing a meta-regression model with threshold effects, with a goal of increasing transfer reliability. We estimate a threshold in coral reef quality and find that increases in live coral cover have a large impact on individuals' WTP for recreation at degraded coral reefs. Relaxing the assumption of users' constant valuation across the distribution of this characteristic improves the performance of coral reef benefit transfers in some instances: tests of convergent validity reveal that including the threshold effect reduces the mean transfer error and the interquartile range of transfer errors in 5 out of 8 tests.

Robust Surveillance and Control of Invasive Species Using a Scenario Optimization Approach

- Ecological Economics---2017---Denys Yemshanov, Robert G. Haight, Frank H. Koch, Bo Lu, Robert Venette, Ronald E. Fournier, Jean J. Turgeon

Uncertainty about future outcomes of invasions is a major hurdle in the planning of invasive species management programs. We present a scenario optimization model that incorporates uncertainty about the spread of an invasive species and allocates survey and eradication measures to minimize the number of infested or potentially infested host plants on the landscape. We demonstrate the approach by allocating surveys outside the quarantine area established following the discovery of the Asian longhorned beetle (ALB) in the Greater Toronto Area (GTA), Ontario, Canada. We use historical data on ALB spread to generate a set of invasion scenarios that characterizes the uncertainty of the pest's extent in the GTA. We then use these scenarios to find allocations of surveys and tree removals aimed at managing the spread of the pest in the GTA. It is optimal to spend approximately one-fifth of the budget on surveys and the rest on tree removal. Optimal solutions do not always select sites with the greatest propagule pressure, but in some cases focus on sites with moderate likelihoods of ALB arrival and low host densities. Our approach is generalizable and helps support decisions regarding control of invasive species

when knowledge about a species' spread is uncertain.

Growing into Water Conservation? Decomposing the Drivers of Reduced Water Consumption in Las Vegas, NV

- Ecological Economics---2017---Christa Brelsford,Joshua K. Abbott

Increasing population and drought have lead to growing concerns about water scarcity across the US despite a long decline in per-capita consumption. To what extent is this decline the result of water policy vs. other exogenous changes? Many municipalities implement multiple water-focused policies simultaneously – while still subject to other exogenous drivers – so it is important to pair policy evaluations with approaches that examine multiple drivers of water use. The importance of water policy, infrastructure change, and broader technological and demographic trends in influencing water demand has not been measured. We demonstrate a novel method for decomposing multiple drivers of consumption using a dataset of neighborhood water consumption, home infrastructure characteristics, and vegetation in Las Vegas. The largest measurable factor driving conservation for Las Vegas as a whole is lower consumption from new homes, while in established neighborhoods it is declining vegetation area. However, factors we measure directly account for only half of the observed consumption decline. This provides indirect evidence that consumption declines coincident with a drought alert, increased water waste enforcement, and other policy responses also played an important role in conservation. An array of approaches directed at both infrastructure and behavior can effectively reduce consumption.

Fifty shades of green: Revisiting decoupling by economic sectors and air pollutants

- Ecological Economics---2017---Syed Ali Asjad Naqvi,Klara Zwickl

Using a consistent dataset for eighteen EU countries, six economic sectors, and six pollution indicators, we analyze decoupling of production-based emissions from

GDP growth from 1995 to 2008. Computing decoupling factors as defined by the OECD (2002), we find that in almost all sectors and by almost all pollutants the median EU country had at least some decoupling. However, considerable heterogeneity in its magnitude can be observed across countries, sectors, and pollutants. For most pollutants and sectors, median decoupling performance improved from 2001–2008 compared to 1995–2001, while between-country disparities increased simultaneously. In a second step, we investigate country-level changes in decoupling states between the two sub-periods based on Tapio (2005). We find high diversity across countries and over time. To explain these differences across countries and sectors, we assess the impact of environmental policy stringency, and find tentative evidence that stricter policy encourages decoupling, however the effects are small and imprecise, differ by economic sector and pollutant, and take several years to materialize.

Green Technologies and Environmental Productivity: A Cross-sectoral Analysis of Direct and Indirect Effects in Italian Regions

- Ecological Economics---2017---Claudia Ghisetti,Francesco Quatraro

This paper provides empirical investigation of the effects of environmental innovations (EIs) on environmental performances, as proxied by the environmental productivity (EP) measure. We focus on sectoral environmental productivity of Italian Regions by exploiting the Regional Accounting Matrix including Environmental Accounts (Regional NAMEA). Patent applications have been extracted by the Patstat Database and assigned to the environmental domain by adopting different international classifications of green technologies: the latest release of the OECD ENV-TECH indicators, and the union of this with the previously established WIPO Green Inventory. Econometric results outline that regions-sectors characterized by higher levels of green technologies (GTs) are those facing better environmental performance. These positive effects directly stem from the introduction of GT in the same sector, as well as from the introduction of GT in vertically

related sectors.

The role of risk and trust attitudes in explaining residential energy demand: Evidence from the United Kingdom

- Ecological Economics---2017---Benjamin Volland

Recent research into the determinants of household energy consumption has aimed to incorporate findings from economics, sociology and psychology in order to obtain a more comprehensive understanding of the factors determining energy demand. The current paper contributes to this nascent stream of literature by studying the relationship between risk attitudes, trust propensity and energy consumption at the household level. Drawing on the British Household Panel Survey, a well-known data set in the context of energy studies, I show that trust is negatively correlated with household energy demand, while higher risk tolerance leads to increases in residential energy use. Potential explanations for these findings are investigated, suggesting that risk preferences may be related with overall appliance stock and the size of the rebound effect.

Temporal Change of China's Pollution Terms of Trade and its Determinants

- Ecological Economics---2017---Yuwan Duan,Xuemei Jiang

Based on the World Input-Output Database (WIOD), this study employed a revised pollution terms of trade (PTT) indicator to investigate the temporal change of China's environmental cost relative to its economic gains from international trade from 1995 to 2009. The results show that China has PTT larger than 1, indicating that China emits more emissions to obtain each unit of value-added from exports than its trade partners. Over the period, China's PTT first decreased from 1995 to 2001 and then increased from 2001 to 2009. The further decompositions show that improving technology is the leading driving force to decrease PTT, while the change in global trade pattern is the leading force increasing PTT, especially after 2001. We further decomposed the temporal change of China's PTT

by income group of the trading partners. The results show that the change in the global trade pattern is the crucial driving force behind the different changes of PTT by income group.

Measuring Impartial Preference for Biodiversity

- Ecological Economics---2017---Yves Meinard,Alice Remy,Bernhard Schmid

Biodiversity undergoes unprecedented rates of erosion despite the important services it provides. This is considered evidence that biodiversity is undervalued. Biodiversity valuation is accordingly a prominent issue in the literature. Economic valuations are, however, largely criticized. Numerous alternatives have been introduced. Most of them involve participatory protocols aimed at producing high-quality results. Being time-consuming and expensive, it is difficult to implement and reproduce them at a large scale. We produce an easily reproducible, inexpensive survey methodology to measure impartial preference for biodiversity. We implement it in Switzerland through a mail-based survey. Our result is that biodiversity should be ranked after retirement schemes and public transportation, but before relations with foreign countries, order and security, and culture and leisure in the expanses of the State. Current expenses therefore substantially underestimate the value that Swiss people grant to biodiversity. Our new method is a viable alternative to standard economic valuation. Given the impartiality achieved, at least in the Swiss political context our estimate can be used by decision makers to assess the legitimacy of conservation programs or to gauge public support. At a philosophical level, our measure is relevant for public policies because it captures the stances that people take when they participate in public decisions.

Inter-industrial Carbon Emission Transfers in China: Economic Effect and Optimization Strategy

- Ecological Economics---2017---Licheng Sun,Qunwei Wang,Jijian Zhang

Understanding inter-industrial carbon emission transfers and their economic effect informs approaches to achieve emission reduction objectives and promote industrial economic development. This paper applies input-output theory to explore ways to optimize carbon emission transfers between industrial sectors. First, China's inter-industrial carbon emission imports and exports were measured for years 2002, 2005, 2007, and 2010. Next, the economic effects of inter-industrial carbon emission transfers were assessed. Finally, strategies to optimize the carbon emission transfer structure were proposed, with the goal of achieving a win-win between industrial carbon emission reduction and economic development. Key study conclusions are as follows. (1) Inter-industrial carbon emission imports and exports in China are significant, and are increasing each year. Traditional energy industries have high carbon emission imports; processing and manufacturing industries have high carbon emission exports; and most light industries have relatively low levels of both carbon emission imports and exports. (2) Carbon emission transfer imports or exports can promote industrial development; combining both imports and exports leads to variable economic effects within specific industries. (3) To achieve the dual goals of carbon emission reduction and economic development, four strategies are proposed to optimize carbon emission transfer structures in different industries.

Payments for Ecosystem Services and Wealth Distribution

- Ecological Economics---2017---Pu Wang, Gregory Poe, Steven A. Wolf

Payment for ecosystem services (PES) has come to be regarded as a promising market-based policy instrument to internalize environmental externalities. The potential of PES is linked to the relationship between the willingness to pay (WTP) of ecosystem service buyers and the willingness to accept (WTA) of ecosystem service providers. This study uses an economic model to analyze factors that influence aggregate WTP and WTA in a PES scheme. We demonstrate that wealth disparity between ecosystem services buyers

and providers can increase transactions. Furthermore, when wealth disparity exists between the buyers and sellers, the wealthier population would contribute more into the program and the poorer population would benefit more from it. Under these conditions, PES can be socially progressive and mitigate preexisting economic inequality. In this sense, the economic model provides justification for integration of PES and poverty alleviation programs. Results of our study indicate that PES is not a universally applicable conservation tool, and there is a need for a more targeted approach to the design and application of PES.

Remittances and Natural Resource Extraction: Evidence from Mexico

- Ecological Economics---2017---Alejandro Lopez-Feldman, Estefanía Chávez

While much attention has been given to the effects of migration and remittances on agricultural activities in the communities of origin, the relationship between remittances and rural households' use of natural resources remains understudied. This paper contributes in filling this gap by using a Mexican data set that contains detailed information on both remittances and use of natural resources at the household level. The data set is representative of the rural population of Mexico at the national level, which allows us to move beyond case studies overcoming one of the main challenges for understanding the relationship between livelihoods and the environment. Results show that remittances have significant effects on the use of natural resources by the receiving households. We find that a) remittances decrease the likelihood that a household will participate in natural resource extraction, and b) households that receive remittances and extract natural resources have lower environmental income and lower environmental reliance than households not receiving remittances. By reducing participation in extraction as well as reliance on natural resources, remittances reduce the pressure that local populations put on the natural resource base that surrounds them. This could mean good news for the conservation of natural resources. However, it also shows the vulnerability of Mexico's natural resource

to periods of low or negative economic growth in the United States inasmuch as they affect the amount of remittances that migrants send back home.

Resistance to Mining. A Review

- Ecological Economics---2017---Marta Conde

This academic review of more than 200 articles, books and reports sheds light to why and how do communities resist mining and how do their forms of resistance change over time. The literature reveals that local communities react not only to perceived environmental impacts but also to their lack of representation and participation in decisions concerning their development path, lack of monetary compensation and distrust with the mining company and the state. Several authors explore the objectives and discourses of these movements that range from compensation and market embedded demands to the articulation of post-material values and the emergence of socio-ecological alternatives. Cross-scalar alliances have emerged as a crucial factor in the formation of discourses and strategies; local narratives and alternatives are being combined with global discourses on rights (to clean water, to take decisions, indigenous rights) and environmental justice. Cross scalar alliances have also allowed local groups to increase their knowledge about the projects, give them visibility, and comprehend and act against their weak position in the global commodity chain. These alliances have also contributed to the emergence or consolidation of a diverse set of resistance strategies such as legal court cases, activist-scientist collaborations and local referendums or “consultas” at community level to reject mining projects. This review also explores the response of the state and the mining companies to these conflicts, exploring responses such as regulatory changes or Corporate Social Responsibility programs.

‘Smart’ policies to reduce pesticide use and avoid income trade-offs: An agent-based model applied to Thai agriculture

- Ecological Economics---2017---Christian Grovermann, Pepijn Schreinemachers, Suthathip Riwithong, Thomas Berger

Policy makers in developing countries need better evidence of how changes in pesticide regulation would affect pesticide reduction and farm incomes, but there are very few modeling tools that can provide such information. The present study develops a new model based on Mathematical Programming-based Multi-Agent System (MPMAS), a simulation software that allows assessing ex-ante the impact of alternative pesticide use reduction strategies, including combinations of pesticide taxes, the introduction of integrated pest management, a price premium for safe agricultural produce, and subsidies for biopesticides. The model is parameterized with farm and plot level data from northern Thailand, where the adoption of high-value cash crops has been accompanied by a rapid increase in synthetic pesticide use. Simulation results suggest that a pesticide tax alone has little effect on synthetic pesticide use. A smart policy package – combining integrated pest management, a progressive pesticide tax based on toxicity and subsidies lowering the price of biopesticides – can reduce average use of hazardous pesticides by 34% over current levels without adverse effects on the average farm income.

Different Types of Environmental Regulations and Heterogeneous Influence on “Green” Productivity: Evidence from China

- Ecological Economics---2017---Rong-hui Xie, Yijun Yuan, Jing-jing Huang

This paper attempts to examine if the “strong” version of Porter Hypothesis is supported in China by investigating how different regulatory instruments and the relative stringency impact “green” productivity. We use a slacks-based measure (SBM) and Luenberger Productivity Index, accounting for undesirable outputs, to evaluate the industrial “green” productivity growth rates of China’s 30 provinces. The estimates imply an unsustainable development model in China with significant regional differences. By employing a panel threshold model and a province-level panel dataset during 2000–2012, empirical results show that both command-and-control and market-based regulation have a non-linear relationship with and can be

positively related to “green” productivity but with different constraints on regulation stringency: there are double thresholds with the command-and-control and exists an optimal range of stringency for productivity improvement; while a single threshold has been found with the market-based regulation and its current stringency is reasonable for most of provinces. Moreover, based on China’s reality, the productivity effect driven by market-based regulation is much stronger than that of the command-and-control. The mechanism of informal regulation is much more complicated. Consequently, we find evidence to support the “strong” Porter Hypothesis that reasonable stringency of environmental regulations may enhance rather than lower industrial competitiveness.

A Context-based Procedure for Assessing Participatory Schemes in Environmental Planning

- Ecological Economics---2017---Guy-El-Karim Berthomé,Alban Thomas

The efficiency of participatory schemes in environmental planning is an emerging research area, and many issues are not solved yet regarding the assessment of such procedures. It is essential for decision makers to identify improvement opportunities of participatory schemes. We propose an original procedure to address such issue, through a bargaining model from the signaling game literature, which accounts for participation design as well as for agents’ preferences, beliefs and bargaining power. The model is calibrated using qualitative data from surveys in French local communities involved in municipal solid waste management. Model simulations are used to test for assumptions on the stakeholder dialogue and explore sensitivity of game outcomes to structural parameters. We propose a set of performance indicators to identify the most effective participatory schemes in achieving convergence in stakeholder positions regarding environmental and land-use planning.

Worktime Reduction as a Solution to Climate Change: Five Scenarios Compared for the UK

- Ecological Economics---2017---Lewis C. King,Jeroen van den Bergh

Reducing working hours in an economy has been discussed as a policy which may have benefits in achieving particular economic, social and environmental goals. This study proposes five different scenarios to reduce the working hours of full-time employees by 20% with the aim of cutting greenhouse gas emissions: a three-day weekend, a free Wednesday, reduced daily hours, increased holiday entitlement and a scenario in which the time reduction is efficiently managed by companies to minimise their office space. We conceptually analyse the effects of each scenario on time use patterns through both business and worker activities, and how these might affect energy consumption in the economy. To assess which of the scenarios may be most effective in reducing carbon emissions, this analytical framework is applied as a case study for the United Kingdom. The results suggest that three of the five scenarios offer similar benefits, and are preferable to the other two, with a difference between the best and worst scenarios of 13.03 MTCO_{2e}. The study concludes that there is a clear preference for switching to a four-day working week over other possible work-reduction policies.

Does Craigslist Reduce Waste? Evidence from California and Florida

- Ecological Economics---2017---Anders Fremstad

There is much discussion but little research on the environmental impacts of online platforms associated with the sharing economy. Economic theory suggests that falling transaction costs in secondhand markets increase incentives for people to exchange rather than discard used goods. This paper uses difference-in-difference methods to estimate Craigslist’s effect on solid waste by exploiting a natural experiment in how the platform expanded across California and Florida. The econometric results suggest that Craigslist reduced daily per capita solid waste generation by about one third of a pound, though the estimates are not very

precise. A plausibility analysis of the weight of items posted on Craigslist concludes that the 200 million annual for-sale posts created by Californians and Floridians can reasonably account for waste reductions of roughly this magnitude.

Organic Farming and Small-Scale Farmers: Main Opportunities and Challenges

- Ecological Economics---2017---Zeynab Jouzi,Hossein Azadi,Fatemeh Taheri,Kiumars Zarafshani,Kindeya Gebrehiwot,Steven Van Passel,Philippe Lebailly

Producing enough food to meet the needs of a growing population has always been the greatest concern of food policy-makers around the world. Given the increasing attention to organic farming (OF), we conducted this study to investigate the main opportunities and challenges of the food production system of small-scale farmers in developing countries with an emphasis on their livelihoods. The study showed that the most significant advantages of OF are environmental protection and a higher resilience to environmental changes, increasing farmers' income and reducing external input cost, enhancing social capacity and increasing employment opportunities. As well as enhancing food security primarily by increasing the food purchasing power of local people. However, the main challenges of this food production system include lower yields in comparison to conventional systems, difficulties with soil nutrient management, certification and market barriers, and the educational and research needs of small-holders. The paper concludes that even though OF might present some significant challenges to small-scale farmers, it could/should still be considered as a part of the solution and means of improving their livelihoods.

A Stakeholder-oriented Framework to Consider the Plurality of Land Policy Integration in Sahel

- Ecological Economics---2017---Hermine Papazian,François Bousquet,Martine Antona,d'Aquino, Patrick

- Established interactions between social and ecological dynamics participate in legitimating different land regulation sources.
- The model helps in understanding how the past land laws have been added to Sahelian users practices.
- The model helps in understanding how the future land reforms will be welcomed by the Sahelian complex reality.
- Agent-based modeling can offer new ways to think about policy diffusion.

Incorporating Outcomes from Collaborative Processes into Government Decision Making: A Case Study from Low Water Response Planning in Ontario, Canada

- Ecological Economics---2017---Alyssa P. Roth,Rob C. de Loë

Collaborative approaches are increasingly being used by governments in western countries to address complex environmental policy problems. These approaches often bring together diverse actors in settings that allow for joint problem solving. However, the effectiveness of collaboration can be undermined if governments choose to ignore the outcomes of collaboration in their decision making processes. In this paper we report findings from a study of a drought-based collaborative process. We evaluate the extent to which the provincial government in Ontario, Canada, used recommendations from collaborative groups in its Low Water Response program. Interviews, document analysis and personal observations provided the data for a qualitative, multi-case study analysis. Three cases were chosen where collaborative teams made decisions designed to balance ecological and economic water issues during drought. The Institutional Analysis and Development framework provided a conceptual foundation for evaluating the extent to which collaborative outcomes were used by government. Even though the provincial government did not accept the most important decision made by collaborative teams (to declare severe drought), participants were generally satisfied with outcomes achieved through collaboration, especially social and environmental outcomes. Challenges revealed through the study included insufficient capacity, lack of clear program requirements, and issues inherent with low

water.

Divergence in stakeholders' preferences: Evidence from a choice experiment on forest landscapes preferences in Sweden

- Ecological Economics---2017---Anna Nordén, Jessica Coria, Anna Maria Jönsson, Fredrik Lagergren, Veiko Lehsten

A great deal of biodiversity can be found in private forests, and protecting it requires taking into consideration the preferences of key stakeholders. In this study, we examine divergence in stakeholders' preferences for forest attributes across the general public, private non-industrial forest owners and public and private forest officials in Sweden by conducting a discrete choice experiment. Our results indicate that citizens have a positive valuation of biodiversity protection. Moreover, their valuation is statistically significantly higher than those of forest owners. Interestingly, our results suggest that both forest owners and forest officials have a strong orientation towards production, with higher valuation than the general public of the common management practice of even aged stands and clear felling. Even though the Swedish Forestry Act regards production and environmental goals as equally important, we find that forest officials prefer management practices that promote production rather than biodiversity protection.

The Economic Impacts of Droughts: A Framework for Analysis

- Ecological Economics---2017---Jaume Freire-González, Christopher Decker, Jim W. Hall, Jaume Freire-González

Droughts are a specific type of natural hazard. Economic assessments of drought impacts require a framework capable of accounting for its unique and particular characteristics. Traditional conceptual frameworks used to assess the impacts of natural hazards do not adequately capture all of the factors that contribute to the economic impacts of droughts, such as: the importance of the level, and composition, of hydraulic capital;

the dispersion of economic impacts across different economic activities and agents; the temporality of drought events; and the critical importance of policy-making in shaping the short and long-term economic impacts of droughts. Nor do traditional frameworks take account of the complex interaction between factors within the domain of decision-making and underlying climate conditions. We propose a new conceptual framework based around two sources of economic impact: 'green water' and 'blue water', and argue that because each source of drought impacts the economy in different ways, they must be differentiated in any assessment of economic impact.

Rice Intensive Cropping and Balanced Cropping in the Mekong Delta, Vietnam — Economic and Ecological Considerations

- Ecological Economics---2017---Yen Dan Tong

Rice intensification in Vietnam relies on the construction of high dykes in the Mekong Delta floodplain to prevent flood waters from entering fields during the flood season. This enables three rice crops to be grown annually instead of two. On the floodplain, two rice crops can be described as "balanced cropping" since it has a long fallow period, which conforms to good agricultural practices, and also takes advantage of the flood's benefits. For example, it integrates the natural fish, other aquatic animals, and flood sediments during the flood season as part of the rice field ecosystem. This study surveys agriculture practices among "three crop" and "two crop" farmers on the floodplain. It is argued that planting three crops ("intensive cropping") cannot provide a sustainable alternative to balanced cropping, either from an economic or an ecological viewpoint. Study findings emphasise the need to recognise the ecological value of balanced cropping systems for an efficient and environmentally sound production of food. In connection with this, it is suggested a case for limiting further dyke heightening since rice intensification, which is the aim of this large-scale water control, does not make economic sense.

What Accounts for the Growth of Carbon Dioxide Emissions in Advanced and Emerging Economies? The Role of Consumption, Technology and Global Supply Chain Participation

- Ecological Economics---2017---Gaaitzen de Vries,Benno Ferrarini

This paper examines the driving forces behind the growth in carbon dioxide emissions in forty advanced and emerging economies between 1995 and 2008. We use the global supply chain concept introduced in Timmer et al. (2014) to measure CO₂ emissions in internationally fragmented production networks and embed the concept in structural decomposition analysis. Our findings suggest that rising levels of domestic consumption are related to increased carbon dioxide emissions in both advanced and emerging economies. A substantial share of CO₂ emissions growth in emerging economies is accounted for by increased participation in global supply chains. However, even for countries that rapidly integrated in global production networks, such as China, rising domestic consumption accounts for the majority of territorial emissions.

The PES Conceit: Revisiting the Relationship between Payments for Environmental Services and Neoliberal Conservation

- Ecological Economics---2017---Robert Fletcher,Bram Büscher

Payments for Environmental Services (PES) has become a popular means to neoliberalize biodiversity conservation throughout the world. Yet research on PES is increasingly focused on debating exactly how neoliberal programmes really are, documenting complexities in PES implementation and concluding that few programmes are very market-based in practice. While we agree that ideal neoliberal implementation of PES does not and cannot exist, we argue that focusing (only) on micro-politics misunderstands the importance of analysing PES as a form of neoliberal conservation. The question is not just whether PES is innately neoliberal but how it functions within a broader neoliberal

political economy. By focusing on the overarching governance and power structures that gave rise to PES in the first place, we more clearly see what we call ‘the PES conceit’, namely that the approach implicitly accepts neoliberal capitalism as both the problem and the solution to the ecological crisis. This strategy is not only contradictory but also commonly fails to achieve intended outcomes, falling far short of conservation objectives while also often exacerbating socioeconomic inequality. This problematic conceit, we conclude, cannot be addressed through only micro-oriented studies; it demands connecting micro- and macro political economic analyses to confront broader neoliberal power structures.

Environmental Jobs and Growth in the United States

- Ecological Economics---2017---Robert Elliott,Joanne Lindley

Green growth is increasingly being seen as a means of simultaneously meeting current and future climate change obligations and reducing unemployment. This paper uses detailed industry-level data from the Bureau of Labor Statistic’s Green Goods and Services survey to examine how the provision of so-called green goods and services has affected various aspects of the US economy. Our descriptive results reveal that those states and industries that were relatively green in 2010 became even greener in 2011. To investigate further we include green goods and services in a production function. The results show that between 2010 and 2011 industries that have increased their share of green employment have reduced their productivity although this negative correlation was only for the manufacture of green goods and not for the supply of green services. In further analysis we investigate skill-technology complementarities in the production of green goods and services and show that industries that increased their provision of green goods and services grew more slowly, reduced their expenditure on technology inputs and increased their demand for medium educated workers, whilst simultaneously reducing their demand for lower skilled workers.

China-USA Trade: Indicators for Equitable and Environmentally Balanced Resource Exchange

- Ecological Economics---2017---Yong Geng,Xu Tian,Joseph Sarkis,Sergio Ulgiati

Trade needs to be evaluated by more comprehensive indicators that complement market-based economic value. The Emergy Accounting (EMA) method proved to be a valuable tool to help address trade complexity by means of environmental quality-oriented indicators. EMA is used in this paper to evaluate the environmental and resource flows involved in China-United States (USA) trade in the years 1993, 2000 and 2008. Results show that China emergy exports (i.e. exports of raw and less processed resources) exceed the imports from USA. Although the money received by China from exports is higher than the money paid for imports, the real imbalance relies in the huge amount of resources that outflow from China, hardly compensated by the value of imports in terms of support to Chinese economy. The conclusion is that trade accounting methods should include holistic valuations beyond the financial costs of traded goods. Policy implications of these results are discussed.

Going to the Woods Is Going Home: Recreational Benefits of a Larger Urban Forest Site — A Travel Cost Analysis for Berlin, Germany

- Ecological Economics---2017---Christine Bertram,Neele Larondelle

We present an application of the travel cost method to a large urban forest site in Berlin, Germany. The analysis is based on a large onsite survey and the same survey administered online. Although such applications are rare in an urban context, applying a seasonal demand model to the case of Grunewald is possible because the distances travelled are relatively large, the majority of the respondents use motorized or public transport, and Grunewald is a large and unique urban forest site with very few substitutes. The main results are the following: (1) The demand for visits to Grunewald is less elastic if only Berlin residents are taken into account compared to when residents from

the entire larger urban area of Berlin are considered. (2) Estimated consumer surpluses are therefore greater if only Berlin residents are taken into consideration. (3) In addition, demand is more elastic for the internet sample than for the on-site sample. (4) Results suggest a lower bound overall consumer surplus of 14.95 € per visit. The results indicate that despite its inherent limitations, non-market economic valuation through the travel cost method can provide administrations with a powerful tool to monetize the benefits of urban forest recreation to increase public funding and redirect resources to address intensified use.

Coupled Societies are More Robust Against Collapse: A Hypothetical Look at Easter Island

- Ecological Economics---2017---Sabin Roman,Seth Bullock,Markus Brede

Inspired by the challenges of environmental change and the resource limitations experienced by modern society, recent decades have seen an increased interest in understanding the collapse of past societies. Modelling efforts so far have focused on single, isolated societies, while multi-patch dynamical models representing networks of coupled socio-environmental systems have received limited attention. We propose a model of societal evolution that describes the dynamics of a population that harvests renewable resources and manufactures products that have positive effects on population growth. Collapse is driven by a critical transition that occurs when the rate of natural resource extraction passes beyond a certain point, for which we present numerical and analytical results. Applying the model to Easter Island gives a good fit to the archaeological record. Subsequently, we investigate what effects emerge from the movement of people, goods, and resources between two societies that share the characteristics of Easter Island. We analyse how diffusive coupling and wealth-driven coupling change the population levels and their distribution across the two societies compared to non-interacting societies. We find that the region of parameter space in which societies can stably survive in the long-term is significantly enlarged when coupling occurs in both social and environmental variables.

Planning for green infrastructure: The spatial effects of parks, forests, and fields on Helsinki's apartment prices

- Ecological Economics---2017---Athanasios Votsis

As the importance of urban green spaces is increasingly recognised, so does the need for their systematic placement in a broader array of socioeconomic objectives. From an urban planning and economics perspective, this represents a spatial task: if more land is allocated to various types of green, how do the economic effects propagate throughout urban space? This paper focuses on the spatial marginal effects of forests, parks, and fields and estimates spatial hedonic models on a sample of apartment transactions in Helsinki, Finland. The results indicate that the capitalization of urban green in apartment prices depends on the type of green, but also interacts with distance to the city centre. Additionally, the effects contain variable pure and spatial spillover impacts, also conditional on type and location, the separation of which highlights aspects not commonly accounted for. The planning of green infrastructure will therefore benefit from parameterizing interventions according to location, green type, and character of spatial impacts.

Health Consequences of the Russian Weather

- Ecological Economics---2017---Vladimir Otrachshenko, Olga Popova, Pavel Solomin

This paper examines and quantifies the impact of weather shocks on all-cause, cardiovascular-, and respiratory-cause mortality for different age groups in Russia. Using a regional panel data analysis from 1989 to 2014, we find that both hot and cold days cause an increase in all-cause and cause-specific mortality. On the other hand, days with extremely cold temperature (below -30°C) may have an opposite impact and reduce mortality. Overall, our findings suggest that the economic costs of all-cause mortality due to one day with hot and cold temperatures correspond to 10.25 million USD and 7.91 million USD or 0.28% and 0.22% of daily GDP in Russia, respectively. The results also

suggest that regions frequently experiencing hot and cold temperatures have adapted to these temperatures.

Environmental and Financial Performance of Fossil Fuel Firms: A Closer Inspection of their Interaction

- Ecological Economics---2017---Halit Gonenc, Bert Scholtens

We investigate the relationship between environmental and financial performance of fossil fuel firms. To this extent, we analyze a large international sample of firms in chemicals, oil, gas, and coal with respect to several environmental indicators in relation to financial performance for the period 2002–2013. We find that these firms have significantly higher scores on environmental performance efforts than other firms. We use a simultaneous equations system to identify the direction of the relationship between environmental and financial performance of the firms. We find that environmental outperformance has no impact on financial performance for chemical firms, reduces returns and risks for coal companies, has a mixed impact on returns in oil and gas, and reduces financial risks for oil and gas firms. Financial outperformance reduces environmental performance in all fossil fuel (sub)industries investigated. Our findings mainly support the opportunistic view regarding the impact of financial returns, which holds that financial performance negatively impacts social performance. Regarding financial risk, we find support for the stakeholder perspective where good environmental performance is beneficial from a finance perspective. We conclude to substantial differences in the environmental-financial performance relationship along fossil fuel firms in different subindustries.

Green nudges: Do they work? Are they ethical?

- Ecological Economics---2017---Christian Schubert

Environmental policies are increasingly informed by behavioral economics insights. ‘Green nudges’ in particular have been suggested as a promising new tool to encourage consumers to act in an environmentally benign way, such as choosing renewable energy sources

or saving energy. While there is an emerging literature on the instrumental effectiveness of behavioral policy tools such as these, their ethical assessment has largely been neglected. This paper attempts to fill this gap by, first, providing a structured overview of the most important contributions to the literature on pro-environmental nudges and, second, offering some critical considerations that may help the practitioner come to an ethically informed assessment of nudges.

When does it pay to cooperate? Strategic information exchange in the harvest of common-pool fishery resources

- Ecological Economics---2017---Michele L. Barnes, Shawn Arita, Kolter Kalberg, Ping Sun Leung

Harvesting common-pool fishery resources is often a competitive activity and important questions remain about the costs and benefits of engaging in cooperative behavior. Here, we link comprehensive data on fisher's information exchange networks and economic productivity to test hypotheses about when it pays to cooperate by exchanging different types of strategic information. We find that being well connected locally in information exchange networks about both short-term topics (e.g., the location of species) and long-term topics (e.g., technical innovations) is positively associated with productivity in both the short-term (within fishing trips) and long-term (annually). In contrast, we find that exchanging both types of information across distinct social divides – a form of brokerage – is negatively associated with productivity. Our results therefore suggest that while there appears to be an economic benefit associated with cooperation across temporal scales in the harvest of common-pool fishery resources, exchanging strategic information across social divides may come at a cost – particularly under conditions of competition. We discuss our results in light of emerging research at the nexus of sociology and economics, providing key insight into the social-structural dynamics that help form the foundation for fisher decision-making and behavior.

Economic structure and energy savings from energy efficiency in households

- Ecological Economics---2017---Jaume Freire-González, David Font Vivanco, Ignasi Puig-Ventosa, Jaume Freire-González

When an energy efficiency improvement occurs at the household level, several mechanisms, grouped under the name of the rebound effect, increase the available income and consumption, increasing the total energy consumption of the economic structure. The present research analyses the links between energy efficiency improvements in households, consumption, and the economic structure in an input-output framework. We examine, from an empirical perspective, the relationship between energy efficiency improvements and the economic structure, and between the direct and the indirect rebound effect. The limits of the input-output methodology in assessing the direct and indirect rebound effect have been empirically tested with respect to efficiency improvements of electricity uses in households in Catalonia.

A framework for mapping and comparing behavioural theories in models of social-ecological systems

- Ecological Economics---2017---Maja Schlüter, Andres Baeza, Gunnar Dressler, Karin Frank, Jürgen Groeneveld, Wander Jager, Marco A. Janssen, Ryan R.J. McAllister, Birgit Müller, Kirill Orach, Nina Schwarz, Nanda Wijermans

Formal models are commonly used in natural resource management (NRM) to study human-environment interactions and inform policy making. In the majority of applications, human behaviour is represented by the rational actor model despite growing empirical evidence of its shortcomings in NRM contexts. While the importance of accounting for the complexity of human behaviour is increasingly recognized, its integration into formal models remains a major challenge. The challenges are multiple: i) there exist many theories scattered across the social sciences, ii) most theories cover only a certain aspect of decision-making, iii) they

vary in their degree of formalization, iv) causal mechanisms are often not specified. We provide a framework-MoHuB (Modelling Human Behavior) - to facilitate a broader inclusion of theories on human decision-making in formal NRM models. It serves as a tool and common language to describe, compare and communicate alternative theories. In doing so, we not only enhance understanding of commonalities and differences between theories, but take a first step towards tackling the challenges mentioned above. This approach may enable modellers to find and formalize relevant theories, and be more explicit and inclusive about theories of human decision making in the analysis of social-ecological systems.

Land consumption and income in Italy: a case of inverted EKC

- Ecological Economics---2017---Salvatore Bimonte, Arsenio Stabile

The EKC hypothesis postulates that the relationship between economic growth and environmental deterioration is represented by an inverted U-shaped function. Its validity has been questioned from several perspectives and a need for public policies has been expressed. This paper uses a heuristic approach to analyze the relationship between per capita income and land consumption, as proxied by the number of Building Permits issued by public authorities. Using data from the Italian regions, we run a panel data regression model to test whether the EKC hypothesis holds. Results confute it, evidencing a U-shaped relationship. In the authors' opinion, the combined effect of market conditions, lifestyle evolution and institutional and political factors have produced an adverse effect on environment. On this basis, the paper claims that, when social and intergenerational aspects are involved, a balanced mix of market, policies and institutional architecture is needed.

Commercial relationships between intermediaries and harvesters of the mangrove crab *Ucides cordatus* (Linnaeus, 1763) in the Mamanguape River estuary, Brazil, and their socio-ecological implications

- Ecological Economics---2017---Douglas Macêdo Nascimento, Rômulo Romeu Nóbrega Alves, Raynner Rilke Duarte Barboza, Anders Jensen Schmidt, Karen Diele, José Silva Mourão

The large mangrove crab *Ucides cordatus* (“caranguejo-uçá”) is a key fisheries resource in Brazil, critical for the sustenance of livelihoods of thousands of people in coastal rural areas. Today's crab populations suffer from habitat degradation, disease, and increasing fishing pressure. Crabs are sold alive on local and regional markets, or traded as processed meat and the market chains typically involve intermediaries (i.e. traders). The present study examined the relationship between crab harvesters and the intermediaries, and the socio-ecological implications thereof. The research was performed between September 2013 and October 2014 in the Mamanguape River estuary, northeastern Brazil. Socioeconomic information and data regarding the catch (sex and carapace width of the crabs), the processing of *U. cordatus* meat and the commercial relationship between harvesters and intermediaries were obtained through structured (questionnaires) and semi-structured interviews and direct observations. The crab harvesters exist under precarious socioeconomic conditions that place them at the edge of society and therefore often seek loans offered by the intermediaries, generating loyalty and dependence that guarantees the intermediaries a stable supply of crabs needed to supply an avid market. Within this relationship, the intermediaries create pressure on natural crab populations by stimulating non-selective captures, as they buy specimens below the legal size limit (6cm wide carapace) for meat processing. During crab meat processing, the intermediaries themselves report that the meat is often mixed with cooked and shredded of other marine vertebrates, such as spotted eagle ray (*Aetobatus narinari*) and nurse shark (*Ginglymostoma cirratum*), to increase the weight of

the final product. As with the crab harvesters, the women involved in processing the crabmeat often accept loans, resulting in the same type of dependence and loyalty to the intermediaries. The intermediaries, with their strong influence on the crab harvesting, are directly linked to the commercial, social and ecological implications of these harvesting activities, together with the crab harvesters themselves. Hence, to ensure sustainability of the *U. cordatus* fishery and maintain (better improve) dependant livelihoods, all actors involved in the production chain of *U. cordatus* must be considered when developing management strategies, rather than the current approach of considering the crab harvesters only. We advise the development and implementation of fisheries associations to give the crab harvesters (and regulating bodies) greater control over and capital gains from their catches.

A new agri-food systems sustainability approach to identify shared transformation pathways towards sustainability

- Ecological Economics---2017---Marianne Hubeau,Fleur Marchand,Ine Coteur,Koen Mondelaers,Lies Debruyne,Guido Van Huylenbroeck
- Development and application of a new agri-food systems sustainability approach • A framework to assess the current sustainability state of the agri-food system • A transdisciplinary implementation method to involve stakeholders • A case study to identify shared transformation pathways, strategies and actions • Co-creation of system, target and transformation knowledge with emphasis on action

Motivations matter: Behavioural determinants of preferences for remote and unfamiliar environmental goods

- Ecological Economics---2017---Tobias Börger,Caroline Hattam

Discrete choice experiments (DCE) are one of the main methods for the valuation of non-market environmental goods. However, concerns regarding the validity of

choice responses obtained in such surveys remain, particularly in surveys dealing with environmental goods remote from and unfamiliar to respondents. This study assesses behavioural determinants of preferences for conservation benefits of a marine protected area on the Dogger Bank, a shallow sandbank in the southern North Sea in an attempt to assess construct validity of survey responses. The Theory of Planned Behavior (TPB) and the Norm Activation Model (NAM) are employed to empirically measure constructs that predict stated choices. The study finds that identified protest respondents score significantly lower on most TPB and NAM components than non-protesters. Results further show that components of both the TPB and the NAM robustly predict choice behaviour. The inclusion of the TPB components improves the predictive power of the estimation model more than the NAM components. In an additional latent class logit model, TPB and NAM components plausibly explain different patterns of WTP for conservation benefits of an offshore marine protected area. These findings support construct validity of stated choice data regarding the valuation of remote and unfamiliar environmental goods.

Irreversibility and uncertainty cause an intergenerational equity-efficiency trade-off

- Ecological Economics---2017---Nikolai Hoberg,Stefan Baumgärtner

Two important policy goals in intergenerational problems are Pareto-efficiency and sustainability, i.e. intergenerational equity. We demonstrate that the pursuit of these goals is subject to an intergenerational equity-efficiency trade-off. Our analysis highlights two salient characteristics of intergenerational problems and policy: (i) temporal irreversibility, i.e. the inability to revise one's past actions; and (ii) uncertainty of future consequences of present actions in human-environment systems. We employ a two-non-overlapping-generations model that combines an intragenerational production decision on the use of circulating capital and a non-renewable resource, with a negative intergenerational externality as an unforeseen contingency. If initially unknown problems become apparent and policy is enacted

after irreversible actions were taken, policy-making faces a fundamental trade-off between ex-post Pareto efficiency and sustainability. That is, one can achieve either one of these two goals, but not both.

Temporal stability of stated preferences for endangered species protection from choice experiments

- Ecological Economics---2017---Daniel K. Lew,Kristy Wallmo

Benefit transfer methods rely on past models and results, so it is important to know whether economic values are stable over time or are subject to change, either because of the reliability of the methodology or due to actual preference changes. The temporal stability of willingness to pay (WTP) has been tested extensively for contingent valuation, but rarely for stated preference choice experiments (CE). We use data from two identical CE surveys on different samples from the same population that occurred 17 months apart (Spring 2009 and Fall 2010) to estimate and compare mean WTP and preference parameters associated with threatened and endangered marine species protection. Our models account for both preference and scale heterogeneity, and the results suggest both types of heterogeneity matter. Tests of preference stability suggest stable preferences between 2009 and 2010. Furthermore, WTP values estimated from both surveys are not statistically different. This provides evidence that economic values estimated using CE methods are temporally stable.

An analysis of the ENERGY STAR® program in Alachua County, Florida

- Ecological Economics---2017---Huan Li,Carmen Carrion-Flores

ENERGY STAR® certification, as a voluntary label, represents a residence that is designed and built to use 30% less energy than its counterparts. We examine the effectiveness of this program using monthly residential energy consumption data for residences in Alachua County, Florida between 2000 and 2013. Our

sample represents about 25% of the ENERGY STAR® qualified homes in the area. We use panel models and a modified repeat sales approach to estimate energy savings of ENERGY STAR® residences relative to Non-ENERGY STAR® ones, while controlling for the bundle of house attributes, spatial and temporal fixed effects, changes in the Florida State Building Code (FBC), and household changes. Our results indicate that ENERGY STAR® residences have a long term, greater energy efficiency savings over Non-ENERGY STAR® houses. Thus, the ENERGY STAR® residential program can be seen as an environmentally conscious housing practice that addresses economic and environmental dimensions.

The political dimensions of Payments for Ecosystem Services (PES): Cascade or stairway?

- Ecological Economics---2017---Daniel Hausknost,Nelson Grima,Simron Jit Singh

This paper aims to advance our understanding of Payments for Ecosystem Services (PES) as ‘political projects’ by offering an analytical tool for investigating power relations, political decisions, place specific ideas and social norms in the construction and operation of PES schemes. This proposed analytic tool is based on a revised version of the ‘ecosystem service cascade’, which we propose to transform into an ecosystem service stairway model as a device to analyse political processes in ecosystem service construction and provision. We show that the key to understanding the politics of PES lies in the antagonistic processes between the different steps of the stairway. In particular, we show that the definition and mobilisation of the ecosystem service potential (ESP) is the stage where the most fundamental political decisions are made. Here, the role of intermediaries is particularly significant as they introduce their own conceptions of society-nature relations, which function as ‘epistemic selectivities’ in further defining and mobilising the ESP and in generating the resulting Ecosystem Services (ESS). We illustrate our main conceptual insights and evaluate the usefulness of our political ecosystem stairway model by applying it to two Latin American

cases, one in Brazil and the other in Bolivia.

Trimming the excess: environmental impacts of discretionary food consumption in Australia

- Ecological Economics---2017---Michalis Hadjikakou

Tackling the overconsumption of discretionary foods (foods and drinks not necessary to provide the nutrients the body needs) is central to aligning human and planetary health. Whilst the adverse health impacts of discretionary foods are well documented, the environmental and broader sustainability impacts of these products deserve more attention, especially since their consumption has been increasing in recent decades, particularly amongst low income groups. This paper presents a quantitative case study analysis of discretionary food consumption and the associated environmental impacts for households from different income groups in Australia. Environmentally extended input-output analysis is used to estimate the full life cycle environmental impacts of discretionary food consumption on the basis of household expenditures. On average, discretionary foods account for a significant 35%, 39%, 33% and 35% of the overall diet-related life cycle water use, energy use, carbon dioxide equivalent and land use respectively. These significant percentages provide further support for the need to incentivise diets that are both healthier and more sustainable, including ‘divestment’ from discretionary food products. The study highlights the challenges ahead, including the need for further research on food substitutions to minimise environmental and social impacts whilst maximising nutritional quality – especially amongst poorer socioeconomic groups.

Multi-scale resilience of a communal rangeland system in South Africa

- Ecological Economics---2017---Sebastian Rasch,Thomas Heckeley,Hugo Storm,Roelof Oomen,Christiane Naumann

Resilience has either been assessed on system or individual scale so far. Ignoring the other scale may

potentially change the interpretation of resilience in socio-ecological systems (SES). Thus, this paper argues that the co-evolution of both resiliencies must be studied to capture multi-scale complexity. We attempt to close this gap by assessing resilience at both scales of a village community in Thaba Nchu, South Africa. Villagers use a commonly managed rangeland for beef cattle production. An agent based model of household interaction coupled with a biophysical model of the rangeland measures the resiliencies of the SES towards a shock, a stress and a policy intervention. Currently, the SES remains in a stable attractor in terms of SES resilience. Household resilience, however, degrades in a process of structural change. A drought scenario shows improved SES resilience but structural change at household level accelerated. An increase in the number absentee herders increases the likelihood for SES collapse by eroding social embeddedness. Finally, an introduced basic income grant demonstrates that the SES is able to cope with an increased number of appropriators. However, interaction of the policy intervention with an exogenous stress translates into an increased probability of SES decoupling.

Inequality, democracy, and the environment: A cross-national analysis

- Ecological Economics---2017---Prakash Kashwan

This paper joins the debate on the relationship between inequality and the environment. Departing from the past contributions, which focused either on the theories of environmental behavior or on economic interests, this paper develops arguments about “political choice” mechanisms that help explain the linkages between inequality and national policymaking related to the establishment of protected areas. A cross-national analysis of the interactions between inequality, democracy and the legal designation of protected areas in a global sample of 137 countries shows that, *ceteris paribus*, the effects of inequality vary depending on the strength of democracy: in relatively democratic countries inequality is associated with less land in protected areas, whereas in relatively undemocratic countries the reverse is true. The highly significant effects of

inequality undermine the democratic dividend in the arena of nature conservation.

A carbon footprint proportional to expenditure - A case for Norway?

- Ecological Economics---2017---Elisabeth T. Isaksen, Patrick A. Narbel

Motivated by the importance of consumption as an underlying driver of CO₂ emissions, we examine the link between consumption and CO₂ emissions for Norwegian households. The main goal is to investigate whether there is a decoupling of consumption expenditures and the environmental impact as we move up the income ladder. By combining a 2007 Norwegian consumer expenditure survey with emission coefficients from an environmental input-output model, reflecting emissions embodied in both domestically produced and imported goods and services, we calculate the per capita carbon footprint. The results from the analysis suggest that the per capita carbon footprint is directly proportional to expenditure with an estimated elasticity close to unity, implying no decoupling. The finding is partly driven by a near zero-emission power sector, which leads to comparatively low emissions embodied in domestically-produced goods and services.

Rhetoric and reality in protected area governance: Institutional change under different conservation discourses in Mount Elgon National Park, Uganda

- Ecological Economics---2017---Jon Geir Pettersen, Paul Vedeld

The approach to governance of protected areas has been in transition over last decades, partly driven by evolving policy discourses that shape the ways in which conservation is thought to be delivered. The most influential discourses are the “fortress” approach, “community conservation” and “back-to-the-barriers” How different discourses translate and are instituted on-ground are, however, complex and disputed. Inclusive policy strategies in relation to local involvement in developing countries are of particular

concern. The study analyses how conservation policy discourses have become manifested, taking the case of Mount Elgon National Park (MENP), Uganda. It outlines main conservation policy discourses, analyses actor’s interests and power relations and further examines how institutions for park governance have evolved and changed according to the different discourses. The results indicate that conservation discourses—and donor support—come and go, while MENP seems to outlast all. The worrying reality is that MENP administration, strongly influenced by the interplay of path-dependent institutional forces rooted in the “fortress” discourse, simply “sticks to its guns”—maintaining the application of law enforcement as key management instruments in its approach to governance, especially to local people interactions. There is an apparent gap between rhetoric and reality in protected area governance.

Economic vs non-material incentives for participation in an in-kind payments for ecosystem services program in Bolivia

- Ecological Economics---2017---Tara Grillos

This study examines the motivations that drive participation in a compensation program for environmental conservation in Bolivia. Previous research on payments programs suggests that institutions that appeal to both economic and non-material incentives should be encouraged. This program attempts such a strategy, offering in-kind compensation for conservation while simultaneously attempting to engage with environmental values and traditional social norms. I take advantage of a comprehensive household survey conducted prior to the offer of the program and employ means-comparison tests and multi-level regression analysis to compare those who chose to participate with those who did not. My research examines whether motivations for participating in this program reflected purely financial calculations regarding the costs and benefits of the program, or whether non-financial motivations such as environmental or social beliefs and norms played a role as well. I find evidence that the program’s effort to engage with social motivations was successful and that social factors, not financial incentives alone, affect

participation in the program. Findings also suggest that environmental values did not play a very large role, and that the financial determinants of participation are related mainly to prohibitive costs or barriers to entry, rather than the size of anticipated benefits.

A stock-flow-fund ecological macroeconomic model

- Ecological Economics---2017---Yannis Dafermos, Maria Nikolaidi, Giorgos Galanis

This paper develops a stock-flow-fund ecological macroeconomic model that combines the stock-flow consistent approach of Godley and Lavoie with the flow-fund model of Georgescu-Roegen. The model has the following key features. First, monetary and physical stocks and flows are explicitly formalised taking into account the accounting principles and the laws of thermodynamics. Second, Georgescu-Roegen's distinction between stock-flow and fund-service resources is adopted. Third, output is demand-determined but supply constraints might arise either due to environmental damages or due to the exhaustion of natural resources. Fourth, climate change influences directly the components of aggregate demand. Fifth, finance affects macroeconomic activity and the materialisation of investment plans that determine ecological efficiency. The model is calibrated using global data. Simulations are conducted to investigate the trajectories of key environmental, macroeconomic and financial variables under (i) different assumptions about the sensitivity of economic activity to the leverage ratio of firms and (ii) different types of green finance policies.

Forms of knowledge and eco-innovation modes: Evidence from Spanish manufacturing firms

- Ecological Economics---2017---Alberto Marzucchi, Sandro Montresor

The paper investigates the knowledge drivers of firms' eco-innovations (EI) by retaining the diverse nature of their target. Different internal and external knowledge sources are examined and the evidence of EI-modes is

searched for with respect to a sample of Spanish manufacturing firms covering the 2007–2009 and 2010–2012 periods. An “attenuated” Science, Technology, EI-mode prevails internally, with R&D more pivotal than either embodied or disembodied non-R&D knowledge, depending on the EI strategy. Externally, synthetic knowledge matters more than the analytical one, suggesting instead a Doing, Using, Interacting EI-mode. Hence, a dichotomic combination of the two modes emerges across the firm's boundaries. However, remarkable differences are in place, depending on whether EIs target efficiency or non-efficiency related environmental improvements. Our evidence also shows that internal and external knowledge turn out difficult to combine, both within and across modes.

Estimating demand for perennial pigeon pea in Malawi using choice experiments

- Ecological Economics---2017---Kurt B. Waldman, David L. Ortega, Robert B. Richardson, Sieglinde S. Snapp

Perennial crops have numerous ecological and agronomic advantages over their annual counterparts. We estimate discrete choice models to evaluate farmers' preferences for perennial attributes of pigeon pea intercropped with maize in central and southern Malawi. Pigeon pea is a nitrogen-fixing leguminous crop, which has the potential to ameliorate soil fertility problems related to continuous maize cultivation, which are common in Southern Africa. Adoption of annual pigeon pea is relatively low but perennial production of pigeon pea may be more appealing to farmers due to some of the ancillary benefits associated with perenniality. We model perennial production of pigeon pea as a function of the attributes that differ between annual and perennial production: lower labor and seed requirements resulting from a single planting with multiple harvests, enhanced soil fertility and higher levels of biomass production. The primary tradeoff associated with perennial pigeon pea intercropped with maize is competition with maize in subsequent years of production. While maize yield is approximately twice as valuable to farmers as pigeon pea yield, we find positive

yet heterogeneous demand for perennality driven by soil fertility improvements and pigeon pea grain yield.

Waiting or acting now? The effect on willingness-to-pay of delivering inherent uncertainty information in choice experiments

- Ecological Economics---2017---Catalina M. Torres Figuerola, Michela Faccioli, Antoni Riera Font

This paper analyzes the effect of inherent uncertainty on the willingness-to-pay (WTP) for a policy aimed at reducing expected climate change impacts. To do this, it relates outcome uncertainty to the probability of occurrence of one of these impacts within a given time horizon. Unlike the existing studies, this paper links outcome uncertainty to the uncontrollable component of environmental uncertainty derived from the stochastic nature of an ecosystem's behavior. Results show that the WTP for the policy in the presence of uncertainty does not decrease compared to the scenario where climate change impacts are assumed to occur with certainty. This suggests individuals are adopting a precautionary attitude when stating their WTP. Thus, the paper provides economic justification for preventive measures in highly uncertain contexts. However, findings are not conclusive with respect to the influence of the degree of uncertainty on the support for such measures.

The Value Base of Water Governance: A Multi-Disciplinary Perspective

- Ecological Economics---2017---Christopher Schulz, Julia Martin-Ortega, Klaus Glenk, Antonio A.R. Ioris

Some scholars promote water governance as a normative concept to improve water resources management globally, while others conceive of it as an analytical term to describe the processes, systems and institutions around the management of water resources and water supply. Critics often highlight how specific water governance scenarios fail to deliver socially desirable outcomes, such as social justice or environmental sustainability. While water governance is often perceived

as a technical matter, its conceptual and practical components are in fact based on multiple values that, nonetheless, often remain implicit. The present paper seeks to uncover this value base and discusses existing research on values from multiple perspectives, using material from economics, philosophy, psychology, and other social sciences. In different disciplines, values can be understood as fundamental guiding principles, governance-related values or as values assigned to water resources. Together, they shape complex relationships with water governance, which from an analytical perspective is understood as a combination of policy, politics, and polity. Introducing a new conceptual framework, this study seeks to provide a theoretical foundation for empirical research on water governance processes and conflicts.

Up the ante on bioeconomic submodels of marine food webs: A data assimilation-based approach

- Ecological Economics---2017---Nils-Arne Ekerhovd, Sturla F. Kvamsdal

While economists have discussed ecosystem-based fisheries management and similar concepts, little attention has been devoted to purposeful modeling of food webs. Models of ecosystems or food webs that make economic analysis viable should capture as much as possible of system structure and dynamics while balancing biological and ecological detail against dimensionality and model complexity. Relevant models need strong, empirical content, but data availability may inhibit modeling efforts. Models are bound to be nonlinear, and model and observational uncertainty should be included. To deal with these issues and to improve modeling of ecosystems or food webs for use in ecosystem-based fisheries management analysis, we suggest the data assimilation method ensemble Kalman filtering. To illustrate the method, we model the dynamics of the main, pelagic species in the Norwegian Sea. In order to reduce parameter dimensionality, the species are modeled to rely on a common carrying capacity. We also take further methodological steps to deal with a still high number of parameters. Our best model

captures much of the observed dynamics in the fish stocks while the estimated model error is moderate.

Benefit-cost analysis of watershed conservation on Hawai'i Island

- Ecological Economics---2017---Kimberly Burnett,Christopher Wada,Adele Balderston

In landscapes around the world, growing attention is being paid to the link between forest structure and water resources. More clarity is vital for informed decision making, especially as water scarcity continues to increase in many regions across the globe. The objective of this study is to estimate the volume of freshwater yield saved per dollar invested in forest restoration at several sites on Hawai'i Island. Using budget information and publicly available land cover and evapotranspiration data, we find that under base-line conditions—a 3% discount rate and 10% rate of spread for existing non-native plant species—1487l are saved on average across management sites per dollar invested. In other words, \$0.67 in present value terms is required to protect every 1000l of freshwater over a 50-year time horizon. Annual benefits increase continuously as the avoided loss of freshwater yield rises over time, while conservation costs tend to be front-loaded, as a result of high fence installation and ungulate removal costs. Thus, it is important to consider the long run when comparing the benefits and costs of conservation activities.

The divisive and disruptive effect of a weight-based waste fee

- Ecological Economics---2017---Marit H. Heller,Arild Vatn

The ability of economic incentives to promote environmentally friendly behavior has been questioned in the literature. Most studies investigating this issue are grounded in the agent-based rational choice model. The aim of this study is to expand our insights by applying an alternative theoretical framework combining elements from classical institutional economics and self-determination theory to study incentives for waste

sorting. The analysis is based on data from a Norwegian municipality, Ulstein, which introduced and later terminated a differentiated waste fee. There are three main findings. First, the important role of normative motivation for sorting household waste is confirmed. Second, the economic incentive had a divisive effect on the motivation to sort household waste. Perceived autonomy linked to fundamental values about environmental concern seems to play an important role in explaining why half the sample reports no extra efforts in sorting waste as a response to the economic incentive. The other half was influenced by the external logic given to them (i.e., to save costs and hence report increased motivation to sort household waste). Finally, an increased practice of illegal waste disposal was observed as a response to the differentiated waste fee.

Towards a green economy through innovations: The role of trade union involvement

- Ecological Economics---2017---Davide Antonioli,Massimiliano Mazzanti

In this paper, we address the overlooked issue of whether and how industrial relations might play a role in the process of greening the economy, primarily through the levers of innovation adoption and organizational change. We address our objective econometrically, assessing the quality of industrial relations as a driver of environmental innovation adoption, through the use of micro-data on manufacturing firms. The results yield two interesting main findings: being a unionised firm is not associated with the adoption of environmental innovation; however, when we consider the industrial relations climate, we observe a positive relationship between a cooperative industrial relations climate (union involvement) and the propensity to introduce environmental innovation. Two models are relevant: a managerially oriented model (unions are informed) and a participatory model (unions bargain on innovation adoption). The contents of environmental innovations are also important: union involvement is more relevant for adopting more complex and radical innovations to abate CO2 and EMS and ISO practices.

Evaluation of social externalities in regional communities affected by coal seam gas projects: A case study from Southeast Queensland

- Ecological Economics---2017---Phelan, Anna (Any),Les Dawes,Robert Costanza,Ida Kurbiszewski

This paper examines the evaluation of social externalities in regional communities affected by four major coal seam gas (CSG) projects in the Surat Basin region of Southeast Queensland, Australia. Using a mixed-methods approach, cross-sectional survey (n=428), and structural equation modelling (SEM) the results of this study reveal community perceptions of rising economic inequality, collective sense of uncertainty about the future, and negative impacts on the standard of living in the affected regions. For example the majority of the respondents are concerned about: the rising cost of living in the area (83.4%), the long-term impacts on groundwater (77.4%), and how their community is being affected (77.3%). We found that perceptions of fairness and inequity weigh heavily, especially on farmers, and correlate to negative psychosocial effects. Our analysis shows that unresolved concerns of community residents about environmental and social issues and the loss of confidence in the local government, contribute to lower life-satisfaction, inhibit the community's ability to plan for the future, and lead to a weaker local economy.

Local rulemaking, enforcement and compliance in state-owned forest commons

- Ecological Economics---2017---Graham Epstein

The literature on rule compliance is divided between those urging greater autonomy for stakeholders in rule-making processes; and those arguing for increased enforcement. However recent experimental evidence highlights the potential for synergies between participatory rulemaking and enforcement. This paper therefore seeks to build upon these findings to explore the relationship between local rulemaking, local monitoring and compliance in field settings. The results which draw upon data about the behavior of 93 fuelwood user

groups in state-owned forest commons in Asia, Africa and Latin America suggest that the average group is more likely to comply with rules when local rulemaking is combined with local monitoring. However, in some contexts it appears that local rulemaking in particular and other institutional arrangements in general may yield similar results.

Modeling the marginal value of rainforest losses: A dynamic value function approach

- Ecological Economics---2017---Jon Strand

The economic value of a rainforest is modeled as a dynamic asset subject to fire risk and potential increase in dryness. I solve two Bellman equations, for unburnt and for already burnt forest, to derive analytically tractable expressions for the total expected, spatially differentiated, asset value of the forest in each state assuming constant growth and forest loss rates over time. I derive the marginal expected discounted value loss when losing a small additional piece of forest, at any alternative site in the forest. Marginal forest value is found to increase when the risk of forest fire increases due to forest fragmentation when forest is lost locally; and also when forest dryness, affecting forest values negatively, increases upon forest fragmentation. Both forest fire risk and dryness serve as “multipliers” on the basic services return loss, both within and outside of the forest. Increased forest fire risk is found to reduce average rainforest value by reducing their future expected lifespans and current returns; but to increase marginal forest value by making primary forest loss avoidance more valuable. I calibrate the model including the impact of the forest fire risk component on forest value, with multipliers in a typical range 1.3–1.5.

Rebound effect of efficiency improvement in passenger cars on gasoline consumption in Canada

- Ecological Economics---2017---Saeed Moshiri,Kamil Aliyev

The fossil fuel-driven transport sector has been one of the major contributors to CO₂ emission across the

world keeping it on the energy policy agenda for the past three decades. Canada ranks second in gasoline consumption among OECD countries and Canadian gasoline expenditure share has been increasing since the 1990s. Fuel efficiency policies aim to decrease gasoline consumption; however, the effect can be mitigated by changes in consumer behavior such as traveling more distances — a rebound effect. Thus, the effectiveness of fuel efficiency policy is dependent on the magnitude of the rebound effect. In this paper, we estimate the rebound effect for personal transportation in Canada using data from the household spending survey for the period 1997–2009. The model includes a system of expenditure share equations for gasoline, other energy goods, and non-energy goods specified by AIDS and QUAIDS models and estimated by the nonlinear SUR method. Our estimation results show a rather high average rebound effect of 82–88% but with significant heterogeneity across income groups, provinces, and gasoline prices. Specifically, the rebound effect ranges from 63 to 96% across income groups and provinces and increases with gasoline prices.

The determinants of households' flood mitigation decisions in France - on the possibility of feedback effects from past investments

- Ecological Economics---2017---Claire Richert,Katrin Erdlenbruch,Charles Figuières

In this paper, we investigate the determinants of private flood mitigation in France. We conducted a survey among 331 inhabitants of two flood-prone areas and collected data on several topics, including individual flood mitigation, risk perception, risk experience, and sociodemographic characteristics. We estimate discrete choice models to explain either the precautionary measures taken by the household, or the intention to undertake such measures in the future. Our results confirm that the Protection Motivation Theory is a relevant framework to describe the mechanisms of private flood mitigation in France, highlighting in particular the importance of threat appraisal and previous experience of floods. Some sociodemographic features also play a significant role in explaining private flood mitigation.

We also observed that respondents who had already taken precautionary measures have a lower perception of the risk of flooding than respondents who planned to implement such measures at the time of the survey. This result can be explained by the existence of a feedback effect of having taken precautionary measures on risk perception. If subsequent studies support this assumption, it would imply that intended measures, rather than implemented ones, should be examined to explore further the determinants of private flood mitigation.

Deliberation as a catalyst for reflexive environmental governance

- Ecological Economics---2017---John S. Dryzek,Jonathan Pickering

Ecological or ecosystemic reflexivity involves the capacity of social-ecological systems to reconfigure themselves in response to reflection on their performance. In this paper we argue that deliberation is central to reflexive governance, mainly because it can reconcile many if not most of the sometimes contradictory claims that are made in the literature about its drivers. We take four key dimensions along which reflexivity may be sought, each of which features a binary that puts two plausible drivers of reflexivity in tension with one another: (i) sources of knowledge (public participation versus expertise); (ii) composition of public discourse (diversity versus consensus); (iii) institutional architecture (polycentricity versus centralization); (iv) institutional dynamics (flexibility versus stability). In each case, we demonstrate that deliberative ideas can manage the tension between the two plausible drivers of reflexivity.

New wine in old bottles: The (changing) socioeconomic attributes of sprawl during building boom and stagnation

- Ecological Economics---2017---Luca Salvati,Adele Sateriano,Efstathios Grigoriadis,Margherita Carlucci

European cities are shifting towards scattered urban

models with important transformations in the local socioeconomic context. With the aim to identify relevant associations with different urban patterns, the present study compares the socioeconomic profile of districts with respectively continuous and discontinuous settlements along the urban gradient in Rome, Italy, during building boom (early 1970s) and economic stagnation (late 2000s). Non-parametric correlation statistics and multivariate techniques were used to investigate the spatio-temporal evolution of 24 indicators (population, settlement, labor market, economic structure) and 14 land-use, environmental and topographic indicators at the municipal scale. The socioeconomic context discriminating discontinuous from continuous settlements in the early 1970s was significantly different from what was observed in the late 2000s. In the early 1970s, economic structure and labor market indicators have played a major role, while demographic variables and heterogeneity in the natural landscape surrounding discontinuous settlements were particularly important in the late 2000s. Policies oriented to urban sustainability and sprawl containment may benefit from an in-depth understanding of the different socioeconomic contexts associated with scattered settlements in expansion and recession times.

Climate change and the economy in Baja California: Assessment of macroeconomic impacts of the State's Climate Action Plan

- Ecological Economics---2017---Dan Wei,Alejandro Brugués,Adam Rose,Carlos A. de la Parra,Rigoberto García,Federico Martínez

Despite its developing country status, Mexico ranks 10th worldwide in total greenhouse gas (GHG) emissions. However, Mexico's vulnerability to climate change impacts is a major motivating factor behind its announced intended contributions at COP21 to cut its baseline emissions by at least 25% in 2030. We analyze the macroeconomic impacts of the Climate Action Plan (CAP) process undertaken in the Mexican border state of Baja California (BC). We adapt a state-of-the-art regional macroeconometric model to analyze the BC economy-wide impacts of 22 GHG mitigation policy

options recommended in the Baja California CAP. The combined effects include an average annual increase of 1680 new jobs (or about 0.11% of the average annual employment in the baseline economic forecast) and a Gross State Product (GSP) increase of \$9.85 billion pesos in NPV over the 2015–2030 planning horizon. Although the main objective of GHG mitigation is to reduce atmospheric concentrations, and hence future potential damages of these pollutants, the stimulus to the BC economy from the implementation of its CAP represents a valuable co-benefit. Moreover, it is a tangible one that will take place in the near-term, in contrast to the more long-term and more uncertain benefits associated with reducing climate change damages.

Proposing a Novel Index Reflecting Both Climate Impact and Nutritional Impact of Food Products

- Ecological Economics---2017---Corné van Dooren,Annely Douma,Harry Aiking,Pier Vellinga

The aim of this study is to explore the relations between the climate impact of food products and their nutritional characteristics, in order to propose a nutrient density index that quantifies these relations. Our study is based on the nutritional characteristics of the 403 most consumed food products in the Netherlands. Metabolic energy density,¹¹ Definitions: Energy density is the total metabolic energy per weight unit of a food product (total kcal/100g product). This value is determined by the proportion of the different macronutrients (proteins, fats, carbohydrates) and the water content. Nutrient Density: Dietary Guidelines for Americans (USDA, 2005, 2010) define nutrient-dense foods as those ‘that provide substantial amounts of vitamins and minerals (micronutrients) and relatively few calories.’ Examples are whole grains, lean meats, low-fat dairy products, and all legumes, vegetables, and fruits (WHO, 2003). NRFx,y: Nutrient Rich Foods index, including x nutrients which should be encouraged and y nutrients which should be limited (Drewnowski, 2009). Essential fatty acids (EFA) are polyunsaturated fatty acids (PUFAs) and consist

of two groups: n = 3 and n = 6 fatty acids. Linoleic acid (LA) is an n = 6. Alpha linolenic acid (ALA), eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are n = 3. EPA and DHA together are known as fish fatty acids. ‘Nutritional characteristics’ are the nutritional values of food products that are associated with increased or reduced health risks of the diet. These can be specific nutrients, energy density, nutrient density, and even category of a specific food group (e.g., fish). Fruiting vegetables: A vegetable with a pulpy, seed-rich body which grows on a vine. nutrient density (Nutrient Rich Foods index: NRF) and Greenhouse Gas Emissions (GHGEs) of the products were calculated. Low GHGE intensity per 100g correlated with positive nutritional characteristics of food products. This is true for low energy density, and high nutrient density, expressed as the well-established NRF9.3 index. This index was improved to include the contribution of food products to GHGEs. GHGEs of product groups correlate more strongly with the proposed Sustainable Nutrient Rich Foods index (SNRF). This SNRF summarizes six distinctive nutrients (three which should be encouraged and three limited), as well as (metabolic) energy density. Including such an index on food product labels could assist consumers in making better informed food choices.

Performance of a cap and trade system for managing environmental impacts of shale gas surface infrastructure

- Ecological Economics---2017---Austin W. Milt, Paul R. Armsworth

Governments across the globe are exploring ways to reduce the environmental and human health impacts created by shale energy production. In active areas, environmental regulations tend to be limited. We apply established instruments to empirically estimated environmental impact abatement cost curves for the development of 56 sites in Pennsylvania, USA. We compare the cost to industry of setting a cap on environmental impacts from land-clearing and building of surface infrastructure under two regulations: cap and trade versus a uniform, inflexible regulation. Greatest

differences in cost are achieved when firm-level permits are allocated to reduce market-wide potential impacts by 36%. Cap and trade achieved this cap at a cost of 0.05% of not developing and allowed all development to proceed. The uniform, inflexible regulation cost 32% of not developing for a similar outcome and prevented 18% of firms from developing. Cap and trade's performance depended on the regulator's ability to accurately allocate firm-level permits that reflect developers' options. In extreme cases, inaccurate allocations made cap and trade perform worse than other the approach. We conclude that, where developers differ in their ability and cost of minimizing impacts, cap and trade should be explored as an inexpensive alternative to traditional approaches.

Physical attractiveness, constraints to the trade and handling requirements drive the variation in species availability in the Australian cagebird trade

- Ecological Economics---2017---Miquel Valllosera, Phillip Cassey

Understanding the traits that drive the demand for exotic pets is crucial for improving our ability to prevent the introduction of new invasive species. We investigated the factors influencing species availability within the Australian cagebird trade. We predicted that species price should be an informative indicator of the species abundance in the trade, and that physical attributes, origin of the species, and limitations for free trade and for captive breeding should be important drivers for species price. We investigated the quantitative relationship between species price and these factors using phylogenetically informed models.

How to create and preserve social capital in climate adaptation policies: A network approach

- Ecological Economics---2017---Karin Ingold

The processes and impacts of climate change require adaptation through what can be described as horizontal and vertical structures of actors' integration. In climate adaptation and natural resource management

literature, this structural component is often related to social capital, which is defined in various ways but usually refers to a public good that is built and fostered within a network of social relations. While hypotheses about social capital in networks are well studied in network literature, here, I argue that they should be reflected and tested in the particular context of climate change adaptation policy. I ask: how do communities affected by climate change and the broad range of actors involved in the design of climate adaptation policies build social relationships? And, how do they manage to maintain those relations over time?

Celestial bodies and satellites – Energy issues, models, and imaginaries in Denmark since 1973

- Ecological Economics---2017---Emil Urhammer

This article uses the history of macroeconomic energy modelling in Denmark as a case for presenting a theoretical framework which describes issues, publics and imaginaries as an important nexus for energy policy. The story evolves around the actions, tensions, and entanglement of two publics – the traditionalist and the environmentalist – and presents macroeconomic modelling as an instrument for issue articulation and the construction of energy policy imaginaries. The article concludes that macroeconomic modelling is an effective instrument for articulating the economic realities of energy policy, and that economic growth plays a key role in these articulations by determining the basic preconditions for collective imaginaries of energy system futures.

Green Returns to Education: Does Schooling Contribute to Pro-Environmental Behaviours? Evidence from Thailand

- Ecological Economics---2017---Thanyaporn Chankrajang,Raya Muttarak

We investigate whether there are green returns to education, where formal education encourages pro-environmental behaviours using nationally representative surveys on environmental issues in Thailand. To establish the causal relationship between education and

green behaviours, we exploit the instrumental variables strategy using the supply of state primary schooling i.e. the corresponding number of teachers per 1000 children, which varies over time and across regions as the instrument, while controlling for regional, cohort and income effects. We find that more years of schooling lead to a greater probability of taking knowledge-based environmentally-friendly actions a great deal, but not cost-saving pro-environmental actions. In addition, the paper finds no significant impact of formal education on concern about global warming nor the willingness to pay for environmental tax.

Equitably slicing the pie: Water policy and allocation

- Ecological Economics---2017---Adam Daigneault,Suzie Greenhalgh,Oshadhi Samarasinghe

Non-point source pollution is deteriorating water quality throughout the world. New Zealand is addressing this issue by regulating land-based nutrient losses, with debates over how to allocate limits across a heterogeneous landscape. We develop a spatially explicit economic land use model to investigate efficiency and equity issues from seven approaches to allocate nutrient discharges across two New Zealand watersheds. We find that the preferred allocation differs across land use, land characteristics, and regulation stringency; and that there is no universal ‘best’ allocation option. Therefore, decision-makers should focus on, at least, efficiency and equity, and on how to compensate those most affected.

Requirements to metrics of greenhouse gas emissions, given a cap on temperature

- Ecological Economics---2017---Asbjørn Aaheim,Torben Mideksa

The literature on metrics to measure contributions to climate change from emissions of different greenhouse gases divides into studies that highlight physical aspects and studies that show the importance of economic factors. This paper distinguishes the physical aspects

and implications of economic factors by asking what is demanded from physically based metrics if used for a specific policy objective. We study the aim of maximizing the welfare of emissions generated by consumption when there is a limit to the increase in global mean temperature. In that case, metrics ought to change over time, with increasing weight on short-living gases before the temperature limit is met. Metrics for short-living gases increase also with increasing uncertainty. Adjustments to new information spur higher metrics for short-living gases if it reduces the expected allowable emissions before the target is met, and lower metrics in the opposite case. Under a binding target, metrics refer to the instantaneous impact on radiative forcing multiplied by the lifetime of the respective gases, and adjusted by the attitude to risk.

Self-protection investment exacerbates air pollution exposure inequality in urban China

- Ecological Economics---2017---Cong Sun,Matthew Kahn,Siqi Zheng

Urban China's high level of ambient air pollution lowers quality of life and raises mortality risk. China's wealthy can purchase private products such as portable room air filters that offset some of their pollution exposure risk. Using a unique data set of Internet purchases, we document that households invest more in masks and air filter products when ambient pollution levels exceed key alert thresholds. Richer people are more likely to invest in air filters, which are much more expensive and more effective than masks. Our findings have implications for trends in quality of life inequality in urban China.

Using the Delphi method to value protection of the Amazon rainforest

- Ecological Economics---2017---Jon Strand,Richard Carson,Stale Navrud,Ariel Ortiz-Bobea,Jeffrey R. Vincent

Valuing global environmental public goods can serve to mobilize international resources for their protection. While stated-preference valuation methods have been

applied extensively to public goods valuation in individual countries, applications to global public goods with surveys in multiple countries are scarce due to complex and costly implementation. Benefit transfer is effectively infeasible when there are few existing studies valuing similar goods. The Delphi method, which relies on expert opinion, offers a third alternative. We explore this method for estimating the value of protecting the Amazon rainforest, by asking more than 200 environmental valuation experts from 37 countries on four continents to predict the outcome of a contingent valuation survey to elicit willingness-to-pay (WTP) for Amazon forest protection by their own countries' populations. The average annual per-household values of avoiding a 30% forest loss in the Amazon by 2050, assessed by experts, vary from a few dollars in low-income Asian countries, to a high near \$100 in Canada, Germany and Norway. The elasticity with respect to average (PPP-adjusted) per-household incomes is close to unity. Results from the Delphi study match remarkably well those from a recent population stated-preference survey in Canada and the United States, using a similar valuation scenario.

Leaving the mainstream behind? Uncovering subjective understandings of economics instructors' roles

- Ecological Economics---2017---Katarzyna Gruszka,Annika Regine Scharbert,Michael Soder

2017

Questioning demand: A study of regretted purchases in Great Britain

- Ecological Economics---2017---Alexandra C.H. Skelton,Julian M. Allwood

This paper presents findings from a nationally representative household survey on the tendency to regret purchases across 20 product groups. The survey reveals that the vast majority of adults in Great Britain (82%) have regretted a purchase in the past. Post-purchase regret is shown to be particularly prevalent for clothing & footwear and takeaway food. The tendency to regret

purchases appears to reduce with age and to be more common amongst white collar rather than blue collar workers. Combining survey results with average price estimates gives an estimated, aggregate, annual expenditure on regretted purchases of £5–25bn, equivalent to 2–10% of annual consumer spending on goods in Great Britain. These findings are interesting because they suggest that there is a degree of self-assessed overconsumption that, if reduced, could help to reduce pressures on the environment.

The Middle-class Collapse and the Environment

- Ecological Economics---2017---Alban Verchere

The thesis that unequal societies are harmful to the planet was defended by Boyce (1994) in a framework based on the unequal bargaining power between rich and poor. Our study reinvestigates this theory by removing any reference to power in order to study the conditions under which it can still occur. We show that a middle-class collapse can aggravate or alleviate the burden on the planet, depending on income disparities and weight of upward vs. downward mobility. Moreover, the paper shows how an appropriate Environmental policy can increase the political acceptability of a Social one designed for mitigating the deleterious effects of a middle-class collapse through the reduction of (ex-post) income disparities.

The coevolution of economic institutions and sustainable consumption via cultural group selection

- Ecological Economics---2017---Timothy M. Waring, Sandra H. Goff, Paul E. Smaldino

Empirical research has identified various institutions that improve resource longevity by supporting individual resource conservation. However, the mechanisms by which these institutions emerge have not been established. We speculate that economic institutions which support resource conservation, such as property regimes and systems of production, may emerge via a process of cultural group selection amongst social-ecological systems. To explore this proposition, we

develop a multilevel selection model of resource management institutions with endogenous group dynamics. The endogenous design permits us to determine whether a given social adaptation is due to individual or group-level evolution. We demonstrate how resource conservation and supporting economic institutions co-evolve, and reveal when cultural group selection is involved. In the model, sustainable societies emerge in only a minority of cases. Simulations reveal that property norms facilitate sustainable outcomes most, followed by social group marking, and production norms. We describe the institutional transitions which occur along the evolutionary trajectory most likely to achieve sustainability. Analysis of the model reveals that when groups compete indirectly for survival in a harsh environment cultural group selection favors institutions that support resource conservation. However, when groups compete for abundant resources institutions emerge to support overconsumption.

Structured pluralism in ecological economics — A reply to Peter Söderbaum’s commentary

- Ecological Economics---2017---Moritz C. Remig

Peter Söderbaum argues in his commentary, concerning my article on sustainability economics (Remig 2015), for more open and radical ecological economics. I agree with that statement. However, I reject Söderbaum’s interpretation that my arguments foster mainstreamed ecological economics or dictatorship. In my critique of sustainability economics, I raised several issues that have remained unspecified and that potentially lead to unsustainable development patterns, once put into practice. Söderbaum does not reply to these conceptual challenges of sustainability economics. In this commentary, I argue that “structured pluralism” (Dow, 2004) is a constituent element of ecological economics. I welcome Peter Söderbaum’s proposal for a discussion about the definition of economics and suggest to rely on Ronald Coase’s proposal to define economics as a science that studies the working of the economic system. I conclude that sustainability economics in its current form is closer to neoclassical than ecological economics.

Oil and the economy: A systematic review of the literature for ecological economists

- Ecological Economics---2017---Giorgos Kallis, Jalel Sager

This article offers a systematic review of the mainstream literature in oil economics, macroeconomics (international and financial economics) and political economy, complementing and complicating the way ecological economics understands the links between oil and the economy. We look at the supply and demand factors that affect oil prices; the ways oil prices affect the economy; the effect of interest rates, capital flows and exchange rates on oil prices and extraction; and the role of (geo)politics in governing oil and money flows. We develop an illustrative system model of the causal pathways that link oil and the economy and compare alternative explanations of the oil price shocks of the 1970s and 2000s. The emphasis of ecological economics on peak oil and resource limits to growth may be relevant over the long run, but is less capable of explaining precisely how oil contributes to concrete economic short-run crises now.

Effects of wildlife resources on community welfare in Southern Africa

- Ecological Economics---2017---Herbert Ntuli, Edwin Muchapondwa

This paper demonstrates the importance of wildlife in the portfolio of environmental income in the livelihoods of poor rural communities living adjacent to a national park. The results show that wealthier households use more wildlife resources in total than do relatively poor households. However, poorer households derive greater proportional benefit than wealthier households from the use of wildlife resources. Excluding wildlife understates the relative contribution of environmental resources while at the same time overstating the relative contribution of farm and wage income. Wildlife income alone accounts for about a 5.5% reduction in the proportion of people living below the poverty line. Furthermore, wildlife income has an equalizing effect,

bringing about a 5.4% reduction in measured inequality. Regression analysis suggests that the likelihood of belonging to a wealthier category of income increases with an increase in environmental income. As expected, household wealth significantly and positively affects environmental income generated by households. This seems to suggest that wildlife-based land reform also needs to empower poor households in the area of capital accumulation while imposing restraints on the use of capital investments by well-off households to harvest wildlife.

Two paradoxes with one stone: A critical reading of ecological modernization

- Ecological Economics---2016---Tasos Hovardas

The current contribution aims at critically reviewing state initiatives in the frame of ecological modernization under the lenses of the labor theory of value. Further, the article addresses two phenomena related to ecological modernization that have received much attention, namely, the Porter Hypothesis and the Jevons' Paradox. State-led environmental regulation in terms of environmental legislation as well as initiatives to promote green technology can be understood as a twofold attempt, which ultimately leads to re-defining socially necessary labor time. First, state intervention would wish to remove surplus profit from polluting or resource depleting capitals through legislation, which would tend to increase socially necessary labor time in the branch of production under reference. State policy might then attempt to propel the adoption of green technology, which would tend to decrease socially necessary labor time in the sectors targeted. Through state initiatives, competition among rival capitals would be re-aligned so as to allow for conditions of production to be renewed. The Porter Hypothesis can be approached as a strategy followed by individual capitals to gain an early-mover advantage, while the Jevons' Paradox can be seen as the result of an imitation process, when rival capitals take up technological modifications launched by innovators.

Factors affecting farmers' willingness to participate in eutrophication mitigation — A case study of preferences for wetland creation in Sweden

- Ecological Economics---2016---Frida Franzén,Patrik Dinnézt,Monica Hammer

Local stakeholder participation in water management is emphasized in the EU Water Framework Directive (WFD). Wetland creation to mitigate nutrient leakage from agriculture is one example where participation of local farmers is needed. In this case study of the Himmerfjärden coastal catchment, south of Stockholm, Sweden, we assessed the importance of socio-demographic factors, and of the existing agri-environmental scheme (AES), for their effects on farmers' willingness to create wetlands on their farms. The main factors from the AES were defined as five attributes in a discrete choice experiment approach, related to the current AES for wetland creation in the area. The results showed that approximately 30% of the farmers were interested in wetland creation. A common reason for not wanting to create wetlands was cost incurred by the farmer. Males were significantly more willing than females to create wetlands. Prior knowledge of the WFD increased willingness almost threefold, and land owners were significantly more willing than leaseholders. The choice experiment showed that higher cost ceiling for compensation, compensation percentage and annual subsidies can significantly increase the willingness to create wetlands. However, other options like result-oriented AES may be taken into consideration to attract the remaining 70% of all farmers.

Quantifying flood mitigation services: The economic value of Otter Creek wetlands and floodplains to Middlebury, VT

- Ecological Economics---2016---Keri B. Watson,Taylor Ricketts,Gillian Galford,Stephen Polasky,O'Neil-Dunne, Jarlath

Functioning ecosystems can buffer communities from many negative impacts of a changing climate. Flooding, in particular, is one of the most damaging natural

disasters globally and is projected to increase in many regions. However, estimating the value of "green infrastructure" in mitigating downstream floods remains a challenge. We estimate the economic value of flood mitigation by the Otter Creek floodplains and wetlands to Middlebury, VT, for Tropical Storm Irene and nine other floods. We used first principles to simulate hydrographs for scenarios with and without flood mitigation by upstream wetlands and floodplains. We then mapped flood extents for each scenario and calculated monetary damages to inundated structures. Our analysis indicates damage reductions of 84–95% for Tropical Storm Irene and 54–78% averaged across all 10 events. We estimate that the annual value of flood mitigation services provided to Middlebury, VT, exceeds \$126,000 and may be as high as \$450,000. Economic impacts of this magnitude stress the importance of floodplain and wetland conservation, warrant the consideration of ecosystem services in land use decisions, and make a compelling case for the role of green infrastructure in building resilience to climate change.

The impacts of petroleum price fluctuations on income distribution across ethnic groups in Malaysia

- Ecological Economics---2016---M. Yusof Saari,Erik Dietzenbacher,Bart Los

Crude oil price hikes have compelled governments of developing countries to let domestic prices of energy increase. Fiscal priorities made it impossible to fully compensate the hikes by raising energy subsidies. This paper examines the potential impacts of a limited deregulation of the petroleum price on the income distribution in Malaysia, paying specific attention to differences in impacts on major ethnic groups. We introduce an extended social accounting matrix (SAM) model, which not only incorporates substitution possibilities among production inputs and consumption goods, but also allows for the exogenous determination of the price of intermediate inputs. The results of simulations indicate that distributional impacts of rising petroleum prices tend to be regressive, affecting poor people more severely than richer people. All ethnic

groups experience income loss with the real incomes of Malay households (which are relatively poor, on average) more than the Chinese and Indian households (which are the generally richer).

Natural amenity-driven segregation: Evidence from location choices in French metropolitan areas

- Ecological Economics---2016---Y. Schaeffer,D. Cremer-Schulte,C. Turtiu,M. Tivadar

Casual observation and numerous studies in economics and psychology suggest that households care about the natural environment of their living places. This paper investigates the role played by natural amenities in the formation of segregated residential patterns with respect to household size and socio-professional status. We estimate residential location choice models for large household samples in two metropolitan areas in France: Grenoble in the Alps, and Marseille on the Mediterranean coast. In a second step, we perform counterfactual segregation analysis using Monte Carlo simulations, to compare segregation outcomes “with” and “without” preferences for natural amenities. Our main result is that households’ search for natural amenities has significant impacts on residential segregation. It most often contributes to strengthening segregation, but can also be a factor attenuating segregation.

Farmer perceptions, policy and reforestation in Santa Catarina, Brazil

- Ecological Economics---2016---A.C.D. Trevisan,A.L. Schmitt-Filho,J. Farley,A.C. Fantini,C. Longo

Extensive reforestation may be required to avert dramatic loss of biodiversity, system resilience and ecosystem services from Brazil’s Atlantic Forest, and is legally required by Brazil’s Forest Code. Restoration on farmland however threatens agricultural output and the livelihoods of small family farmers, leading to weak enforcement of the law and a national debate over the Code which resulted in revisions in 2012 that significantly reduced legally mandated restoration. To

inform the design of effective environmental policies, we interviewed 60 typical dairy family farmers utilizing pasture-based agroecological grazing practices to assess their perceptions and knowledge of the pre-2012 Forest Code, its impacts and their willingness to comply. Multiple correspondence analysis (MCA) identified three distinct clusters: farmers who understood the forest code and its ecological impacts and were willing to comply; farmers who understood the ecological benefits of restoration, but were unwilling to comply; and those with little knowledge of benefits or interest in compliance. We evaluate three policy options for promoting restoration, paying particular attention to their impacts on farmer livelihoods and on their intrinsic willingness to restore and preserve forest cover. We conclude that payments for ecosystem services in the form of subsidies for agroecology practices are promising.

Varieties of experimentalism

- Ecological Economics---2016---Christopher K. Ansell,Martin Bartenberger

Across a range of disciplines and issues, experimentalism has emerged as a prominent approach for addressing environmental problems. Yet the meaning of “experiment” varies markedly across these domains. We survey the diversity of experimentation, identifying three distinct experimental logics—controlled, Darwinian, and generative. Building on Pragmatist philosophy, we argue that each of these logics has different strengths and weaknesses, but taken together they offer a valuable experimentalist approach to environmental problem-solving. However, from a transdisciplinary perspective, it is important to recognize the different values, purposes, and stances toward knowledge that they entail. Controlled experiments primarily aim to isolate causality, while Darwinian experimentation endeavors to enhance systemic innovation and generative experimentation seeks to generate new solution concepts. Appreciating these differences allows us to be more reflexive about an experimentalist agenda, illuminating the appropriate role of these logics and suggesting possibilities for fruitfully combining them. To advance this reflexive agenda, we also distinguish be-

tween epistemic and political learning and argue that experimental approaches to environmental problem-solving may benefit from being more sensitive to this distinction.

Building the consensus: The moral space of earth measurement

- Ecological Economics---2016---Marc A. Saner, Michael Bordt

We chart the moral space of Earth measurement with the aim to develop practical tools to evaluate and improve Earth measurement frameworks (including environmental-economic accounting and ecosystem services). Based on a survey of environmental ethics, we develop four concepts that are fundamentally important to fostering agreement in debates over Earth measurement frameworks among stakeholders with diverging belief systems. The four concepts can thus be used as criteria to evaluate the completeness and defensibility of existing measurement frameworks. The first two concepts, the consideration of broad human values and long time frames follow the landmark work by Bryan Norton. We further propose the adoption of the capital approach and precaution as the third and fourth concept, respectively. We conclude with suggestions for how current frameworks could be rendered more complete, defensible and internationally acceptable.

Can urban areas help sustain the preservation of open space? Evidence from statewide referenda

- Ecological Economics---2016---Matthew Altonji, Corey Lang, Gavino Puggioni

Statewide referenda for land conservation are likely to entail a disparity between people who vote on the referenda and those who live in proximity to conserved areas, which may lead to a lower probability of passage than a more local referendum. This paper examines trends in voting preferences on statewide land conservation referenda in Rhode Island using precinct-level voting data. We identify two similar referenda in 2004

and 2012 and estimate a first difference spatial regression model that seeks to understand the determinants of changes in support over time. Controlling for socioeconomic characteristics and political ideology, we find that referenda support is growing in densely populated communities relative to sparse ones, and there is a multiplicative effect of rapidly growing dense areas. This implies urban areas are becoming critical supporters for the preservation of farm, forest and open space lands, despite being non-proximate to lands at risk of development.

Assessing the potential for niche market development to contribute to farmers' livelihoods and agrobiodiversity conservation: Insights from the finger millet case study in Nepal

- Ecological Economics---2016---Giacomo Palante, Adam G. Drucker, Sajal Sthapit

This paper explores the potential for niche market development of neglected and underutilized species as an intervention for improving both smallholder livelihoods and the agrobiodiversity conservation. We consider the case of finger millet, which plays an important role in the food security of Nepalese poor and marginalized farmers. Despite such importance, production and consumption are decreasing as a result of, inter alia, the expanding availability of more profitable crops, a lack of awareness regarding its nutritional qualities by urban consumers and limited R&D dedicated to this crop. Nevertheless, the potential to improve the ability of farmers to capture the values related to the positive environmental and nutritional externalities associated with the production and consumption of local landraces, suggests that the conservation through use of such genetic resources can support the achievement of development goals. We analyse both the demand and supply side of a potential niche market for local finger millets. Using a choice experiment we find that urban consumers have a willingness to pay a premium price sufficient to compensate producers' conservation opportunity costs. We also identify a range of challenges for such an intervention to be considered effective from both an economic and ecological perspective.

Determining visitor preferences for rhinoceros conservation management at private, ecotourism game reserves in the Eastern Cape Province, South Africa: A choice modeling experiment

- Ecological Economics---2016---Deborah E. Lee,Mario Du Preez

South Africa harbours 95% of the world's threatened white rhinoceros (18000) population and 40% of the critically endangered black rhinoceros (1950) population. Increased levels of rhinoceros poaching in South Africa, and the imminent threat of extinction, have emphasized the need for improved management and conservation policies. This study employs a discrete choice experiment in order to value selected supply-side rhinoceros management and conservation strategies at private, ecotourism game reserves in the Eastern Cape Province, South Africa. The valuation setting is couched in real-world management and conservation strategies presently under consideration at state-owned and privately-owned game reserves in South Africa. Results suggest that visitors to these reserves support the sale of stockpiled rhinoceros horn but are strongly opposed to the introduction of trophy hunting or the continuation of rhinoceros darting experiences. Based on the findings of this study, it appears that the choice experiment technique is a promising instrument, which can inform the design of rhinoceros management and conservation policies for privately-owned, ecotourism game reserves in South Africa, with the possibility of extending its use to state-owned nature reserves.

Micro-equity for sustainable development: Selection, monitoring and exit strategies of micro-angels

- Ecological Economics---2016---Gloria Estape-Dubreuil,Arvind Ashta,Jean-Pierre Hédou

Sustainable development requires balancing environmental, social and financial concerns. This requires investors to select and monitor entrepreneurs who would balance these triple concerns. At the same time, there has been considerable attention to “small is beautiful” and micro-investors have stepped in to look for

such eco-entrepreneurs. To the classical institutional logic of economic returns, they add the logic of social returns as well as the logic of environmental and local safeguards.

Fishers' perceptions about the EU discards policy and its economic impact on small-scale fisheries in Galicia (North West Spain)

- Ecological Economics---2016---Sebastian Villasanté,Graham J. Pierce,Cristina Pita,César Pazos Guimeráns,João Garcia Rodrigues,Manel Antelo,José María Da Rocha,Javier García Cutrín,Lee C. Hastie,Pedro Veiga,U. Rashid Sumaila,Marta Coll

This paper investigates the impact of the European Union landing obligation in the Galician (North West of Spain) multispecies small-scale gillnet fishery. By combining results from semi-structured interviews with small-scale fishers and a bioeconomic model, we found that the percentage of discards for small-scale fisheries is usually low, which is consistent with general empirical observations globally but can be high when quotas are exhausted.

Welfare and sustainability effects of dietary recommendations

- Ecological Economics---2016---Xavier Irz,Pascal Leroy,Vincent Réquillart,Louis-Georges Soler

The paper develops a framework combining a model of rational behaviour under dietary constraints, an epidemiological model of diet-related mortality, and a life-cycle-analysis model of environmental impact, which permits the ex-ante assessment of dietary recommendations in multiple sustainability dimensions (i.e., taste cost, welfare effect, deaths avoided, reductions in greenhouse gas emissions and acidification). It is applied to compare in a French context the relative effects and efficiency of six popular sustainable diet recommendations. The results confirm the synergies between the health and environmental dimensions: healthy-eating recommendations usually have a positive effect on the environment, although some exceptions exist. Most of

the sustainable diet recommendations appear highly cost-effective, but those most commonly promoted on health grounds (e.g., targeting consumption of salt, fruits and vegetables and saturated fat) rank highest in terms of overall efficiency. Moreover, the valuation of benefits indicates that in most cases health benefits are significantly larger than environmental benefits. Overall, the analysis reveals some under-investment in the promotion of sustainable diet recommendations in France. The general lack of enthusiasm in policy circles for informational measures promoting behavioural change may reflect unrealistic expectations about the speed and magnitude of dietary change rather than an objective assessment of the efficiency of those measures.

A practical optimal surveillance policy for invasive weeds: An application to Hawkweed in Australia

- Ecological Economics---2016---Tom Kompas,Long Chu,Hoa Nguyen

We propose a practical analytical framework which can help government agencies determine an optimal surveillance strategy for invasive weeds, including cases of slow-growing or ‘sleepers weeds’, and for all weeds at early stages of invasion where quantitative information is scant or rough. The framework consists of three key components: (a) a simple rule that can determine weed surveillance zones or where early detection is desirable, (b) a function that maps surveillance effort to early detection probability, and (c) a schedule to determine an optimal surveillance budget. A calibration to Hawkweed in Australia provides an example of the framework and shows that the optimal annual surveillance budget for this sleeper weed is substantial.

Integrating non-monetary and monetary valuation methods – SoftGIS and hedonic pricing

- Ecological Economics---2016---Piotr Czebrowski,Jakub Kronenberg,Michał Czepkiewicz

In order to address the increasing need for improved linkages between different value perspectives, we examine the possibility of integrating two valuation methods:

the non-monetary softGIS and monetary hedonic pricing. We find them compatible and their output more comprehensive compared to traditional valuation based on one value perspective. The public participatory soft-GIS survey delivers information on the perception of urban green spaces, which we use as a criterion for dividing green space categories in a hedonic pricing model. We find that the perception expressed in the survey is generally consistent with the impact on property prices in the case of formal green spaces. However, it is inconsistent when it comes to informal ones: places identified as lacking well-maintained greenery exert a positive influence on property prices, while positively evaluated informal green spaces had no impact at all. We identify the latter as a typical trade-off between different value perspectives: informal green spaces are perceived differently following a monetary and a non-monetary approach.

Transactions costs of expanding nutrient trading to agricultural working lands: A Virginia case study

- Ecological Economics---2016---Gwendolen De-Boe,Kurt Stephenson

Agricultural nonpoint sources (NPS) figure prominently in the design of many water quality trading programs. In concept water quality trading programs can create incentives for agricultural operators to supply low cost pollutant reductions while still keeping land in agricultural production. In practice water quality trading programs in the United States have produced few trades involving agricultural NPS. Transactions costs are a critical, but poorly understood, feature of water quality trading programs. The objective of this study is to examine the transactions costs associated with expanding the use of NPS credits in a water quality trading program in Virginia (United States) to include credits generated from agricultural working lands best management practices (BMPs). Findings indicate that transactions costs for agricultural NPS trades in Virginia are currently relatively low, due to the activity being credited: simple land conversion. Based on best available evidence, transactions costs of creating credits

using management and structural BMPs will be 2 to 16 times more costly on a per project basis than for land conversion credits. Compliance monitoring protocols are a significant driver of costs for working lands credits. Our results suggest an important cost/risk tradeoff between verification costs and compliance certainty for program designers to consider.

Water consumption and subjective wellbeing: An analysis of British households

- Ecological Economics---2016---Jonathan Chenoweth,Alma López-Avilés,Stephen Morse,Angela Druckman

While having basic access to water resources is clearly critical for survival, the extent to which water consumption contributes to wellbeing once basic needs have been met is not clear. In this study the link between household water consumption and wellbeing is assessed via a household survey conducted in southern England and actual water consumption data for the same households received from their water supply company. While the study revealed a few correlations, in general no link was found between actual water use and wellbeing. This suggests that high wellbeing is attainable regardless of low water use (assuming basic needs are met). In fact, when assessed through individual rather than composite measures of wellbeing, a weak but statistically significant link was shown between higher water use and some indicators of low wellbeing. Our results also show that actual water use appears to be unlinked to environmental attitudes, attitudes to water use or willingness to adopt water saving measures. This suggests that seeking a sustained reduction in water consumption via attitudinal change alone is unlikely to be effective.

Normalization in sustainability assessment: Methods and implications

- Ecological Economics---2016---N.L. Pollesch,V.H. Dale

One approach to assessing progress towards sustainability makes use of multiple indicators spanning the

environmental, social, and economic dimensions of the system being studied. Diverse indicators have different units of measurement, and normalization is the procedure employed to transform differing indicator measures onto similar scales or to unit-free measures. Given the inherent complexity entailed in interpreting information related to multiple indicators, normalization and aggregation of sustainability indicators are common steps after indicator measures are quantified. However, it is often difficult for stakeholders to make clear connections between specific indicator measurements and resulting aggregate scores of sustainability. Motivated by challenges and examples in sustainability assessment, this paper explores various normalization schemes including ratio normalization, target normalization, Z-score normalization, and unit equivalence normalization. Methods for analyzing the impacts of normalization choice on aggregate scores are presented. Techniques are derived for general application in studying composite indicators, and advantages and drawbacks associated with different normalization schemes are discussed within the context of sustainability assessment. Theoretical results are clarified through a case study using data from indicators of progress towards bioenergy sustainability.

The implementation costs of forest conservation policies in Brazil

- Ecological Economics---2016---Felipe Arias Fogliano de Souza Cunha,Jan Börner,Sven Wunder,Carlos Alberto Nunes Cosenza,André F.P. Lucena

Tropical forest conservation is considered a low-cost option for climate change mitigation. But mitigation cost assessments have featured opportunity costs, neglecting policy implementation costs. Here we use official data to identify the Brazilian federal government's operational and institutional budgets related to forest conservation policies implemented from 2000 to 2014. We distinguish the allocated and executed budgets of these policies, and provide scenario-based estimates of their cost-effectiveness. On average, Brazil spent US\$ 1billion/year on forest conservation policies

at the federal level. Brazil's substantial reduction in annual forest loss after 2004 was accompanied by a higher operational budget execution of disincentive-based policy instruments, and an absolute increase in both allocated and executed institutional budgets. The post-2004 successful mitigation effort represented additional implementation costs to the Brazilian federal government of US\$ 308–923/ha of avoided deforestation, or US\$ 0.87–2.60/tCO₂ of avoided emissions. Factoring in also approximate municipal and state expenditures, these costs increase to US\$ 385–1153/ha or US\$ 1.09–3.25/tCO₂. We conclude that implementations costs are non-trivial in size, including compared to estimates of land users' opportunity costs. This has important implications for REDD+ policy design, in the sense that implementation costs need to be adequately considered.

Using choice modeling to map aesthetic values at a landscape scale: Lessons from a Dutch case study

- Ecological Economics---2016---Boris T. van Zan-
ten,Peter H. Verburg,S.S.K. Scholte,K.F. Tieskens

Quantifying and mapping ecosystem services is increasingly employed to guide policies in their search for environmental sustainability. In this study, we present a method for mapping aesthetic values as an ecosystem service, combining insights from landscape research and ecosystem service mapping practices. We review our method through a comparison to existing aesthetic value mapping approaches and verify the results through a comparison to a revealed landscape preferences indicator. Disagreement between the methods arises from many factors, including the type of ecological/landscape features that are assumed to contribute to the provision of aesthetic values, the use of context-specific or generic aesthetic value estimates, the scale of landscape evaluation and the level of integration of the landscape preference analysis. We argue that the approach presented here is a suitable generically applicable methodology for context-sensitive mapping of aesthetic landscape values for a number of reasons: (i) a careful and transparent selection process of land-

scape attributes, (ii) the use of primary preference data, (iii) an integrated evaluation of landscape attributes introducing trade-offs between specific features in the agricultural landscape and (iv) application of visual landscape scale manipulated photographs for the elicitation of preferences as a surrogate for a real landscape experience.

Some vegetarians spend less money on food, others don't

- Ecological Economics---2016---Jayson Lusk,Bailey
Norwood

Vegetarianism is often promoted as a more ethical and less expensive diet. This study tests whether vegetarians do indeed spend less on food. A large U.S. internet survey consisting of 24,537 respondents is used to determine whether the self-reported food expenditures for vegetarians are different from their meat eating counterparts. Compared to meat eaters, results show that “true” vegetarians do indeed report lower food expenditures. They spend less partly due to the foods they eat and partly due to different demographics. We also find that some individuals self-identify as vegetarians even though they sometimes eat or buy meat, and this category of consumer spends more money on food than meat eaters. This demonstrates that there are at least two different types of self-identified vegetarians.

Influence of institutional access and social capital on adaptation decision: Empirical evidence from hazard-prone rural households in Bangladesh

- Ecological Economics---2016---GM Monirul
Alam,Khorshed Alam,Shahbaz Mushtaq

An understanding of the factors that shape resource-poor households' heterogeneity in adopting adaptation strategies is crucial in developing adaptation policies. This research examines the determinants of household adaptation choices and the barriers to adaptation. It also focuses on the influence of institutional access and social capital on adaptation choice as a way forward to support and sustain local adaptation process

by using the survey data of 380 hazards-prone vulnerable households in Bangladesh. The results reveal that households are implementing adaptation strategies such as diversifying crops, tree plantation (adopted by large and medium farmers), and homestead gardening and migration (adopted by small and landless farmers). Barriers to adaptation are observed heterogeneously among the farming groups where access to credit and lack of information on appropriate adaptation strategies are among the important barriers to adaptation. The model results indicate that the choice of adaptation strategies is significantly influenced by social capital and access to institutions. To support adaptation locally and to enhance vulnerable households' resilience to better cope with riverbank erosion and other climatic change issues, interventions by the government through planned adaptation, such as access to institutions and credit facilities, and a package of technologies through agro-ecological based research are required.

Sliding-scale environmental service payments and non-financial incentives: Results of a survey of landowner interest in Costa Rica

- Ecological Economics---2016---Cody T. Ross

This study presents the results from a survey of landowner interest in a propositional payment modality for Costa Rica's Pagos por Servicios Ambientales (PSA) program that is based on a sliding-scale payment scheme. This payment scheme would transition from higher monetary payments per hectare per year for the first units of land invested, to lower payments per hectare per year for additional units of land invested; however, as payments per hectare decrease, monetary payments would be supplemented with non-financial rewards. This program structure is designed to 1) offer higher per-hectare financial incentives to smaller-scale landowners, who would otherwise face steep trade-off costs by transitioning to conservation-based land-use, and 2) offer greater non-financial incentives to larger-scale landowners, who face less sharp trade-off costs, and who might be more interested in prestige- and status-based non-financial incentives than

the currently meager PSA payments. I found support for the proposed program modality across all classes of landowners. Interest in PSA participation by small- and medium-scale landowners showed sensitivity to proposed payments, with landowners indicating a strong desire to participate in conservation land-use as soon as the proposed financial incentives were sufficient to cover their opportunity costs. Large-scale landowners showed little sensitivity to payment size, and in general—with mode=10 and median=7 responses on a 10 point Likert-scale—indicated strong willingness to participate in the PSA program under the proposed structure, even if financial incentives per hectare were decreased significantly for large investments of land, but prestige- and status-based awards were introduced. These results are discussed in the context of an emerging literature on signaling theory, conspicuous conservation, and the interaction of financial incentives and social norms.

Emissions reduction benefits of siting an offshore wind farm: A temporal and spatial analysis of Lake Michigan

- Ecological Economics---2016---Amy C. Chiang, Michael R. Moore, Jeremiah X. Johnson, Gregory A. Keoleian

Siting decisions of offshore wind farms influence the magnitude of emissions reduction benefits. This paper calculates electricity generation and emissions reduction of CO₂, NO_x, and SO₂, and values these reductions to determine the impact of the siting location for a 300MW offshore wind farm in Lake Michigan. The most important patterns for emissions reduction were the monthly trends, where January, March, and December consistently had the highest electricity generation and emissions reduction benefits. Summer months such as July and August had the lowest emissions reduction benefits. The intra-day trends showed higher emissions reduction benefits during off-peak hours, due to a higher likelihood of coal units being the marginal generator. These diurnal differences were smaller in magnitude than the seasonal differences. Two benefit valuation scenarios were analyzed for a

20-year time period, one using marginal damages of pollution and another using market prices for pollution allowances. The first scenario resulted in emissions reduction benefits ranging from \$1827/kW to \$2690/kW (\$2508/kW averaged) throughout the Lake Michigan region for the 20-year period (applying a 3% discount rate). This equates to approximately \$33/MWh in all lake locations since the emissions reduction benefits are primarily a function of electricity generation. The market price scenario resulted in a much lower range of \$820/kW to \$1060/kW (\$987/kW average or 39% of the pollution damage costs). In scenario 1, the major component of emissions reduction benefits was CO₂ reduction (86% of benefits), and 83% of these CO₂ benefits were from offsetting coal plant emissions. A sensitivity analysis on size and region of emission reduction location showed that the NO_x and SO₂ benefits vary significantly (unlike CO₂ benefits), but this variation had minimal effects on the total emissions reduction benefits. In comparison with economic investment costs, the scenario 1 emissions reduction benefits equal 49% of the total investment cost (in 2014 \$million) on average. Spatial maps and heat maps are generated to illustrate the spatial and temporal variations in the emissions reduction benefits.

Drivers of heritage value: A meta-analysis of monetary valuation studies of cultural heritage

- Ecological Economics---2016---William C.C. Wright, Florian V. Eppink

Decisions about cultural and historical heritage conservation can be contentious. Improved insight into the economic benefits derived from preservation could be achieved through a better understanding of the underlying economics. In response to this challenge, a growing number of studies estimate the economic value of heritage sites. The purpose of this study is to identify common drivers of the economic value of cultural and historical heritage by conducting a meta-analysis of heritage valuation studies. We find that heritage sites in areas with higher population density hold higher value, and conservation that supports adaptive re-use of sites generates higher values than passive protec-

tion. Valuation studies of tangible heritage dominate our dataset, but our findings are robust across model specifications. We identify a need for more economic and interdisciplinary research on the value of non-built heritage to improve understanding of the composition and drivers of heritage value.

Scale dynamics of grassroots innovations through parallel pathways of transformative change

- Ecological Economics---2016---Frans Hermans, Dirk Roep, Laurens Klerkx

An important issue for the study of grassroots innovations and the geography of sustainability transitions is how scales affect transformative change. In this paper we will address the questions of 1) how grassroots innovations for sustainable agriculture are scaled and 2) the consequences of crossing different scales and levels on the characteristics of the grassroots innovation. We propose a framework of five different scales to analyze the development of grassroots innovations and we apply this framework on the long-term development of an agricultural grassroots innovation movement that pioneered innovative dairy farming practices combined with landscape management. The results show how the initial innovation coalition built around low external input farming became fragmented. Each of the resulting new grassroots innovation coalitions used different strategies for upscaling and outscaling that depended on differences in their (regional) contexts and institutional support. The grassroots innovation thus developed along three parallel, at times intersecting, innovation pathways. The distributed agency of multiple actor groups working in parallel leads to a continuous renegotiating of meaning that poses a challenge to the idea of planned processes of outscaling and upscaling of grassroots innovations.

Determinants of International Standards in sub-Saharan Africa: The role of institutional pressure from different stakeholders

- Ecological Economics---2016---Mahalet G. Fikru

International environmental and quality standards in Africa are seen as being driven by pressure from international markets and importers. This study presents a conceptual framework where other stakeholders and plant resources are included in the argument for standards. We argue that among other stakeholders, international banks as creditors are important determinants. International banks, most of which are committed to sustainable practices, facilitate the diffusion of standards; they also perform sustainability-related risk-analysis urging customers to demonstrate corporate social responsibility. Our results also suggest that foreign ownership, plant size and business communications through company website are important for the adoption of standards in Africa.

Place attachment as a factor of mountain farming permanence: A survey in the French Southern Alps

- Ecological Economics---2016---Leonith Hinojosa, Eric F. Lambin, Naoufel Mzoughi, Claude Napoléone

In France, agricultural land abandonment constitutes a critical issue. Mountains, in particular, are reckoned to be particularly vulnerable to this phenomenon; therefore, several policy measures attempt to maintain agricultural activities in mountains. In addition to the role of targeted subsidies in reducing abandonment of mountainous areas, we contend that place attachment helps explain the permanence of economic activity in these areas. By using survey data and controlling for several variables likely to influence place attachment, we investigated the relationship between place attachment and living in high or lower altitude mountains in a sample of livestock farmers in the French Southern Alps. Applying an ordered probit model, we found high-mountain farmers to be relatively more attached to their place compared to medium-mountain ones. Our findings also suggest that social relations at the family and neighborhood levels, satisfaction at work, and the distinctiveness farmers assign to a place are important factors of attachment. However, we found no significant association between place attachment and

farm profitability. Several policy implications regarding agricultural abandonment and support for mountain livelihoods are derived.

Personal carbon allowances: A revised model to alleviate distributional issues

- Ecological Economics---2016---Martin Burgess

Personal Carbon Allowances (PCAs) are a policy proposal designed to facilitate carbon emissions reduction and engender carbon consciousness: they were investigated by the UK government in 2006–2008 but subsequently shelved. With continuing growth of atmospheric CO₂ concentrations and increasing interest in behaviour change agendas PCAs are worthy of fresh development.

The probable foundations of sustainabilism: Information, energy and entropy based definition of capital, Homo Sustainabiliticus and the need for a “new gold”

- Ecological Economics---2016---Meir Russ

This conceptual, interdisciplinary paper will start with an introduction to the new-networked knowledge-based global economy and the importance of intellectual and, specifically, human, capital. Next, an advanced definition of human and other forms of capital using information, energy and entropy will be introduced. This will be followed by a discussion of the premises framing the study of economics and will focus on the role of law in the economy. Afterwards, the paper will suggest the addition of a new model of humans that should serve as the base for the concept of law, the homo sustainabiliticus. Ensuing this discussion and consistent with the newly proposed definition of capital, a proposal for a new currency (“new gold”) will be offered. This proposal suggests viewing usable, renewable energy, knowledge and data as the most important assets for the 21st century and is seen as the building block for the new sustainabilistic economy.

Gains from investments in snowmaking facilities

- Ecological Economics---2016---Martin Falk,Laurent Vanat

The process of making snow requires low temperatures as well as vast quantities of water and considerable amounts of energy for the air compression. In this article the effectiveness of investment in snowmaking systems is investigated (equipment, construction works) based on data for 109 French ski resorts covering eight winter seasons (2006/2007 to 2013/2014). Both static and dynamic panel data estimations show that ski areas with large investments in snowmaking systems have a higher number of skier visits. On average a 10% higher capital stock of snowmaking infrastructure leads to an increase in the number of skier visits by 8% over the winter seasons studied. However, positive effects of snowmaking can only be observed for ski areas located at high elevations, with a magnitude decreasing by higher cumulated investments in snowmaking, indicating diminishing returns to scale. Ski areas at lower elevations, benefit effectively from snowmaking to a lower degree and only in extremely dry or snow poor winter seasons.

On the adequacy of scope test results:

Comments on Desvouses, Mathews, and Train

- Ecological Economics---2016---David J. Chapman,Richard C. Bishop,W. Michael Hagemann,Barbara J. Kanninen,Jon A. Krosnick,Edward R. Morey,Roger Tourangeau

Desvouses et al. (2012) investigate criteria for judging the adequacy of scope test differences in contingent valuation studies. They focus particular attention on our study (Chapman et al. 2009), arguing that, while it demonstrated a statistically significant scope effect, the effect is too small. Unfortunately, DMT misinterpreted Chapman et al., an error that makes DMT's criticisms of our study invalid.

Environmental awareness, consumption, and labor supply: Empirical evidence from household survey data

- Ecological Economics---2016---Maria Iosifidi

What is the effect of environmental awareness on the households' consumption of polluting goods and labor supply decisions? We answer this question using household survey data from the United States and measuring environmental awareness with the decision to make environmental donations. We find that environmental awareness has a negative and economically significant effect on labor supply. The respective impact on the consumption of polluting goods is also negative, but less robust in terms of statistical significance. Our results highlight the importance of understanding the foundations of household behavior related to environmental quality. Indeed, environmentally aware households are willing to tradeoff work hours with improved environmental quality and less so to change their consumption habits.

Comprehensive versus inclusive wealth accounting and the assessment of sustainable development: An empirical comparison

- Ecological Economics---2016---Hans-Jurgen Engelbrecht

This paper compares alternative wealth estimates reported by the World Bank and in the Inclusive Wealth Reports. Although theoretical limitations and shortcomings are widely acknowledged in the literature, the extent to which the alternative approaches to wealth accounting matter empirically is not well known. Comparing the alternative data in levels, shares, growth rates, and monetary sustainability indices derived from them, major differences emerge between OECD and non-OECD countries. For the former, the alternative wealth estimates seem complementary, but only if a key assumption made in the derivation of inclusive wealth is violated. For the latter, the data seem much less useful. For example, depending on which data source is used, for the group of low income countries the share of natural capital in total wealth is either

36.8% or 60.4%, suggesting that extreme care must be taken if the composition of wealth were to be used to inform policy-making. Neither wealth data set provides a ‘definite guide’ to economic sustainability, but a combination of indices derived from both might be useful in a holistic assessment of sustainability.

Conditional cooperation, context and why strong rules work — A Namibian common-pool resource experiment

- Ecological Economics---2016---Dirk Röttgers

Common-pool resource experiments in the field have not yet fully explored cooperative decision-making in its dependence on established past behavior, explicit rules and environmental context. The purpose of this paper is to analyze these factors and their single as well as combined influence on cooperative behavior. The results show that rule enforcement changes the influence of past action as a determinant of cooperation: Past action retains relevance for decision-making but reveals a partly contrarian influence as long as rules are strong. Further, the introduction of explicit rules does not change the influence of personal relationships among participants, but renders the influence of leadership insignificant. Furthermore, the experiments show that context plays a decisive role, which suggests the possibility of tailoring experiments to specific uses: If the context-specific behavior of locals is relevant to policy decisions, then experiments can help capture these effects.

Ecosystems, strong sustainability and the classical circular economy

- Ecological Economics---2016---Nuno Martins

In this article I argue that notions such as ecosystem services and strong sustainability can be best understood and developed within the theoretical framework advanced by the classical political economists, in which a circular conception of the economy is provided. I also argue that the development of notions such as ecosystem services and strong sustainability has been constrained by the dominance of neoclassical economics,

which provides a linear conception of the economy and leads to an emphasis on weak sustainability, which in turn springs from an emphasis on substitutability and aggregate capital. When assessing the relevance of classical political economy for studying ecosystem services and strong sustainability I consider not only the contributions of the classical political economists, but also more recent contributions which draw upon the classical perspective, such as Piero Sraffa’s and Amartya Sen’s.

The role of public information in increasing homebuyers’ willingness-to-pay for green housing: Evidence from Beijing

- Ecological Economics---2016---Li Zhang, Cong Sun, Hongyu Liu, Siqu Zheng

To explain the weak demand for green housing in Chinese cities, researchers point to the lack of reliable and accurate information to convince owners to invest, yet there is little concrete evidence that such information would in fact promote homebuyers’ investment in green housing. We implement an information experiment in Beijing. We select two pairs of residential complexes – each pair has two complexes located in the same housing submarket, and one is green while the other is not. We ask the respondents’ willingness to buy a new green housing unit, and, if yes, the price premium they are willing to pay. Then we show them an information card that documents that green apartments outperform their non-green counterparts in terms of several indoor environmental indicators, and then ask them the same two questions. We find that dwellers living in green complexes present a significantly higher initial willingness-to-pay for greenness, but this difference narrows significantly after our information treatment, as the non-green-complex dwellers’ willingness-to-pay for greenness increases dramatically. This inspiring result suggests that Chinese urban households will be encouraged to purchase green housing if they are provided more reliable and concrete information.

Valuing unfamiliar and complex environmental goods: A comparison of valuation workshops and internet panel surveys with videos

- Ecological Economics---2016---Erlend Dancke Sandorf,Margrethe Aanesen,Ståle Navrud

We compare two discrete choice experiments eliciting willingness-to-pay (WTP) for increased cold-water coral protection in Norway using valuation workshops and an internet panel survey with videos. The video presentation provides the same visual presentation of information about the good and valuation task as in the valuation workshop. In doing so, we are the first to compare these survey modes. The two survey modes perform equally well with respect to sampling, but the internet survey gives significantly lower WTP estimates. We identify a large number of status quo (SQ) choosers in the internet survey that partly explain this result. Furthermore, respondents who speed through the survey questionnaire, and believe the survey to be inconsequential are more likely to be SQ choosers. While an internet survey is a fast and cost-effective way of obtaining a representative population sample, the potential biases in the valuation of complex and unknown environmental goods outlined here should be carefully addressed in future internet panel surveys.

Where have all the funds gone? Multiregional input-output analysis of the European Agricultural Fund for Rural Development

- Ecological Economics---2016---Fabio Monsalve,Jorge Zafrilla,María-Ángeles Cadarso

The new European Agricultural Fund for Rural Development (EAFRD) was purposely established to “contribute to the promotion of sustainable rural development throughout the EU community” . This paper addresses the sustainability of the EAFRD from a triple bottom line perspective in a multiregional input-output model. This framework allows us to study both the trade relations within the EU target regions and also the relations of the EU with some other regions in the world. Additionally, the model allows us to determine the losses (leakages) or gains (boosts and feedbacks)

of a wide range of effects. On the other hand, this framework allows a simultaneous consideration of socioeconomic and environmental fund effects to identify their causes and flows and to clarify and reallocate benefits and responsibilities across levels and regions. The estimation of direct and indirect impact effects in an EU country clarifies the following: a) how the leakages to other regions generate a final economic impact that redistributes the prior fund distribution; b) how relevant the countries’ participation in global production chains are; and c) how the potential existence of an ecological unequal exchange is assessed. The main data originate from the WIOD database and the European Network for Rural Development.

Pesticide lock-in in small scale Peruvian agriculture

- Ecological Economics---2016---Courtney Hammond Wagner,Michael Cox,José Luis Bazo Robles

Despite decades of research into the negative impacts of synthetic pesticides, farmers in Latin America continue to use pesticides at high levels and at a high cost to social and environmental sustainability. In this paper, we present a case study of pest management strategies in small-scale agriculture, focusing on the unsustainable technological lock-in of synthetic pesticides. Of the 196 smallholder farmers we surveyed in the coastal Mala and Omas Valleys of Perú, 22% of respondents experienced pesticide poisoning themselves or by an immediate family member. Additionally, the two most common pesticide categories reported in use are potent neurotoxins. We hypothesized that the farmers in the valleys were locked into synthetic pesticides due to uncertainty, coordination and learning associated with adopting an alternative strategy. Logistic regressions revealed gender (male), consulting an agro-chemical technician, quantity of cultivated land, and apple as a primary crop to be important predictors of synthetic pesticide use. Our findings suggest that these predictors represent the lock-in of synthetic pesticides through network externalities, learning economies and adaptive expectations. We conclude with opportunities to transition to sustainable pest management

strategies at the local level in Latin American communities through interventions countering the lock-in of synthetic pesticides.

Stuck in the middle with you: The role of bridging organisations in urban regeneration

- Ecological Economics---2016---Stephan Kampelmann,Sarah Van Hollebeke,Paula Vandergert

The literature on the governance of social-ecological systems increasingly recognizes a key role of bridging organisations (BOs) in transition processes towards sustainability. BOs can be defined as facilitators who allow for interorganisational collaboration. Our paper provides a more nuanced understanding of specific BO activities and their contributions towards urban sustainability. Our analysis is based on applying three complementary methodological angles (drawing on geolocalised data, interviews and action research) to 20years of urban renovation investments in the city-region of Brussels. We distinguish between multi-scale, multi-actor and multi-dimensional tensions in urban renovation programmes and link these tensions to bridging challenges for BOs. Results suggest that the corresponding three types of bridging roles form a trilemma rather than a trilogy: the BOs in study have mediated one tension by de facto exacerbating another. Lessons from action research suggest that a wider use of temporality and shared language to communicate about urban renovation projects could attenuate the bridging trilemma.

Land for biodiversity conservation — To buy or borrow?

- Ecological Economics---2016---Oliver Schötker,Karin Johst,Martin Drechsler,Frank Wätzold

The conservation of endangered species and habitats frequently requires a certain type of land use which, however, leads to opportunity costs compared to profit-maximising land-use. In such a setting biodiversity conservation organisations have two main options: (1) The ‘buy alternative’ where they buy the area of interest and either carry out the necessary land-use

measures themselves or hire firms to do so, or (2) the ‘borrow alternative’ where they ‘borrow’ the land for conservation from private landowners who agree to carry out biodiversity-enhancing land-use measures over a certain period while the conservation organisation compensates them for their opportunity costs. Comparing both alternatives raises the question of budget efficiency, i.e. which alternative will lead to a higher level of biodiversity conservation for a given financial resources? In this paper we present a conceptual ecological-economic model, and then apply the model to analyse how changes in ecological and economic parameters influence the relative efficiency performance of the two alternatives.

Background inequality and differential participation in deliberative valuation: Lessons from small-group discussions on forest conservation in Colombia

- Ecological Economics---2016---Andrés Vargas Perez,Alex Y. Lo,Nicholas Rohde,Michael Howes

Deliberative monetary valuation (DMV) methods have been proposed as a more democratic alternative to traditional contingent valuation methods (CVM) for natural- resource decision making. These deliberative methods are subject to criticisms. One issue of concern is that the socio-economic inequalities among members of the deliberative group may severely impede communication and consequently distort deliberative outcomes. To examine such possibility we applied the deliberative methodology in a case study of forest conservation in Colombia. We found that those individuals who assumed social (environmental) leadership positions tended to dominate group discussion. Nevertheless, the variations in the capacity to engage in group deliberation were better explained by participants’ personal characteristics than external constraints or group pressure. Also, there was little evidence that leadership and domination in group deliberation significantly influenced participants’ stated WTP. We conclude that DMV is vulnerable to the background inequalities among group members. The democratic potential of deliberative methods should

be critically examined in terms of the capacity to communicate effectively and equally.

Links between urban structure and life satisfaction in a cross-section of OECD metro areas

- Ecological Economics---2016---Zachary Brown, Walid Oueslati, Jérôme Silva

Contemporary urban planning is often oriented towards encouraging compact cities and the prevention of sprawl. But relatively little empirical work has quantitatively examined how land-use fragmentation, population density and compactness determine individual wellbeing. We analyse the relationship between these aspects of urban structure and life satisfaction in 33 cities distributed across five OECD countries. We create a unique dataset merging a household survey on environmental attitudes and behaviours in these countries with geospatial data on a number of indicators related to urban structure. In support of standard urban economic theory, we find a life satisfaction trade-off in terms of households' home sizes and distances to the urban core. A novel finding from the analysis is that the degree of local land-use fragmentation around households' residence is associated strongly and negatively with life satisfaction. We also find suggestive evidence that city centralization (the relative proportion of the population living in the core) decreases life satisfaction on average for individuals residing both within and outside the core.

Does policy process influence public values for forest-water resource protection in Florida?

- Ecological Economics---2016---Melissa M. Kr- eye, Damian C. Adams, Francisco J. Escobedo, José R. Soto

Forest ecosystems play a critical role in protecting water resources; yet the neoclassical stated preference assumption is that willingness-to-pay (WTP) for forest conservation is solely a function of the ecosystem services provided by these lands. Thus, little attention has

been paid to the importance of policy processes as potentially influential drivers of WTP. Using a statewide web-based survey in Florida US and a relatively novel valuation approach (i.e., Best-Worst Choice), we examine public preferences for clean water benefits (e.g., recreation, drinking water resources) as well as common conservation policy processes, such as land acquisition and financial assistance for landowners. We found forest/water protection programs provide an annual average of \$154–230 million in clean water benefits, and a significant portion of that value was associated with the policy process. Attitudes and beliefs about whom forests should be managed for, and who should manage forests, were also found to influence WTP behaviors. We conclude that including policy process information in the valuation survey allows respondents to better determine changes in utility among realistic policy alternatives. Our findings have important implications for WTP estimation techniques and public participation in environmental policy design.

A proposed structural model for housewives' recycling behavior: A case study from Turkey

- Ecological Economics---2016---Erkan Arı, Veysel Yilmaz

Recycling is a major factor in environmental behavior as it supports the conservation of natural resources and reduces the amount of solid waste. In addition to its environmental benefits, recycling is also an effective way to fundraise. Although recycling is commonplace in many countries, it is still relatively rare in Turkey. In this study, the attitudes and behaviors of housewives toward recycling were investigated using Ajzen's Theory of Planned Behavior (TPB) and the proposed Structural Equation Model (SEM). It was found that the Housewives' Recycling Model (HRM), obtained as a result of the analysis, could be employed to explain their recycling behavior. In particular, the research established that the positive ideas housewives have in terms of their perceived behavioral control and the individuals in their immediate social surroundings, whose opinions they value, have a positive impact on guiding their recycling behavior.

Trade openness and the changing water polluting intensity patterns of ‘dirty’ and ‘clean’ industrial sectors

- Ecological Economics---2016---Alejandro Del-lachiesa,Aung P. Myint

This study analyzes the economic activity–BOD (Biochemical Oxygen Demand) relationships of the so-called ‘dirty’ and ‘clean’ water polluting industries, during the period of 1995–2005. The results indicate that the economic activity–environment trade-off of ‘dirty’ and ‘clean’ industrial sectors has been altered during the period of study. On average, pollution-intensive ‘dirty’ industries in the poorer nations were found to benefit – in terms of BOD emissions – from extra exports and openness to trade. The opposite was true for ‘clean’ sectors where increased trade openness seems to have contributed to a wider gap between poorer and richer nations’ pollution intensities. With openness to trade skewing innovations away from the ‘clean’ industries – industrial sectors in which the poorer countries specialize – the classical model of opening the economy and lifting barriers to technology adoption will not be enough to improve the poorer nations’ water quality. Policies that induce innovation by reducing the cost and increasing the return on innovation, particularly on R&D activities in which the poorer countries have a comparative advantage, will be necessary in order to improve their economic activity–environment relationship.

What are political leaders’ environmental intentions? The impact of social identification processes and macro-economic conditions

- Ecological Economics---2016---Anna Maria Biscotti,D’Amico, Eugenio

Evidence of continued environmental degradation has led to a questioning of the traditional vision of unlimited economic growth in favour of sustainable development. Although several explicit environmental strategies were designed at the supranational level, the pursuit of environmental sustainability remains an aim driven by political concerns at the country level. This

study aims to investigate the role of both “internal” (cognitive and motivational factors) and “external” (social forces and macro-economic conditions) contexts in influencing the propensity of political leaders regarding environmental matters. The findings indicate that cognitive and motivational factors tend to shape the environmental intentions of political leaders, whereas the “external” context does not have a significant impact. Our results suggest that the political leaders’ propensity for addressing environmental matters is largely affected by the desire of leaders to establish or confirm an individual status (through political processes) or to conform to group norms. However, younger political leaders demonstrate a higher environmental propensity than do older leaders.

Predicting cannabis cultivation on national forests using a rational choice framework

- Ecological Economics---2016---Frank H. Koch,Jeffrey P. Prestemon,Geoffrey H. Donovan,Everett A. Hinkley,John M. Chase

Government agencies in the United States eradicated 10.3 million cannabis plants in 2010. Most (94%) of these plants were outdoor-grown, and 46% of those were discovered on federal lands, primarily on national forests in California, Oregon, and Washington. We developed models that reveal how drug markets, policies, and environmental conditions affect grow siting decisions. The models were built on a rational choice theoretical structure, and utilized data describing 2322 cannabis grow locations (2004–2012) and 9324 absence locations in the states’ national forests. Predictor variables included cannabis market prices, law enforcement density, and socioeconomic, demographic, and environmental variables. We also used the models to construct regional maps of grow site likelihood. Significant predictors included marijuana street price and variables associated with grow site productivity (e.g., elevation and proximity to water), production costs, and risk of discovery. Overall, the pattern of grow site establishment on national forests is consistent with rational choice theory. In particular, growers consider cannabis prices and law enforcement when selecting sites. On-

going adjustments in state cannabis laws could affect cultivation decisions on national forests. Any changes in cannabis policies can be reflected in our models to allow agencies to redirect interdiction resources and potentially increase discovery success.

Gains of integrating sector-wise pollution regulation: The case of nitrogen in Danish crop production and aquaculture

- Ecological Economics---2016---Lars-Bo Jacobsen,Max Nielsen,Rasmus Nielsen

This paper extends the Orani-G Computable General Equilibrium model with an externality market. The externality market is modelled with a limited number of pollution permits that are traded between representative firms in different sectors. The model is applied to identify the gains of a common nitrogen regulation system for Danish agriculture crop and aquaculture production. Common regulation across the two sectors is found to increase GDP by euro 32 million, corresponding to 2.2% of their initial GDP contribution. The direct effect in the two sectors is euro 39 million, where the spill-over effect is 7 million. Full use of recirculation technology in aquaculture entails a further increase in GDP to 106 million. The introduction of a common regulatory system and recirculation technology, simultaneous with a reduction of the common nitrogen cap of 17.6%, corresponding to the current policy objectives, is found to increase GDP by 52 million, 4.1% of their initial contribution. Hence, introducing a common regulatory system and taking advantage of the new technology more than counterbalances the negative socio-economic effect of a cap reduction. The analysis points to the importance of introducing more coherent regulatory frameworks that include all polluters under the same regulatory system.

The ecological economics of land degradation: Impacts on ecosystem service values

- Ecological Economics---2016---Paul C. Sutton,Sharolyn J. Anderson,Robert Costanza,Ida Kubiszewski

We use two datasets to characterize impacts on ecosystem services. The first is a spatially explicit measure of the impact of human consumption or ‘demand’ on ecosystem services as measured by the human appropriation of net primary productivity (HANPP) derived from population distributions and aggregate national statistics. The second is an actual measure of loss of productivity or a proxy measure of ‘supply’ of ecosystem services derived from biophysical models, agricultural census data, and other empirical measures. This proxy measure of land degradation is the ratio of actual NPP to potential NPP. The HANPP dataset suggests that current ‘demand’ for NPP exceeds ‘supply’ at a corresponding ecosystem service value of \$10.5 trillion per year. The land degradation measure suggests that we have lost \$6.3 trillion per year of ecosystem service value to impaired ecosystem function. Agriculture amounts to 2.8% of global GDP. With global GDP standing at \$63 trillion in 2010, all of agriculture represents \$1.7 Trillion of the world’s GDP. Our estimate of lost ecosystem services represent a significantly larger fraction (~10%) of global GDP. This is one reason the economics of land degradation is about a lot more than the market value of agricultural products alone.

Modeling the interaction between flooding events and economic growth

- Ecological Economics---2016---Johanna Grames,Alexia Prskawetz,Dieter Grass,Alberto Viglione,Günter Blöschl

Recently socio-hydrology models have been proposed to analyze the interplay of community risk-coping culture, flooding damage and economic growth. These models descriptively explain the feedbacks between socio-economic development and natural disasters such as floods. Complementary to these descriptive models, we develop a dynamic optimization model, where the inter-temporal decision of an economic agent interacts with the hydrological system. We assume a standard macro-economic growth model where agents derive utility from consumption and output depends on physical capital that can be accumulated through

investment. To this framework we add the occurrence of flooding events which will destroy part of the capital. We identify two specific periodic long term solutions and denote them rich and poor economies. Whereas rich economies can afford to invest in flood defense and therefore avoid flood damage and develop high living standards, poor economies prefer consumption instead of investing in flood defense capital and end up facing flood damages every time the water level rises like e.g. the Mekong delta. Nevertheless, they manage to sustain at least a low level of physical capital. We identify optimal investment strategies and compare simulations with more frequent, more intense and stochastic high water level events.

Fat tails and truncated bids in contingent valuation: An application to an endangered shorebird species

- Ecological Economics---2016---George Parsons,Kelley Myers

A yes-response function in a contingent valuation study is said to have fat tails if it has a high and slowly declining yes-response rate at high bid levels. Truncated bids refer to the practice of dropping high bid offers before a yes-response rate of near zero is reached. This is a common practice in contingent valuation. We explore the extent and implications of fat tails and truncated bids in a study of an endangered shorebird species. We find, among other things, that mean willingness to pay is quite sensitive to the highest bid offered – so much so that the choice of highest bid nearly dictates outcomes.

How (not) to pay — Field experimental evidence on the design of REDD+ payments

- Ecological Economics---2016---Tim Reutemann,Stefanie Engel,Eliana Pareja

Payments for Ecosystem Services (PES) can use many design features. We investigate the impact of payment conditionality types, i.e. different specifications when to pay and when not to pay, for PES on deforestation and agricultural production in a lab-in-the-field

experiment. Our experiment also tests variations in contract period and payment volatility. We designed a highly visual simulation game to characterize the decision situation of a cattle rancher in Brazil. The player can expand extensive pasture by deforestation or intensify existing pasture. The model includes both a land and a capital constraint. We applied the game in an economic, framed lab-in-the-field experiment in Tocantins, Brazil. Payments conditional on forest carbon stock lead to slow, but steady deforestation, while payments conditional on forest carbon stock-change suppressed deforestation more strongly. But payments conditional on stock increase cattle production while payments conditional on stock-change have no effect on production. Thus, depending on the level of leakage, either type of conditionality can be more cost-effective in reducing global carbon emissions. Contracts with limited periods lead to strong deforestation after the end of the payment period. Payment volatility had no significant effect.

Individual preferences regarding environmental offset and welfare compensation: a choice experiment application to an offshore wind farm project

- Ecological Economics---2016---Charlène Kermagoret,Harold Levrel,Antoine Carlier,Jeanne Dachary-Bernard

This paper uses the choice experiment method to investigate the preferences of local communities with respect to various compensatory measures in connection with a development project. A survey was conducted among recreational users of the bay of Saint-Brieuc, where an offshore wind farm is currently planned. The goal is to identify the preferences of the bay's users with respect to various compensation possibilities: monetary compensation, investment in publicly owned assets, or the ecological restoration. Two multinomial logit (MNL) models and a latent class (LC) model are used to explore the preferences and some sources of heterogeneity within the community. The results of this study show that form of compensation is an important determinant of preferences and has an effect on the ac-

ceptability towards the compensation principle. More precisely, results shows that compensation is better accepted if it obeys the principle of strong sustainability, which includes ecological restoration for the gain of the population as a whole and which excludes monetary transactions, associated with the bribe effect. The study also highlights the naturalists' specific attitude for who compensation should be determined within a regulatory framework, one which imposes compensatory measures related to objectively determined ecological impacts.

Ecological economics: A Luhmannian analysis of integrated reporting

- Ecological Economics---2016---David Alexander, Véronique Blum

This paper integrates the ideas of the German sociologist Niklas Luhmann (1927–1998) with the highly topical issue of sustainability reporting. Luhmann sought a detailed description of the world as a set of complex systems which he applied to ecology. We discuss the gestation and requirements of the International Integrated Reporting Council (IIRC) conceptual framework of 2013, suggesting that as finalised it has little relevance to either sustainability or ecology.

Thou shalt not sell nature: How taboo trade-offs can make us act pro-environmentally, to clear our conscience

- Ecological Economics---2016---Britt Stikvoort, Therese Lindahl, Tim M. Daw

Many nature/natural areas are threatened by economic development and urban expansion. Oftentimes nature is not considered part of the cost/benefit analyses preceding such economic development, and most people find it offensive to price-tag nature. To pit (sacred) nature-values against other monetized values (these are so-called taboo trade-offs) is seen as morally offensive. Non-nature related taboo trade-offs (e.g. between life-saving and money-saving) were found elsewhere to induce moral cleansing — attempts to reaffirm one's own moral position by performing overly

moral 'cleansing' behaviour. This study investigated whether trade-offs between nature as sacred value and money as secular induces such moral cleansing in shape of pro-environmental behaviour (PEB).

Environmental and market determinants of economic orientation among rain forest communities: Evidence from a large-scale survey in western Amazonia

- Ecological Economics---2016---Oliver T. Coomes, Yoshito Takasaki, Christian Abizaid, J. Pablo Arroyo-Mora

Large scale surveys of rain forest livelihoods open up new possibilities for understanding the role of forest resources in the well-being of forest peoples but often overlook the factors that influence the diverse economic foci of forest-based communities. In this paper we describe the Peruvian Amazon Rural Livelihoods and Poverty (PARLAP) Project which seeks to identify the factors that contribute to rural poverty among indigenous and folk peoples through the first large scale survey conducted in this data poor region. Our paper draws upon a community census undertaken in four major river sub-basins in eastern Peru (n=919 communities) and asks the question, how do environmental and market factors influence the economic orientation of rain forest communities? Recognizing that standard approaches that explain activity choice by current conditions are problematic because of potential endogeneity, we propose a new analytical framework that examines how historical (initial) conditions determine current conditions and thus current economic activities. Our approach produces a rich array of results that point to the importance of initial environmental endowments and market access of communities in shaping their economic orientation, interacting in different ways depending on the key natural resource upon which they rely.

Pollination service delivery for European crops: Challenges and opportunities

- Ecological Economics---2016---Sandra Nogué, Peter R. Long, Amy E. Eycott, Lea de Nasci-

mento, José María Fernández-Palacios, Gillian Petrokofsky, Vigdis Vandvik, Kathy J. Willis

Crop pollination by bees has long been recognized as an ecosystem service of huge economic value; a large number of food crops depend upon pollination. Features across landscapes that are important for pollination delivery include: nesting habitats, floral resource availability at foraging distance, and climate. The conditions for presence/absence of pollinators are therefore complex and rely upon a combination of biotic and abiotic factors. To date there has been no easily available method for landowners to determine the potential of pollination delivery across the land effectively and rapidly. In this paper we develop a method that uses freely available datasets to remotely estimate the relative provision of pollination service delivery provided by bees across Europe at a 300m-pixel resolution. We then identify the potential pollination delivery and efficiency across Europe at country and regional level. This study illustrates an approach that obtains a first approximation for land managers to identify potential areas across landscapes to protect in order to enhance pollination service delivery.

What is a “meal” ? Comparative methods of auditing carbon offset compliance for fuel-efficient cookstoves

- Ecological Economics---2016---Stephen Harrell, Theresa Beltramo, Garrick Blalock, Juliet Kyayesimira, David Levine, Andrew Simons

Smoke from inefficient biomass cookstoves contributes to global climate change and kills approximately four million people per year. Credits for reduced carbon emissions can potentially subsidize fuel-efficient cookstoves that reduce these harmful effects. Understanding the accuracy of different methods of monitoring stove usage is useful to measure the effects of cookstove programs and to target carbon credits. This paper compares four methods of measuring stove usage: hours cooked (derived from a predictive logistic regression of stove usage monitors and observations of stoves in use); number of people cooked for reported in

household food diaries; fuel weight used gathered in a kitchen performance test; and household air pollution using mean 24-hour concentrations of particulate matter collected with particulate air monitors. We find statistically significant positive correlations between five out of six of these pairs of measures. While the correlations are positive, the explanatory power of each measure for another is weak. The weak correlations emphasize the importance of using multiple measures to track changes in stove use for both researchers and carbon auditors.

Plausible responsiveness to scope in contingent valuation

- Ecological Economics---2016---John Whitehead

Plausible responsiveness to scope is a question of economic significance, in addition to statistical significance, of the scope test in contingent valuation. We briefly review the history of the scope test in order to place the current issue in the context of the BP Deepwater Horizon oil spill. As a result of the review we gain insights into how the issue of scope “adequacy” arose twenty years after it was first mentioned by the NOAA Panel on Contingent Valuation following the Exxon Valdez oil spill. We then provide a review of Desvousges, Mathews and Train (2012) who promote the adding-up test to identify inadequate responsiveness to scope adequacy. The adding-up test is a test of the construct validity of the contingent valuation method but is flawed as a measure of economic significance. We propose scope elasticity of willingness-to-pay as a measure of economic significance. A simulation suggests a likely range of elasticity estimates given linear and quadratic functional forms for the willingness-to-pay function. In order to illustrate the ease of implementation of scope elasticity within the context of the standard scope test we calculate scope elasticity with willingness-to-pay estimates from several studies, describe two studies that directly estimate scope elasticity and estimate scope elasticity with primary data from two studies. All of these empirical estimates of scope elasticity fall within the range of scope elasticity suggested by the simulation. Scope elasticity provides

a practical way forward, relative to the adding up test, on the issue of economic significance of scope effects.

A practice approach to the institutionalization of economic degrowth

- Ecological Economics---2016---Maria Joutsenvirta

The degrowth literature is rich in critical debate about the unsustainability of the growth-economies and in normative envisioning of a transition. It lacks analyses on actual materialization and the nature of the change required. There have been calls for research that pay attention to institutional constraints and possibilities of implementing a democratic process of sustainable degrowth. This paper introduces a practice approach to institutional agency as a fruitful tool for future studies and politics of degrowth. The potential of this approach is demonstrated through a struggle between Finnish Timebanking activists and the tax authorities. The cultural and institutional transition promoted by radical bottom-up initiatives requires a disruption of existing institutional arrangements some of which may be very persistent and supported by defenders who want to maintain the present institutional order. In the case example, the authorities and politicians managed to preserve the mechanisms through which certain sanctions are associated with the non-compliance of Timebanking with the income tax law. A practice approach to institutionalization increases our understanding of institutional persistence and makes visible forces that support the present ‘status quo’. It also enhances understanding of the opposing dynamics and gives tools to engage in more effective efforts to change institutions.

Impacts of climate change and ocean acidification on coral reef fisheries: An integrated ecological–economic model

- Ecological Economics---2016---Ann E. Speers,Elena Y. Besedin,James E. Palardy,Chris Moore

Coral reefs are highly productive shallow marine habitats at risk of degradation due to CO₂-mediated global

ocean changes, including ocean acidification and rising sea temperature. Consequences of coral reef habitat loss are expected to include reduced reef fisheries production. To our knowledge, the welfare impact of reduced reef fish supply in commercial markets has not yet been studied. We develop a global model of annual demand for reef fish in regions with substantial coral reef area and use it to project potential consumer surplus losses given coral cover projections from a coupled climate, ocean, and coral biology simulation (CO₂-COST). Under an illustrative high emission scenario (IPCC RCP 8.5), 92% of coral cover is lost by 2100. Policies reaching lower radiative forcing targets (e.g., IPCC RCP 6.0) may partially avoid habitat loss, thereby preserving an estimated \$14 to \$20 billion in consumer surplus through 2100 (2014\$ USD, 3% discount). Avoided damages vary annually, are sensitive to biological assumptions, and appear highest when coral ecosystems have moderate adaptive capacity. These welfare loss estimates are the first to monetize ocean acidification impacts to commercial finfisheries and complement the existing estimates of economic impacts to shellfish and to coral reefs generally.

The value of environment across efficiency quantiles: A conditional regression quantiles analysis of rangelands beef production in north Eastern Australia

- Ecological Economics---2016---Daniel Gregg,John Rolfe

In agricultural systems the value of environmental inputs can be measured using the production function approach whereby the marginal contributions of factors are associated with a shadow value under perfect competition and rationality assumptions. However, empirical studies show that inefficiency in production is common indicating that the rationality assumption is not met. Furthermore, substantial evidence exists to suggest that the contributions of environmental inputs in particular may be differentiated across the efficiency distribution. This means that the frontier technology may not be an appropriate reflection of the technology in use by inefficient enterprises. This

article presents the use of conditional regression quantiles to consider how the value of environmental inputs, measured by their contributions to production, vary across efficiency quantiles. We employed a case study of rangelands beef production in Australia to consider how environmental health differentially contributes to production values across efficiency quantiles. Our approach generates detailed insights into the nature of environmentally-sourced technical inefficiency and suggests that conditional quantile regression approaches are ideal for consideration of issues wherein substantial heterogeneity exists limiting the information content of conditional mean based analyses.

Processes for the sustainable stewardship of marine environments

- Ecological Economics---2016---Henrik Scharin,Siv Ericsson,Michael Elliott,R. Kerry Turner,Susa Niiranen,Thorsten Blenckner,Kari Hyytiäinen,Lassi Ahlviik,Heini Ahtiainen,Janne Artell,Linus Hasselström,Tore Söderqvist,Johan Rockström

Sustainable stewardship of the marine environment necessitates a holistic approach encompassing all the relevant drivers, activities and pressures causing problems for the natural state of the system and their impact on human societies today and in the future. This article provides a framework as well as a decision support process and tool that could guide such an approach. In this process, identifying costs and benefits of mitigation is a first step in deciding on measures and enabling instruments, which has to be accompanied by analyses regarding distributional effects (i.e. who gains or loses) related to different targets and policy instruments. As there are risks of future irreversible regime shifts and even system collapses, the assessments have to be broadened to include scenarios on possible future developments as well as ethical considerations. In particular, a deeper sustainable management strategy may be needed to respond to possible future increases in the rate of environmental change, amongst growing evidence of external pressures, interactions and non-linear dynamics. This adaptive management strategy

should focus on building the resilience required to cope with and adapt to change.

The implicit value of tree cover in the U.S.: A meta-analysis of hedonic property value studies

- Ecological Economics---2016---Shyamani D. Siriwardena,Kevin Boyle,Thomas P. Holmes,P. Eric Wiseman

Trees in residential neighborhoods and communities provide benefits for homeowners that are capitalized into residential property values. In this paper, we collected data from hedonic property value studies and merged these data with ancillary spatial data describing forest and socio-economic characteristics surrounding each study area to conduct a meta-analysis of the impact of tree canopy cover on the value of residential properties. The meta-analysis suggests that property-level tree cover of about 30% and county-level tree cover of about 38% maximize the implicit price of tree cover in property values. Currently, tree cover in the original study areas was about 14%, on average, around or near study properties. The empirical results, therefore suggest under investment of tree cover on private property from the perspective of individual property owners and from a societal perspective. The findings also have implications for community forest programs regarding planting trees and protection of mature trees to address potential changes in tree abundance, species diversity and stand age due to development and climate change.

Household carbon inequality in urban China, its sources and determinants

- Ecological Economics---2016---Xinkuo Xu,Liyan Han,Xiaofeng Lv

Designing mitigation policies for households requires knowledge of household carbon distributions. This study surveys the household carbon inequality in urban China and analyzes its sources and determinants using weighted household survey data. Different from existing literatures studying carbon inequality on the

international or regional level, we focus on the household aspect and first survey its characteristics by some comparisons. By ascribing household carbon emissions calculated by the Consumer Lifestyle Approach to several consumption categories with the method of Gini coefficient decomposition, we find that residential consumption with high carbon intensity is the most important source of household carbon inequality in urban China. Food consumption and the consumption of educational, cultural and recreational services are the next largest sources because of the consumed quantities or carbon intensity. The application of Shapley decomposition shows the determinants of household carbon inequality in urban China and their contributions, which are household demographic characteristics (59.74%), household employment and income (24.31%), household burdens (8.00%), and household assets and financial plans (7.95%). The policy implications of these results are also discussed.

A socio-ecological exploration into urban form: The environmental costs of travel

- Ecological Economics---2016---Zeenat Kotval-K,Igor Vojnovic
- 40% of low-income households compared to over 99% of high-income households own a vehicle. • Urban deteriorating neighborhoods have increased travel distances to daily destinations. • Environmental burdens associated with travel are shaped by class.

To buy or not to buy: The roles of self-identity, attitudes, perceived behavioral control and norms in organic consumerism

- Ecological Economics---2016---Miles H. Johe,Navjot Bhullar

The current study examined the role psychological determinants (self-identity, attitudes, perceived behavioral control, and norms) play in organic consumerism. Participants (N=252, meanage=44.35, SD=15.29, 97% resided in Australia) were randomly assigned to one of the three experimental conditions: (1) organic identity prime, (2) pro-environmental identity prime, and (3)

neither pro-environmental nor organic identity primes (control). Analysis of variance revealed that organic identity prime was associated with significant increase in intentions to purchase organic products, relative to both pro-environmental identity and control conditions. Follow-up mediation analysis indicated that organic self-identity increased consumer intentions by influencing their attitudes and group norms. These results demonstrate that organic identity can be primed to create identity-congruent shifts toward organic consumerism. Importantly, these findings have direct application for marketing strategies aiming at promoting and developing an “organic” brand.

The rise and fall of the sand monopoly in colonial Hong Kong

- Ecological Economics---2016---Lawrence W.C. Lai,K.W. Chau,Frank T. Lorne

A state monopoly over a scarce natural resource under open access can theoretically reduce the costs of supply by constraining rent dissipation and innovations. A monopoly over the collection and trading of sand was formed in Hong Kong by legislation in 1935 in the wake of disputes between sandmen and villagers and imminent shortages of sand. Arguably, a monopoly at this stage of Hong Kong's development was a better alternative to merely defining rights over sand extraction in terms of the transaction costs of enforcement. During the 1950s and 1960s, when Hong Kong's economy and construction industry began to boom, the monopoly's existence was further justified due to the politics of China being the sole source of Hong Kong's sand supply. However, this case study of the sand monopoly and its post-war operation as a bilateral monopoly shows that it did not protect coastal villagers, as violations of the sand law were not infrequent. The local sand supply was huge, and the monopoly's abolition in 1981 was followed by a long period of falling, rather than rising, real wholesale prices of the resource. Nor was there any sign of scale economies, as claimed by the government. The policy implications of this are discussed.

Efficient water-using technologies and habits: A disaggregated analysis in the water sector

- Ecological Economics---2016---María Pérez-Urdiales, María Ángeles García-Valiñas

This paper studies the determinants of owning water-efficient technologies and practicing the corresponding water-saving habits, and the potential relationship between both decisions as poor water-saving habits related to these technologies could lead to significant losses in water-use efficiency. We explore this relationship using a cross-section database of households in the city of Granada, distinguishing between electrical and non-electrical water-saving appliances. This distinction is made to account for the difference in the technical characteristics and to provide useful information for policy design. Our results show significant differences in the determinants of each decision. Moreover, a negative relationship between pro-environmental habits and efficient technologies in the case of non-electrical devices has been detected.

The social metabolism of biomass in Spain, 1900–2008: From food to feed-oriented changes in the agro-ecosystems

- Ecological Economics---2016---David Soto, Juan Infante-Amate, Gloria I. Guzmán, Antonio Cid, Eduardo Aguilera, Roberto García, Manuel González de Molina

The main aim of this article is to reconstruct the main biomass flows and indicators for the Spanish agriculture between 1900 and 2008. We reconstruct the Net Primary Productivity for Spanish agro-ecosystems, but also the main Economy-Wide/material flow accounting indicators as Domestic Extraction of biomass, Physical Balance Trade (PTB) and Domestic Material Consumption (DMC) of biomass in Spain. The main results shows that the transition from agrarian to industrial metabolism has meant a decrease in the per capita consumption of biomass. However, in absolute terms, the consumption of biotic materials has also increased considerably. This has been due to the changes in the functionality of biomass for social metabolism as a

whole: it has gone from being the main source of energy and materials to specializing in two essential functions, the provision of raw materials for industry and the supply of food. The Spanish case confirms that the industrialization of agriculture has led to an increase in pressure on the Spanish agro-ecosystems. But there has also been a transfer of pressure on agro-ecosystems of other countries through international trade. Spain is a net biomass importer in order to maintain a diet that is ever richer in meat and dairy products.

Predicting the total economic impacts of invasive species: The case of *B. rubostriata* (red streaked leafhopper)

- Ecological Economics---2016---Lirong Liu, Brian Piper

This paper predicts the total economic impacts of an impending invasion of *Balclutha rubostriata* (henceforth *B. rubostriata*) in the sugarcane-producing regions of Louisiana. *B. rubostriata* is a non-native species that feeds on sugarcane and can be a carrier of sugarcane white leaf phytoplasma, a disease capable of causing up to 100% crop loss. The total economic impacts considered in the prediction include direct, indirect and induced economic impacts. These estimates are essential for policy-makers to formulate appropriate responses. Results show that the cumulative total impacts could be as high as \$5.4 million from *B. rubostriata* only or \$71.6 million from *B. rubostriata* and the phytoplasma after 5 years. State and local governments could lose a cumulative total of \$438,450 in tax while federal revenues would be reduced by \$4 million with *B. rubostriata* and phytoplasma after 5 years. Cumulative employment effects range from 184 lost jobs with just *B. rubostriata* to 2460 lost jobs with *B. rubostriata* and phytoplasma by year 5, about one-tenth percentage point increase in Louisiana's unemployment rate at current employment levels.

‘Environmental load displacement’ from the North to the South: A consumption-based perspective with a focus on China

- Ecological Economics---2016---Shuijun Peng,Wencheng Zhang,Chuanwang Sun

Quantifying environmental load displacement from developed countries (the North) to developing countries (the South) is of particular importance for understanding the environmental implications of consumption in the North and global sustainability. Based on a global input–output model, this paper estimates emissions transfers between the North and the South for eight types of air pollutants from a consumption perspective, with a focus on emissions transfers between the North and China. The results show that 14%–30% of air pollutant emissions in the South were caused by consumption in the North in 2007. There is a large ‘pollution deficit’ between the North and South, which significantly increased during the period 1995–2007, that favors the theory of ecologically unequal exchange. Although the emissions per capita of the North from production for most air pollutants decreased over this period, the emissions per capita from consumption increased or decreased more mildly. The decomposition of emissions transfers further shows that South–South trade in intermediates has played an increasingly important role in environmental load displacement from the North to the South. It is important to assess the sustainability of so-called ‘weightless economies’ in the North from a global perspective that takes environmental load displacement into account.

Transferring Williamson’s discriminating alignment to the analysis of environmental governance of social-ecological interdependence

- Ecological Economics---2016---Andreas Thiel,Christian Schleyer,Jochen Hinkel,Maja Schlüter,Konrad Hagedorn,Sandy Bisaro,Ihtiyor Bobojonov,Ahmad Hamidov

Institutional fit is operationalized by transferring transaction costs economics (TCE) to the analysis of instances of social-ecological interdependence. We care-

fully spell out the differences with conventional TCE and outline analytical steps based on discriminating alignment that enable a TCE analysis of environmental governance of “nature-related transactions”. We illustrate the approach through the example of wildlife management in Germany. Here we find hierarchical governance (a prohibition) of killing of wolves embedded into a polycentric hybrid monitoring arrangement. In applying TCE to nature-related transactions, we argue that characteristics of nature-related transactions can be subsumed under the core categories of jointness, uncertainty, asset specificity, frequency, rivalry, excludability and social-relational distance. Benefits of this approach include its generating a narrow list of descriptors of instances of biophysically mediated interdependence related to one evaluation criterion: cost-effectiveness. The TCE of nature-related transactions thus identifies sets of stylized contextual factors and aspects related to the governance of hazards of ex-post opportunistic behavior that cut across scales. They can be used as composite descriptors that facilitate analysis of complex multi-scalar arrangements of natural resource governance. We propose the concept of ‘governance challenge’, derived from TCE, as being useful for building research on environmental governance.

Application of the ecosystem services concept in environmental policy—A systematic empirical analysis of national level policy documents in Poland

- Ecological Economics---2016---Krzysztof Maczka,Piotr Matczak,Agata Pietrzyk-Kaszyńska,Marcin Rechciński,Agnieszka Olszańska,Joanna Cent,Małgorzata Grodzińska-Jurczak

We explore the occurrence of the ecosystem services (ES) concept in public policies in Poland by providing a systematic content analysis of national environmental policies. A detailed analysis of the legal acts, national strategies, and decrees using the Common International Classification of Ecosystem Services codes, which embraces a full range of ES, shows that the ES concept is

reflected in the investigated documents. However, it is mainly depicted in an indirect, latent form. We further explore the ES concept occurrence in the Polish legislation with in-depth interviews of experts. From the interviews we identify two general groups of barriers to the ES concept implementation in environmental policy: (a) a limited understanding and acknowledgement of the concept among individuals involved in policy making; and (b) sectoral divisions within environmental governance that hinder the spread of the concept. Analysis reveals that the concept of services for society provided by nature had already been perceived in Polish national environmental policies before the emergence of the ES concept and the implementation of the EU biodiversity policy. However, the concept is referred to mostly in a latent form, before and after its emergence.

Consumption-based material flow indicators — Comparing six ways of calculating the Austrian raw material consumption providing six results

- Ecological Economics---2016---Nina Eisenmenger,Dominik Wiedenhofer,Anke Schaffartzik,Stefan Giljum,Martin Bruckner,Heinz Schandl,Thomas O. Wiedmann,Manfred Lenzen,Arnold Tukker,Arjan Koning

Understanding the environmental implications of consumption and production depends on appropriate monitoring tools. Material flow accounting (MFA) is a method to monitor natural resource use by countries and has been widely used in research and policy. However, the increasing globalization requires the consideration of ‘embodied’ material use of traded products. The indicator raw material consumption (RMC) represents the material use – no matter where in the world it occurs – associated with domestic final demand. It provides a consumption-based perspective complementary to the MFA indicators that have a territorial focus. Several studies on RMC have been presented recently but with diverging results; hence, a better understanding of the underlying differences is needed. This article presents a comparison of Austrian RMC for the year 2007 calculated by six different approaches (3 multi-

regional input–output (MRIO) and 3 hybrid life-cycle analysis-IO approaches). Five approaches result in an RMC higher than the domestic material consumption (DMC). One hybrid LCA-IO approach calculates RMC to be lower than DMC. For specific material categories, results diverge by 50% or more. Due to the policy relevance of the RMC and DMC indicators it is paramount that their robustness is enhanced, which needs both data and method harmonization.

External validity of artefactual field experiments: A study on cooperation, impatience and sustainability in an artisanal fishery in Colombia

- Ecological Economics---2016---Luz Elba Torres-Guevara,Achim Schlüter

This paper contributes to the experimental analysis of sustainable behavior in artisanal fisheries and the external validity of economic experiments. We run a standard one-shot public goods experiment and two time preferences experiments with fishermen from Tasajera. It is a small fishing community located in the Caribbean coast of Colombia, which depends mainly on the fishery resources of the Ciénaga Grande de Santa Marta for its livelihood. To investigate the external validity of the experiments, we related the fishermen’s individual decisions in the experiments to some indices measuring the ecological impact of fishing activities among the same group of fishermen. We found that fishermen’s contributions to the public good and their levels of impatience are not robustly correlated to their real fishing behavior. We argue that the link between fishermen’s behavior in the field experiments and real life could be associated to various factors, such as the specific context in which fishermen live, and the way in which cooperation in real life is measured.

Divers’ willingness to pay for improved coral reef conditions in Guam: An untapped source of funding for management and conservation?

- Ecological Economics---2016---Shanna Grafeld,Kirsten Oleson,Michele Barnes,Marcus Peng,Catherine Chan,Mariska Weijerman

Coral reefs are increasingly threatened despite being essential to coastal and island economies, particularly in the Pacific. The diving industry relies on healthy reefs and can be positively and/or negatively impacted by ecological change. Quantifying divers' ecological preferences that influence economic outcomes can help inform managers and justify conservation. Utilizing non-market valuation, we assess SCUBA divers' preferences for ecological attributes of coral reef ecosystems in Guam, estimate WTP for coastal and watershed management, and investigate drivers influencing preferences. A discrete choice experiment grounded in ecosystem modeling reveals divers prefer reefs with greater ecological health (higher fish biomass, diversity, and charismatic species). Individuals with stronger environmental values expressed stronger ecological preferences. Fish biomass improvement from low ($<25\text{g}/\text{m}^2$) to high ($>60\text{g}/\text{m}^2$) was worth $>\$2$ million/year. The presence of sharks and turtles together was the preeminent attribute, worth $\$15\text{--}20$ million/year. Divers are willing to voluntarily contribute ($\$900$ thousand) towards watershed sediment-reduction projects that could benefit divers by improving reef conditions. Few policies are in place worldwide collecting fees from divers for coral reef management, and none in Guam. Our results suggest that understanding divers' preferences and the drivers behind them may assist managers in designing policies that capture divers WTP and create partners in conservation.

Optimizing intermediate ecosystem services in agriculture using rules based on landscape composition and configuration indices

- Ecological Economics---2016---Rong-Gang Cong, Johan Ekroos, Henrik G. Smith, Mark Brady

Important intermediate ecosystem services (ES) such as crop pollination and biological control of pests, which underpin the final ES agricultural yields, are mediated by mobile organisms that depend on availability of habitat and its arrangement in the landscape. It has been suggested that landscape-scale management (LSM) of habitat in a multi-farm setting results in higher provisioning of such ES compared to farm-scale management

(FSM). However, to achieve the LSM solution, farmers' land-use decisions need to be coordinated. To this end, we develop rules based on novel landscape composition and configuration indices. We model farmers' interdependencies through ES in an agent-based model (ABM) and optimize land use at both the farm and landscape scales for comparison. Our analysis is based on a simple artificial landscape with homogeneous soil quality and uses crop pollination as an illustrative ecosystem service. We consider habitat configuration at the field scale. Our rules demonstrate that the coordinated solution is characterized by a higher degree of habitat availability and a configuration of habitat that is dispersed rather than agglomerated. We tested these rules over a range of assumptions about ecological parameter values and suggest that such rules could be used to improve governance of ES in agricultural landscapes.

Additionality and reverse crowding out for pollution offsets in water quality trading

- Ecological Economics---2016---Richard Woodward, David Newburn, Mariano Mezzatesta

Market-based environmental policies frequently include offset provisions that allow polluters who are not subject to a binding cap to participate in trading programs. When offsets are used for compliance, it is important that they are additional in the sense that the payment from the trading program induces environmental benefits that would not occur without the program. In this paper we analyze a water quality trading program in Ohio, U.S., to estimate the extent to which the offsets are additional. Using data from the program and a farmer survey, we estimate the number of additional conservation practices that are adopted by farmers who participated in the trading program relative to the counterfactual outcome without the program. Using matching methods, we find no statistically significant increase in the number of conservation practices due to the trading program. We also examine whether the trading program may have crowded out government funding. We also do not find significant evidence for such crowding out, instead finding some evidence that

the trading program may have led to greater participation in federal cost-share programs.

Psychographic profile affects willingness to pay for ecosystem services provided by Mediterranean high nature value farmland

- Ecological Economics---2016---Tamara Rodríguez-Ortega,Alberto Bernués,Frode Alfnes

Our aim was to examine how psychographic profiles affect willingness to pay for ecosystem services in Mediterranean high nature value farmland. We combined psychographic analysis and economic valuation to: i) identify different psychographic profiles based on attitudes towards the economy and environment, rural development and agricultural intensification, food quality and consumption, and agri-environmental policy; and ii) measure the economic value that the psychographic profiles assign to key ecosystem services in different agricultural policy scenarios. We analysed two populations in Spain (the general population and the local residents of the study area). We identified two psychographic profiles in each population focusing on productivist and conservationist attitudes. Respondents in all profiles were highly concerned about forest wildfires, followed by the availability of quality products for those with productivist profiles, the biodiversity maintenance for the general conservationists and a more human-intervened landscape for the local conservationists. The willingness to pay for ecosystem services altogether differed between the psychographic profiles, from 88€ of general productivists to 334€ of local conservationists. We demonstrated that attitudes concerning ecosystem services have a strong influence on their willingness to pay. We argued that psychographic differences should be considered when designing and legitimising EU agri-environmental and conservation policies.

Mitigation of adverse effects on competitiveness and leakage of unilateral EU climate policy: An assessment of policy instruments

- Ecological Economics---2016---Alessandro Antimiani,Valeria Costantini,Onno Kuik,Elena

Paglialunga

The European Union (EU) has developed a strategy to mitigate climate change by cutting greenhouse gas (GHG) emissions and fostering low carbon technologies. However, the risk of implementing unilateral policies is that distortive effects are generated at the global scale affecting world energy prices, international competitiveness and the geographical allocation of carbon intensive production processes. Using a dynamic CGE model, we assess the rate of carbon leakage and adverse impacts on competitiveness in a number of scenarios over the period 2010–2050. According to the model results, we highlight two major issues. First, in the case of a unilateral EU climate policy, carbon leakage and negative effects on competitiveness are quite serious. Anti-leakage measures can only mitigate leakage and adverse economic impacts on competitiveness in a limited way. On the contrary, an optimality analysis addressing the environmental effectiveness, cost-effectiveness and political feasibility of alternative policy solutions reveals that the EU long term decarbonisation strategy by investing in energy efficiency and renewable energy might ensure protection of vulnerable manufacturing activities while enhancing the competitiveness of technologically-advanced industries.

A review and comparative assessment of existing approaches to calculate material footprints

- Ecological Economics---2016---Stephan Lutter,Stefan Giljum,Martin Bruckner

Effective implementation of resource policies requires consistent and robust indicators. An increasing number of national and international strategies focussing on resource efficiency as a means for reaching a “green economy” call for such indicators. As supply chains of goods and services are increasingly organised on the global level, comprehensive indicators taking into account upstream material flows associated with internationally traded products need to be compiled. Particularly in the last few years, the development of consumption-based indicators of material use – also

termed “material footprints” – has made considerable progress. This paper presents a comprehensive review of existing methodologies to calculate material footprint-type indicators. The three prevailing approaches, i.e. environmentally extended input–output analysis (EE-IOA), coefficient approaches based on process analysis data, and hybrid approaches combining elements of EE-IOA and process analysis are presented, existing models using the different approaches discussed, and advantages and disadvantages of each approach identified. We argue that there is still a strong need for improvement of the specific approaches as well as comparability of results, in order to reduce uncertainties. The paper concludes with recommendations for further development covering methodological, data and institutional aspects.

Stated preference methods and landscape ecology indicators: An example of transdisciplinarity in landscape economic valuation

- Ecological Economics---2016---C. Tagliaferro,M. Boeri,A. Longo,W.G. Hutchinson

This paper addresses the representation of landscape complexity in stated preferences research. It integrates landscape ecology and landscape economics and conducts the landscape analysis in a three-dimensional space to provide ecologically meaningful quantitative landscape indicators that are used as variables for the monetary valuation of landscape in a stated preferences study. Expected heterogeneity in taste intensity across respondents is addressed with a mixed logit model in willingness to pay space. Our methodology is applied to value, in monetary terms, the landscape of the Sorrento Peninsula in Italy, an area that has faced increasing pressure from urbanisation affecting its traditional horticultural, herbaceous, and arboreal structure, with loss of biodiversity, and an increasing risk of landslides. We find that residents of the Sorrento Peninsula would prefer landscapes characterised by large open views and natural features.

Wind power externalities: A meta-analysis

- Ecological Economics---2016---Matteo Mattmann,Ivana Logar,Roy Brouwer

This study presents the first quantitative meta-analysis of the non-market valuation literature on the external effects associated with wind power production. A data set of 60 observations drawn from 32 studies is constructed. The relative economic values of different types of externalities as well as the impact of various methodological and sample characteristics on welfare estimates are examined. The results indicate a significant effect of visual externalities on welfare estimates in both directions, i.e., a positive effect of visual improvements and a negative effect of deteriorations. This finding corresponds to predictions of the importance of visual impacts in the social science literature. External effects of wind power on biodiversity (mainly birds) do not affect welfare estimates. Indirect externalities caused by conventional sources of electricity that can be avoided by wind power, such as the reduction of air pollution, do neither have a significant impact on welfare measures. Methodologically, we find substantial but inelastic income effects and, for choice experiments, clear evidence of sensitivity to scope. From a policy point of view, our results suggest that a policy mix combining a promotion of wind turbines with another green policy facilitates expansion of wind energy.

Modeling individual preferences for energy sources: The case of IV generation nuclear energy in Italy

- Ecological Economics---2016---Davide Contu,Elisabetta Strazzera,Susana Mourato

The planned re-introduction of nuclear energy in Italy was abandoned in the aftermath of the Fukushima nuclear accident. Twenty years earlier, soon after the Chernobyl accident, Italians had also voted against nuclear energy. However, a new nuclear energy technology, i.e. fourth generation, is under research and development. This paper investigates its social acceptance by means of a robust methodology, employing 1) choice experiments, 2) structural equation modeling

and 3) information treatments within an online nationwide survey. Results show a great deal of preference heterogeneity: the majority of the sampled respondents oppose new nuclear plants in Italy, with some not willing to accept any monetary compensation at all. However, another segment of respondents, more confident that fourth generation nuclear energy goals will be achieved, show a modest support towards the implementation of new nuclear projects. Additional variables were found to affect opposition.

Pay the farmer, or buy the land?—

Cost-effectiveness of payments for ecosystem services versus land purchases or easements in Central Kenya

- Ecological Economics---2016---Michael Curran, Boniface Kiteme, Tobias Wünscher, Thomas Koellner, Stefanie Hellweg

Payments for Ecosystem Services (PES) have emerged as a popular conservation tool, yet evaluation alongside other direct conservation strategies remains piecemeal. We prospectively compared cost-effectiveness of PES to Land Purchases or Easements (LPE) in Central Kenya. We spatially predicted opportunity costs and land prices using household survey and literature data, and sampled conservation management costs from four regional conservation organizations. We simulated a fixed-budget, spatial ecological-economic site selection process for conservation intervention (PES or LPE) over 30 years. We included effects of land markets, property value fluctuations, rising agricultural productivity and climate change. Depending on the scenario, the LPE strategy led to larger reserves (by 26%–610%), better representation of mammal species' ranges (by 47%–112%) and lower unit costs (by 26%–48%). Adding a yearly egalitarian social development payment to the LPE strategy did not increase costs beyond the basic PES model. Our findings were robust to discount rate choice, but cost savings of LPE only materialized after about a decade. Furthermore, Kenyan law restricts foreign land ownership and the use of land easements, thus simpler institutional requirements make PES a more immediate, if less effective,

property-based tool.

Labor as a driver of changes in herd feeding patterns: Evidence from a diachronic approach in Mediterranean France and lessons for agroecology

- Ecological Economics---2016---C. Aubron, L. Noël, J. Lasseur

Ruminant livestock farmers rely on diverse resources to feed their herds and the ways they combine these resources play a significant role from an agroecological perspective. In French Mediterranean mountainous areas, feeding patterns for sheep herds have been changing over the past decades in a manner which may not be favorable for agroecology. We hypothesize that labor plays a key role in this evolution. To test this hypothesis, we carried out observations and interviews, using the agrarian systems framework, with retired and active farmers in two areas of France. We built 7 sheep farm models and defined indicators assessing the contribution of different feed resources and the physical labor productivity in feed units in 1970 and 2013. The comparison of farm models highlights that herd growth has led to a focus on less labor-demanding feed resources, namely: (i) purchased feed in the Cévennes; (ii) meadows for single transhumance farms in the Alpine foothills; (iii) lowland winter grazing for double transhumance farms in the Alpine foothills. These changes are problematic from an agroecological perspective. This focus on labor offers a new perspective on changes in trajectories of livestock farming in the French Mediterranean region and serves as a basis for discussion on the importance of labor in agroecological transition.

Linking individuals' ecological footprint to their subjective well-being

- Ecological Economics---2016---Elsy Verhofstadt, L. Van Ootegem, B. Defloor, B. Bleys

Sustainable development poses a major challenge to Western societies as many of their citizens have lifestyles with resource use beyond the earth's carrying

capacity. Sustainability transitions will be easier to implement if they also increase individuals' well-being. We investigate the relation between the ecological footprint and the subjective well-being at the individual level, using a questionnaire carried out in Flanders (Belgium). Our results suggest that a lower footprint does not reduce well-being in the sense that we find no significant correlation. In a next step, we investigate the direct impacts of the different ecological footprint components on subjective well-being. Switching to a more environmentally friendly diet and not using electricity for domestic heating create win-win situations as these actions decrease the ecological footprint while increasing reported levels of well-being. Finally, we investigate the socio-demographic determinants of the ecological footprint and subjective well-being to look for indirect impacts. Having a relationship and being a house owner increase subjective well-being and decrease the ecological footprint. Better social life and health and living in a pleasant environment increase subjective well-being with no cost in terms of ecological footprint.

The value of whale watching to local communities in Baja, Mexico: A case study using applied economic rent theory

- Ecological Economics---2016---Tobias Schwoerer,Duncan Knowler,Salvador Garcia-Martinez

Nature-based tourism can provide opportunities for local stewardship and create incentives to support habitat and conservation of marine species where there is pressure on local habitat. We investigate the local economic value of Eastern Pacific gray whales (*Eschrichtius robustus*) to two communities in Baja California Sur, Mexico, that benefit from nature-based tourism associated with the whales. Using a producer side approach and data for 2006, we estimate the economic rent associated with whale watching in 2006 and then examine the distribution of that rent among local stakeholders. We find a substantial local value associated with the presence of gray whales, with the largest share (two-thirds) going to the whale watching owner-operators. Our findings suggest that increasing

the whale watching price in 2006 would have been a cost-effective strategy for increasing the rent captured locally from whale watching. Finally, we conclude with a brief assessment of developments since 2006.

Land use and general equilibrium implications of a forest-based carbon sequestration policy in the United States

- Ecological Economics---2016---Juan J. Monge, Henry L. Bryant, Jianbang Gan, James W. Richardson

A comparative static Computable General Equilibrium model was used to assess the impacts of forest-based carbon payments on sequestration, land use, and agricultural commodity prices in the U.S. A modified 2008 regional Social Accounting Matrix, considering land as a heterogeneous factor, was used as the model's main input. The matrix was projected to its 2050 counterpart using capital and labour growth projections. The forest-generated carbon offset sources considered were afforested set-asides, commercial forestry intensification and harvested wood products. A new dataset on regional afforestation carbon uptake rates and costs was used to include afforested set-asides as latent activities. For a carbon offset price of \$20/MT CO₂, 12% of U.S. annual emissions could be sequestered in 2050. More than half of the additional carbon sequestered (611millionMT CO₂), compared to the 2050 baseline, would be attributed to set-asides and composed mainly of softwood forests. High carbon prices would increase land prices resulting in the diversion of 15% and 8% of pasture and cropland to carbon set-asides, respectively, mainly in the Central Plains. The high agricultural land diversion would force activities to intensify production systems driving the prices of beef up by 14% as well as oilseeds and grains by 3% and 4%, respectively.

Estimating the demand curve for sustainable use of pesticides from contingent-valuation data

- Ecological Economics---2016---Cristina Amaro da Costa, José Lima Santos

Stated-preference valuation techniques are often used

to assess consumers' willingness-to-pay for food items produced in farming systems that adopt a sustainable use of pesticides (SUP). We propose an innovative valuation methodology in which dichotomous-choice contingent valuation is used to estimate the demand curve (price-quantity relationship) for such food items where price means price premium for the SUP output, quantity is the probability of choosing SUP and the conventional food product is kept available in the market at the current market price. This methodology can be used to evaluate market differentiation as a policy option to promote the SUP.

A qualitative meta-synthesis of the benefits of eco-labeling in developing countries

- Ecological Economics---2016---Anna Carlson, Charles Palmer

Eco-labeling (or environmental certification) is often promoted as a regulatory instrument capable of incentivizing sustainable resource use, even in the absence of stringent government environmental regulations. Despite slow uptake in developing countries and high producer costs, a growing body of case study evidence suggests that producers benefit in varied ways from certification. A qualitative meta-synthesis approach is applied to this body of evidence in order to assess the type and extent of producer benefits reported in case studies of Forest Stewardship Council (FSC) and Marine Stewardship Council (MSC) certification, in developing countries. While benefits from price premiums and market access appear to be limited, less tangible benefits were more common, including learning, governance, community empowerment, and reputational benefits. These benefits may justify the cost of certification.

A proposed framework to systematically design and objectively evaluate non-dominated restoration tradeoffs for watershed planning and management

- Ecological Economics---2016---David M. Martin, Virgilio Hermoso, Francis Pantus, Jon Olley, Simon Linke, N. LeRoy Poff

Human-driven alterations to freshwater ecosystems are leading to a global decline of river function and biodiversity. In our experience, managers want to be given many possible options to restore freshwater ecosystems that are workable within spatial, temporal, operational, and budgetary constraints of the system. Correspondingly, a new field for systematic river restoration planning has emerged through the use of well-established systems design concepts like multi-objective optimization and tradeoff analysis. In this article, we propose a decision framework for systematic river restoration planning where economic-environment systems design and tradeoff analyses are employed as a concurrent planning procedure before restoration interventions are implemented. Heuristic optimization and multi-criteria decision analysis methods are proposed to systematically design and objectively evaluate non-dominated economic-environment tradeoffs associated with restoration strategies within a watershed, and to provide a short-list of viable restoration alternatives to decision makers for negotiation and implementation. The proposed framework has the capacity to make science-based information and sophisticated decision support methods available for stakeholder deliberation. To illustrate the phases of the framework, we use a published case study of systematic restoration planning in South East Queensland, Australia.

Casting a long shadow: Demand-based accounting of Canada's greenhouse gas emissions responsibility

- Ecological Economics---2016---Brett Dolter, Peter A. Victor

Canada is the only country to have ratified the Kyoto protocol and then withdrawn. Part of the justification for Canada's reluctance to commit to greenhouse gas (GHG) emissions reductions is the country's status as fossil fuel exporter. In this paper we use input-output analysis and the World Input-Output Database (WIOD) to ask whether Canada's contribution to global GHG emissions changes when calculated using a demand-based shadow emission approach that excludes GHG emissions created in the production

of exports like fossil fuels, but includes emissions released to produce imports to Canada. We find that from 1995 to 2005 Canada's contribution to global emissions was lower using this demand-based GHG accounting approach than a production-based approach. From 2006 to 2009 however, increased imports from GHG-intensive trading partners like China meant that Canada's demand-based shadow emissions were higher than its production-based GHG emissions.

Tracking cultural ecosystem services: water chasing the Colorado River restoration pulse flow

- Ecological Economics---2016---Rosalind H. Bark, Catherine J. Robinson, Karl W. Flessa

The release of environmental flows for ecological restoration is a challenge for water policymakers and managers as it involves complex trade-offs between productive and ecosystem uses of water. While it is crucial to demonstrate that such environmental flows produce the desired hydro-ecological results, allocation of environmental water is also influenced by perceived social values of this water. This research draws on the sub-field of socio-hydrology to track two-way feedbacks between humans and environmental flows and shows why and how social responses to river restoration can be monitored. Media coverage, posted comments and in-person interviews were used to track the responses of stakeholders who 'chased' the progress of the 2014 "pulse flow" down the Colorado River. These data framed in the cultural ecosystem systems typology revealed the temporal patterns and dynamics of dramatic shifts in socio-hydrologic processes and highlight the value of understanding the human wellbeing benefits and complex social values that are affected by freshwater restoration. This experimental and mixed evidence approach is useful for contexts where multiple stakeholders shape water resource management and we suggest it can be used by water decision-makers in their efforts to understand and appropriately respond to the social-ecological dynamics of a changing river system.

Evading invasives: How Eurasian watermilfoil affects the development of lake properties

- Ecological Economics---2016---James S. Goodenberger, Henry Klaiber

Eurasian watermilfoil is an aquatic invasive plant that has spread rapidly through freshwater lakes across the United States. Along with being a hazard to local ecosystems, milfoil is a nuisance to those who use lakes for recreation, and its presence has been shown to lower lakefront property values. This study presents the first evidence of the effects of Eurasian watermilfoil on the probability that undeveloped properties near lakes are developed into single-family housing units. Using a comprehensive dataset from the Twin Cities, Minnesota region, a duration model of land conversion is estimated using data on new home construction from 1990 through 2005. We find that undeveloped parcels of land on and near lakes invaded by Eurasian watermilfoil are less likely to be developed than their counterparts on non-invaded lakes. In counterfactual simulations, we show that absent spread after 1990, total development would increase in 112 of the region's 650 census tracts by an average of 19 houses per tract.

Exploring the role of economic incentives and spillover effects in biodiversity conservation policies in sub-Saharan Africa

- Ecological Economics---2016---Ariane Amin

A vast array of empirical work investigates the issue of biodiversity conservation, but the focus is often limited on the search for possible causes of biodiversity erosion. Biodiversity conservation policymaking is still understudied. In this study, this gap is empirically addressed on a sample of 48 sub-Saharan countries over the 1990–2009 period taking the "Ecoregion protection" score provided by the Center for International Earth Science Information Network (CIESIN) as a measure of biodiversity conservation policies. It is sought whether economic incentives such as biodiversity targeted international transfers as well as tourism revenues have an impact on biodiversity conservation policies.

Moreover, spillover effects are also hypothesized owing to the public good character of biodiversity conservation policies. International financial assistance as well as tourism are found to have an effect on biodiversity conservation policymaking. Our results also evidence complementary spatial spillover effects between biodiversity conservation policies.

The macroeconomic cost of catastrophic pollinator declines

- Ecological Economics---2016---Dana Marie Bauer,Ian Sue Wing

We develop a computable general equilibrium (CGE) approach to assess the macroeconomic impacts of productivity shocks due to catastrophic losses of pollination ecosystem services at global and regional scales. In most regions, producers of pollinator dependent crops end up benefiting because direct output losses are outweighed by increased prices, while non-agricultural sectors experience large adverse indirect impacts, resulting in overall losses whose magnitudes vary substantially. By comparison, partial equilibrium analyses tend to overstate the costs to agricultural producers, understate aggregate economy-wide losses, and overstate the impacts on consumers' welfare. Our results suggest an upper bound on global willingness to pay for agricultural pollination services of \$127–\$152 billion.

Sustainability in a post-Keynesian growth model for an open economy

- Ecological Economics---2016---Giulio Guarini,Gabriel Porcile

The paper expands the BOP-constraint growth model and Kaldorian regimes (productivity and demand regimes) in order to include some of the concerns raised by ecological economics in post-Keynesian models for open economies. The demand regime is modified by taking into account Porter's hypothesis, which suggests that environmental innovations, spurred by environmental policies, can foster competitiveness. As a result, the equilibrium BOP-constrained rate of growth increases, leading to a different version of Thirlwall's

Law, which opens room for analyzing the impact of environmental innovations on convergence between developing and developed economies. The productivity regime in turn considers the growth and employment implications of innovations in labor productivity (standard innovations) and environmental efficiency (environmental innovations). It is argued that the fiscal policy and composition of public expenditure matter for long run growth, employment and sustainability.

Linkage between crop diversity and agro-ecosystem resilience: Nonmonotonic agricultural response under alternate regimes

- Ecological Economics---2016---Kyohei Matsushita,Fumihiro Yamane,Kota Asano

This study investigates the dynamic linkage between crop diversity and agro-ecosystem resilience. The analysis estimates a panel data of rice farming in Japan using a time-varying transition probability Markov switching model, capturing (i) the alternate regimes of agro-ecosystems, (ii) the controlling factors affecting the regime shifts of agro-ecosystems, and (iii) the nonmonotonic response of agricultural production under alternate regimes. Results show that the effect of crop diversity on agro-ecosystem productivity differs depending on its regimes. Crop diversity increases productivity during normal periods, a normal regime, while it decreases the productivity during periods exposed to disturbances such as extreme weather events and disease and insect damage, an adverse regime. Further, we find that crop diversity enhances the agro-ecosystem resilience. Thus, it increases the likelihood of the agro-ecosystem remaining in a normal regime and staving off an adverse regime. The crop diversity loss has gradually increased in agro-ecosystems without sufficient understanding about the linkage between crop diversity and agro-ecosystem resilience. Our findings suggest the possibility that the agro-ecosystem resilience would be a key driver of sustainable agriculture under increasing uncertainties. This study gives useful insights on this issue by empirically demonstrating the effects of crop diversity on the agro-ecosystem resilience.

Scaling up pro-environmental agricultural practice using agglomeration payments: Proof of concept from an agent-based model

- Ecological Economics---2016---Andrew Bell, Gregory Parkhurst, Klaus Doppelmann, Tim G. Benton

Rates of adoption of pro-environmental practices in agriculture in many parts of the world are low. In some cases, this is attributable to the private costs borne by farmers to adopt these practices, often well in advance of any benefits – public or private – that they may bring. Monetary incentives, such as through payments-for-ecosystem services (PES) programs, may be of assistance, and in this study we examine the potential for a recent innovation (the agglomeration payment) to improve adoption of pro-environmental practice in a rural agricultural context. Agglomeration payments include bonus payments for adoption by neighboring farms, which may help to encourage both compliance with the program they promote as well as the overall diffusion of the program across rural contexts. We develop an abstract agent-based model (ABM) of an agglomeration payment program to encourage adoption of the pro-environment practice of conservation agriculture (CA). We find that agglomeration payments have the potential to improve levels of adoption of pro-environmental practice per program dollar, and may help to reduce required spending on project monitoring and enforcement.

Ecological sufficiency, individual liberties, and distributive justice: Implications for policy making

- Ecological Economics---2016---Peter Heindl, Philipp Kanschik

We investigate the prospects of voluntary ecological sufficiency for environmental and climate policy under the constraints implied by political liberalism. We find that freedom of choice restricts sufficiency to rather wealthy societies and that a sufficiency threshold cannot be derived by referring to the poor. Sufficiency can be in conflict with the demands of social justice, i.e. if

the sufficiency threshold is below the social minimum implied by social justice. Benefits from sufficiency are highly related to individual perceptions. Such benefits cannot be expressed in a standard preference framework. Consequently, alternative measures of welfare and inequality are required if sufficiency is a significant phenomenon in society. ‘Standard’ environmental policies can have a pronounced interaction with voluntary sufficiency, i.e. if ‘quantity regulation’ is present. Overall, the voluntary notion of sufficiency causes a dilemma as sufficiency is largely a matter of civil society. However, voluntary sufficiency is expected to make important contributions to the preservation of ecological resources if properly balanced with social and environmental policies and framed by public discursive control.

Floods and happiness: Empirical evidence from Bulgaria

- Ecological Economics---2016---Filka Sekulova, Jeroen van den Bergh

• We conduct an econometric study on the effect of floods on happiness in Bulgaria. • Experiencing floods causes lasting reduction in subjective well-being. • The intensity of the flood seems to matter more than its timing. • Intangible or psychological damages of low-intensity floods can be substantial. • Material damages do not capture the entire impact of extreme events on happiness.

Farmer perceptions of wetlands and waterbodies: Using social metrics as an alternative to ecosystem service valuation

- Ecological Economics---2016---Simon Greenland-Smith, John Brazner, Kate Sherren

The ecosystem goods and services (EGS) model is implicit in many conservation schemes, including agricultural extension programmes with the aim of conserving and protecting wetlands and waterbodies. The design of such programmes requires an understanding of how farmers perceive these features, their associated cost and benefits. Very little research has sought to

do this. Employing unstructured interviews with 18 farmers and using ponds and two wetland types on their Nova Scotia farms as in situ visual prompts, we determine which wetland- and pond-related services are recognized by, and most important to, farmers. We see that wetlands and ponds are not valued equally, and that farmers consider ‘farm ponds’ most valuable in EGS terms. We also see seasonal variation in farmer perceptions and recommend multiple-visit elicitation accordingly to establish robust understanding. We analyse our results in the broader context of EGS literature and make comparisons to economic valuations of similar wetlands and ponds from the TEEB database. The implications of this study for effectively integrating extant EGS frameworks with agricultural extension programmes are discussed. Possibilities for improved wetland and waterbody conservation in the agricultural landscape are presented.

The value of endangered forest elephants to local communities in a transboundary conservation landscape

- Ecological Economics---2016---Jonas Ngouhouo,Jens Abildtrup,Dénis Jean Sonwa,Philippe Delacote

This paper seeks to determine and characterize social and cultural preferences for the conservation of endangered forest elephants (EFEs) in the Congo Basins Tridom Landscape. Using unique data from a stratified, random, face-to-face survey with 1,035 households in 108 villages in 2014, we combine double-bounded dichotomous choice with open-ended elicitation formats to assess the willingness-to-pay (WTP) for EFE conservation. We find that local households are willing to pay CFA 1,139.4 (€1.74) per month to prevent EFE extinction. This totals CFA 753.9 million (€1.15 million) per year for all inhabitants. Indigenusness positively influences the WTP for EFE conservation. Spatial data suggest that local communities prefer that elephants remain far from their crops. The existence of human-elephant conflicts has a neutral effect on preferences for EFE conservation. Therefore, our study suggests that local communities would engage

in biodiversity preservation when the public benefits of conservation are accompanied by private benefits, such as human-elephant conflict avoidance.

Distributive fairness in paying for clean energy infrastructure

- Ecological Economics---2016---Harry Granqvist,David Grover

Despite the rapid rise in public expenditure on clean energy infrastructure, there has been little discussion about what constitutes a fair distribution of this new spending burden. We examine four ethical principles that speak to different notions of fairness in the way this burden can and should be shared, and use them to produce three normative criteria for pursuing fairness in the clean energy fiscal policy context. We use these criteria to examine the extent to which fairness is being achieved in large clean energy roll-out programs in Australia, California and the United Kingdom. Maintaining a close focus on providing practical guidance for decision makers in similar policy contexts, we find that fairness is more achievable when program design explicitly considers which households should pay for the program and which should be exempt; when the idea of proportionality guides the distribution of the cost across paying households, and when the interests of low-income households are protected, by ensuring that they share in the benefits of the program, for example.

Measuring nuclear power plant externalities using life satisfaction data: A spatial analysis for Switzerland

- Ecological Economics---2016---Heinz Welsch,Philipp Biermann

We investigate the relationship between Swiss citizens' life satisfaction (understood as a proxy of utility) and the distance of their place of residence from the nearest nuclear power plant. Using survey data for up to 12,264 Swiss citizens, elicited in February–August 2011, and several specifications of distance, we find a

statistically and economically significant satisfaction-distance gradient. The gradient is smaller for those who may feel protected by wind direction and topographical conditions, and it differs by age, sex, and the level of education. The satisfaction-distance gradient has changed significantly after the nuclear disaster at Fukushima, Japan, indicating a reassessment of distance-dependent nuclear risk due to an information shock.

Forest clearing, livelihood strategies and welfare: Evidence from the Tsimane' in Bolivia

- Ecological Economics---2016---Emilie Perge,Andy McKay

This study analyzes the relationship between forest households' livelihood strategies, and forest clearing, and the relationship of both to welfare. The analysis relies on a rich panel dataset collected on the Tsimane' communities in Bolivia to highlight how forest households combine sales and wage activities. Forest clearing is associated with all livelihood strategies, but the association with welfare differs depending on the strategy pursued. Households that clear more and that generate their earnings by combining agricultural sales and wage activities are better-off (judged in terms of assets) than those undertaking other strategies. By contrast, households in a subsistence strategy are not able to accumulate assets in the long run. Overall, households clear only small areas of forest, which has a positive effect on welfare and enables accumulation of assets.

Public willingness to pay for carbon farming and its co-benefits

- Ecological Economics---2016---Marit Kragt,F.L. Gibson,F. Maseyk,K.A. Wilson

Governments worldwide have implemented climate change mitigation policies that aim to encourage abatement by changing agricultural practices. In Australia, farmers can gain carbon credits for sequestering carbon or reducing emissions. In addition to mitigation, these 'carbon farming' activities often generate ancillary (co-)benefits, such as creating native habitat or

preventing erosion. This paper presents results of an Australia-wide choice experiment, conducted to estimate community values for climate change mitigation and the cobenefits of carbon farming. Values for carbon farming benefits are shown to depend on respondent's opinions about climate change. Respondents who do not believe that climate change is happening have a lower willingness to pay for reducing Australia's greenhouse gas emissions than people who believe climate change is (at least partly) caused by human actions. On average, respondents were willing to pay \$1.13/Mt of CO₂-e reduction. Respondents were willing to pay around \$19/ha increase in the area of native vegetation on farmland. Value estimates for reducing soil erosion were not significant. Our results demonstrate that the community benefits from carbon farming extend beyond their effects on climate change mitigation. Future policies should take these positive values for cobenefits into account.

Evaluating conceptual definitions of ecosystem services and their implications

- Ecological Economics---2016---Brian Danley,Camilla Widmark

"Ecosystem services" is a phrase with many meanings, yet very few studies have primarily focused on comparing different definitions of the term. Ecosystem services are now generally used in identifying an appropriately wide range of environmental variables for policy and management as well as better understanding the benefits provided by those aspects of the environment. A review of the dominant definitions of ecosystem services reveals the term is comprehensive in its scope and requires further specification for most purposes. Analysis further reveals that there are four main categories of conceptual definitions. The paper concludes that ecosystem services can be identified at various points along the spectrum of nature-human interaction depending on which specific definition is chosen and that the term was not created to identify a novel set of environmental objects or processes.

A framework of attitudes towards technology in theory and practice

- Ecological Economics---2016---Christian Kerschner,Melf-Hinrich Ehlers

A trend analysis of Eurobarometer data shows that attitudes towards science and technology are diversifying in the EU, with enthusiasm clearly losing out to more ambivalent stances. In the past any diversion from unquestioned optimism was interpreted as a bad sign and attributed to the public's ignorance. Today it is often welcomed as a sign of an increasingly emancipated public. In the sustainability sciences, including Ecological Economics, attitudes towards technology also cover a wide spectrum, the formalisation and exploration of which are the goals of this paper. Drawing on social and philosophical studies of technology and insights from Ecological Economics and related fields, we develop a framework of attitudes towards technology consisting of four main categories: Enthusiasm, Determinism, Romanticism and Scepticism. We illustrate the empirical relevance of our framework with a qualitative content analysis of Ecological Economics lecture material. The analysis uncovered and mapped a diversity of views, which co-exist without an open debate. It suggests difficulties of scholars to consistently articulate their techno-attitudes, except for enthusiasm. Our framework could help to amplify underlying vocabularies and visions of research and teaching in Ecological Economics and beyond. It could be applied in both deeper qualitative and broader quantitative analysis.

Why are grain-legumes rarely present in cropping systems despite their environmental and nutritional benefits? Analyzing lock-in in the French agrifood system

- Ecological Economics---2016---Marie-Benoit Magrini,Marc Anton,Célia Cholez,Guenaëlle Correhellou,Gérard Duc,Marie-Hélène Jeuffroy,Jean-Marc Meynard,Elise Pelzer,Anne-Sophie Voisin,Stéphane Walrand

Grain-legume plants fix atmospheric nitrogen in the

soil and thus do not need nitrogen fertilizers. Therefore, grain-legumes can potentially decrease global warming, as nitrogen fertilization is responsible for half of all agricultural greenhouse gas emissions. Moreover, grain-legumes have many functional and nutritional properties both as feed and food. Despite the fact that the European Union has granted considerable subsidies to promote grain-legume cultivation, their production continues to fall and there has been no satisfactory explanation as to why. This study provides an answer by showing that a situation of technological lock-in has resulted from the co-evolution of crop systems, based on an agrochemical paradigm, public policies, and market dynamics that promote cereals. This process began with the historical choice by European and French public institutions to relegate grain-legumes to feed in direct competition with imported soybeans. Moreover, interrelated factors, such as breeding selection, public subsidies, and food systems, have favored increasing returns to adoption for cereals to the detriment of grain-legumes. Finally, the evolutionary economics approach used here identified several actions that must be implemented together, such as agricultural cost-accounting methods, nitrogen management, institutional innovations, and market outlets to promote grain-legumes and move towards more sustainable agriculture.

Ecological monetary economics: A post-Keynesian critique

- Ecological Economics---2016---Louison Cahen-Fourot,Marc Lavoie

The monetary analysis of some ecological economists currently appears to be mostly articulated around the following core: a stationary economy (and a fortiori a degrowth economy) is incompatible with a system in which money is created as interest-bearing debt. To question the relevance of the debt-money/positive interest rate/output growth nexus, this paper adopts a critical stance towards the currently emerging ecological monetary economics from the standpoint of another strand of heterodox economics – the post-Keynesian approach. In its current state, ecological monetary economics is at odds with post-Keynesian economics in its

analysis of the money–growth relationship. This will be shown using the theory of endogenous money and a simple Cambridgian–Kaleckian model where debt-money and a positive interest rate are compatible with a full stationary economy.

Tracing the impacts of a northern open economy on the global environment

- Ecological Economics---2016---Eneko Garmendia, Leire Urkidi, Iñaki Arto, Iñaki Barcena, Roberto Bermejo, David Hoyos, Rosa Lago

The globalization of the world economy has increased resource flows around the planet, raising pressures on the environment. Historically, northern industrialized economies have been responsible for the majority of resource consumption, while developing countries have suffered the associated social and environmental impacts. This article analyzes the extra-territorial responsibility of the Basque economy (Europe), to illustrate the responsibility of northern open economies towards the global environment. To do this, we: (i) analyze the material and energy flows of the Basque economy, their source and impacts on other regions of the world, (ii) study the impact of the economic and investment activities of Basque companies abroad, and (iii) examine, together with other paradigmatic examples, three case studies from Latin-America, East Africa and Southeast Asia that represent the liabilities of northern economies in the Global South. This approach allows us to connect production and consumption processes in affluent countries with associated socio-ecological impacts in the extraction frontiers in order to better understand and potentially transform current economic patterns and their consequences. In addition, the study indicates how to bridge the gap between local and global scales, creating a useful approach to raising social awareness and informing public policies in resource intensive societies.

Degrowth: A “missile word” that backfires?

- Ecological Economics---2016---Stefan Drews, Miklós Antal

Language use and cognition are generally underappreciated topics in ecological economics, even if effective communication is essential for social and political impact. To challenge the economic growth paradigm, the concept and term “degrowth” has recently been embraced by various activists and scholars. Drawing on a body of evidence from cognitive science, psychology, and related fields, we argue that using the word degrowth might be disadvantageous in public communications about alternatives to growth. We begin by reviewing arguments in favor of the term. Then we outline three main counterarguments: First, degrowth has a downward orientation which triggers negative initial feelings due to the basic conceptual metaphor “up is good—down is bad”. This puts advocates of an alternative to the growth paradigm in an unfavorable starting position, given that subsequent thought will be unconsciously biased by the initial feeling. Second, more conscious reactions are likely to be negative as well because people unfamiliar with the term will (mis)interpret it as a contraction of the economy, even though it is not always meant as such. Third, degrowth repeats and possibly strengthens the growth frame and may activate undesirable frames associated with economic recessions. To conclude, we briefly discuss alternative terms and summarize key aspects to be considered for more effective communication.

Incentivising flood risk adaptation through risk based insurance premiums: Trade-offs between affordability and risk reduction

- Ecological Economics---2016---Paul Hudson, Wouter Botzen, Luc Feyen, Jeroen C.J.H. Aerts

The financial incentives offered by the risk-based pricing of insurance can stimulate policyholder adaptation to flood risk while potentially conflicting with affordability. We examine the trade-off between risk reduction and affordability in a model of public–private flood insurance in France and Germany estimating household flood adaptation decisions in response to financial insurance incentives. An integrated model of household level mitigation behaviour and insurance premiums is

developed. The model investigates how aggregated household adaptation behaviour differs under financial incentives as compared to when households act on their own subjective risk beliefs. The results indicate that insurance based incentives are able to promote adaptation. The incentives could reduce residential flood risk by 12% in Germany and 24% in France by 2040. The higher level of flood risk in France results in a strong present incentive to reduce risk. Rapid growth of flood risks in Germany results in more effective incentives in later periods. Insurance is unaffordable for approximately 20% of households at risk. Providing vouchers, to correct for unaffordability, after 2040 has a lower cost than the total incentivised damage reduction. A policy recommendation is that strengthening the link between flood insurance and financial incentives can guide household level adaptation.

Carbon dioxide emissions and international trade at the turn of the millennium

- Ecological Economics---2016---Octavio Fernández-Amador,Joseph Francois,Patrick Tomberger

We present a new dataset of geographical production-, final (embodied) production-, and consumption-based carbon dioxide emission inventories, covering 78 regions and 55 sectors from 1997 to 2011. We extend previous work both in terms of time span and in bridging from geographical to embodied production and, ultimately, to consumption. We analyse the recent evolution of emissions, the development of carbon efficiency of the global economy, and the role of international trade. As the distribution of responsibility for emissions across countries is key to the adoption and implementation of international environmental agreements and regulations, the final production- and consumption-based inventories developed here provide a valuable extension to more traditional geographical production-based criteria.

How to significantly reduce pesticide use: An empirical evaluation of the impacts of pesticide taxation associated with a change in cropping practice

- Ecological Economics---2016---Fabienne Femenia,Elodie Letort

2016

Theory of planned behavior approach to understand the green purchasing behavior in the EU: A cross-cultural study

- Ecological Economics---2016---Genovaitė Liobikienė,Justina Mandravickaitė,Jurga Bernatienė

Due to the fast growth of consumption, the promotion of purchasing green products could be a way to minimize the environmental impact and achieve the sustainable consumption. Considering that there is a lack of studies about green purchase behavior and its determinants in all European Union countries (EU), the aim of this paper is to evaluate the main determinants of green purchase behavior by applying the Theory of Planned Behavior. Referring to Hostefe's cultural dimensions we revealed how cultural aspects contribute to purchase behavior. The results showed that there were observed big differences in terms of green purchase behavior in the EU countries and it did not depend on economic development significantly. The subjective norms and interaction of knowledge and confidence in green products significantly determined the green purchase behavior in all countries. According to the cross-culture studies, all cultural dimensions did not have significant influence on green purchase behavior. However, cultural dimensions are related to factors which directly influence green purchase behavior. Therefore, due to the process of the EU cultural convergence and economic crisis, it could have indirect impact on green purchase behavior. These findings have important implication for marketers and policy makers.

Carbon dioxide emissions allocation: A review

- Ecological Economics---2016---P. Zhou,M. Wang

Carbon dioxide (CO₂) emissions allocation plays a fundamental role in determining reduction responsibility at economy level or emission permits at firm level. Past decades have seen the development and applications of various methods for CO₂ emissions allocation. This paper provides a literature review of CO₂ emissions allocation with emphasis on the evolution of allocation methods used. It begins with a summary of the most popular allocation principles and criteria that lay a foundation for the development of allocation methods. We then classify the existing allocation methods into four groups, namely indicator, optimization, game theoretic and hybrid approaches. The main features and findings of past studies are identified and summarized. While the fairness principle prevails in earlier studies, the efficiency principle has been found to receive increasing attention recently. We also present a comparison of the empirical results based on ten popular indicator methods to show how indicator choice affects the allocation results. Issues related to selecting appropriate methods in CO₂ emissions allocation are finally discussed. Further research may be carried out to strike a balance between fairness and efficiency so that the allocation results become more widely acceptable and economically feasible.

The foundations of the environmental rebound effect and its contribution towards a general framework

- Ecological Economics---2016---David Font Vivanco,Will McDowall,Jaume Freire-González,Rene Kemp,Ester van der Voet,Jaume Freire-González

The study of the so-called rebound effect has traditionally pertained to the domain of neoclassical energy economics. In recent years, other disciplines have applied this concept in the context of the environmental assessment of products and policies, and multiple perspectives have unfolded more or less in parallel. Among

these, the environmental rebound effect (ERE) perspective, focused on efficiency changes and indicators that go beyond energy to multiple environmental issues, has remained relatively unnoticed. This article thus asks the following questions: What are the foundational aspects of the ERE and how these relate to other perspectives? Are there irreconcilable differences between perspectives? And what is the value of the ERE towards a general framework? We map the fundamental ideas behind the ERE and find that the lack of articulation has resulted in inconsistent usage and lack of clarity. We also argue that the ERE offers many valuable insights for rebound assessment, such as the study of broader efficiency changes and of innovations aimed at tackling multiple environmental issues. Perhaps most importantly, the ERE helps bringing together the existing rebound perspectives, as its application shows that it is both possible and valuable to articulate broader definitions for the rebound effect.

Status concern and the exploitation of common pool renewable resources

- Ecological Economics---2016---Hassan Benchekroun,Ngo Long

We examine the impact of social status concern in a common pool renewable resource oligopoly. A small number of players share access to a common pool resource and sell their production in a common market where they are oligopolists. We depart from the mainstream literature on common pool resource oligopolies by considering that each player cares about her social status. We allow for two channels to impact a player's welfare: harvest and profits. Under the first channel, a player has a bump in her utility when her harvest is larger than the average harvest of the rest of the players. In this case we show that the presence of this channel exacerbates the tragedy of the commons. Under the second channel, a player enjoys a bump in her utility if she manages to earn more profits than the average profits of the other players. In this case we show that social status concern may temporarily alleviate the tragedy of the commons: it results in a decrease of extraction over an interval of stock sizes.

The urban political ecology of ecosystem services: The case of Barcelona

- Ecological Economics---2016---Yaella Depietri, Giorgos Kallis, Francesc Baró, Claudio Cattaneo

This paper advances two arguments. First, the liveability of modern cities depends to a large extent upon urban and peri-urban ecosystems and their services. Second, these services are not only a gift of nature, but co-produced by human labour. Ecosystem services, in other words, are not just natural; they are also the outcome of historical, political, economic and social endeavours. We support our case with a study of the city of Barcelona and the adjacent Collserola Natural Park. Through an inter-disciplinary project combining biophysical, historical, and archival research, interviews and activist research we show that, first, the liveability of Barcelona highly improves because of the services provided by the ecosystem of Collserola. Second, that Collserola was not originally a pristine forest; it became one after agricultural abandonment institutional interventions and the action of social movements. If ecosystem services are co-produced by human action, and social struggles, as we argue is the case of Collserola, then this has implications for the ways ecological economists think about ecosystem services, their value and valuation. Whereas the social production of ecosystem services may seem an obvious and intuitive idea, it certainly challenges the foundational aspects of monetary valuation.

Serving the public good: Empirical links between governance and research investment in the context of global environmental change

- Ecological Economics---2016---Lorrae van Kerkhoff, Helen Berry
- Addressing global environmental change needs science and governance to work together. • Global R&D investment and governance measures indicate the strength of that capacity. • Governance and R&D investment are directly associated over and above income

levels. • Relationships between governance and R&D are more complex in lower-income countries.

Environmental concerns, volunteering and subjective well-being: Antecedents and outcomes of environmental activism in Germany

- Ecological Economics---2016---Martin Binder, Ann-Kathrin Blankenberg

Do perceptions about the state of the environment impact on individuals' well-being and do they lead to environmental activism? While the impact of objective features of the environment (e.g., pollution, parks) is well-researched, the present paper fills a research gap by analyzing how concerns about the environment impact on subjective well-being. Based on German panel data (SOEP) for the years 1984–2012, we show that egoistic concerns have a negative impact on subjective well-being while altruistic concerns are positively associated with well-being, an effect likely driven by omitting variables for environmental activism such as volunteer work. We show that environmental concerns also lead to an increased propensity to volunteer and such volunteering is positively associated with well-being, but only for those who are very concerned about the environment.

Drivers of industrial and non-industrial greenhouse gas emissions

- Ecological Economics---2016---Luis F. Sanchez, David Stern

Though there has been extensive analysis of the drivers of aggregate carbon dioxide emissions from fossil fuel combustion and cement production, there has been much less analysis of the drivers of greenhouse gases in general and especially of aggregate emissions of greenhouse gases from agriculture, forestry, and other land uses, which we call non-industrial emissions in this paper. We statistically analyze the relationship between both industrial and non-industrial greenhouse gas emissions and economic growth and other potential drivers for 129 countries over the period from 1971 to 2010. Our analysis combines the three main approaches in

the literature into a single framework for investigating the evolution of emissions and income. We find that economic growth is a driver of both industrial and non-industrial emissions, though economic growth has twice the effect on industrial emissions. The time effect is negative for both sources of emissions, though this effect is larger for non-industrial emissions. There is also convergence in emissions intensity for both types of emissions but given these other effects there is no evidence for an environmental Kuznets curve.

Energy metabolism of the Balearic Islands (1986–2012)

- Ecological Economics---2016---Francisco Javier Ginard-Bosch, Jesus Ramos-Martin

Researchers from multiple disciplines point to the link between fossil fuel consumption and socio-ecological deterioration. Studying the energy metabolism of the Balearic Islands (1986–2012) gives insights on the ecological, economic and social consequences of regional specialization in mass tourism. The methodology applied, Multi-Scale Integrated Analysis of Societal and Ecosystem Metabolism (MuSIASEM), has been developed in the last decades to analyze societal metabolism from the perspective of complex systems. This study has allowed us to see that since the entry of Spain in the European Economic Community in 1986, the real-state/tourism business model has been reinforced giving place to a higher level of consumption of fossil fuels, an increase in work instability and a diminishing of labor productivity.

Buying spatially-coordinated ecosystem services: An experiment on the role of auction format and communication

- Ecological Economics---2016---Michal Krawczyk, Anna Bartczak, Nick Hanley, Anne Stenger

Procurement auctions are one of several policy tools available to incentivise the provision of ecosystem services and biodiversity conservation. Successful biodiversity conservation often requires a landscape-scale

approach and the spatial coordination of participation, for example in the creation of wildlife corridors. In this paper, we use a laboratory experiment to explore two features of procurement auctions in a forest landscape: the pricing mechanism (uniform vs. discriminatory) and availability of communication (chat) between potential sellers. We modify the experimental design developed by Reeson et al. (2011) by introducing uncertainty (and hence heterogeneity) in the production value of forest sites as well as an automated, endogenous stopping rule. We find that discriminatory pricing yields to greater environmental benefits per government dollar spent, chiefly because it is easier to construct long corridors. Chat also facilitates such coordination but also seems to encourage collusion in sustaining high prices for the most environmentally attractive plots. These two effects offset each other, making chat neutral from the viewpoint of maximizing environmental effect per dollar spent.

Work more and play less? Time use impacts of changing ecosystem services: The case of the invasive emerald ash borer

- Ecological Economics---2016---Benjamin Jones

Invasive alien species may have indirect impacts on human behavior through disruption of ecosystem services. Individuals in infested areas may optimally reallocate how they spend their time in response to degradations in environmental quality, for example, by altering their outdoor interactions with nature or levels of community engagement. Limited qualitative evidence is suggestive that indirect impacts of invasive species on behavior and time use may be substantial, though causally-consistent empirical evidence on the sign and magnitude of such impacts is lacking. To address this gap, this study exploits a natural experiment provided by exogenous variation in ash tree (*Fraxinus* spp.) coverage produced by the invasive emerald ash borer (*Agrilus planipennis*) to investigate changes in time use patterns across infested US counties over 2003–2013. Focusing on the labor–leisure decision, results indicate a negative and persistent relationship between emerald ash borer detection and daily out-

door leisure time as well as a positive and persistent relationship between detection and daily time spent on labor market activities. Results highlight a previously unexplored dimension of impacts created by invasive species induced ecological shocks.

Urban green space recreational service assessment and management: A conceptual model based on the service generation process

- Ecological Economics---2016---Jialin He,Hongmei Yi,Jian Liu

The current understanding of urban green space (UGS) recreational service is limited due to the lack of being examined under the logic that underlies the ecosystem service paradigm, leading to limitations in the application of ecosystem based management in urban land use planning. This paper offers a conceptual model of UGS recreational service that follows the logical flow of ecosystem service generation, supplementing the knowledge gap and supporting the use of ecosystem base management in urban land use planning. The model includes four categories; UGS features, population characteristics, recreational use behavior, and recreational benefits while considering the use behavior as the service carrier. A process analysis shows the role of each model component in generating the services, and highlights the important role of regulating service potentials and their mobilization. Ways of informing interventions for improving efficiency or equity have been suggested. Efficiency can be assessed by applying the dose-response mechanism in the model. Equity on the other hand, can be measured by exploring which predictors of use are dominant, which advances UGS access assessment by shifting from the spatial-based to the use-based. Survey design techniques and indicators measuring various variables of the model have also been proposed.

Economic viability and small-scale fisheries — A review

- Ecological Economics---2016---Anna Schuhbauer,Ussif Sumaila

Globally, over 90% of all fishing vessels and about 22 million fishers are considered small-scale. Despite their high numbers, small-scale fisheries are often understudied. They are usually economically and politically marginalized, and therefore vulnerable to large-scale threats (e.g., globalized markets). To support this sector and contribute to its sustainability, we argue that it is fundamental to understand how economically viable small-scale fisheries are. Hence, the main objective of this article is to critically review and describe the current discourse on the economic viability of small-scale fisheries. We find that currently, economic viability is mainly equated with financial viability, where profitability is the goal. In consideration of socio-economic aspects, the maintenance of nonnegative net benefits to society is often not considered in current notions of economic viability. While these shortcomings have been acknowledged in some of the existing literature, our review shows that they have not yet been addressed comprehensively. We therefore conclude that it is necessary to develop or expand current methods to better take into account social aspects when assessing the economic viability of small-scale fisheries. This would help find solutions to make these fisheries less vulnerable and better equipped to face large-scale processes of change.

The metabolic transition of a planned economy: Material flows in the USSR and the Russian Federation 1900 to 2010

- Ecological Economics---2016---Fridolin Krausmann,Birgit Gaugl,James West,Heinz Schandl

The study of long-term historical trends in material flows has gained some prominence in Ecological Economics since the first studies for Austria and the United Kingdom were published as part of a special section in 2002. This research expands the existing knowledgebase by presenting material flows for the Russian Federation and its predecessor states employing a standard accounting framework. The study of material flows for the Russian Federation provides an interesting and unique case of a planned economy and its transition to a market based form of economic or-

ganization. We show that in spite of considerable differences in the physical economy, the USSR developed material use patterns similar to that of Western industrialized economies. Lower levels of consumption were more than outweighed by inefficient production. The transition towards a market economy drove rapid improvements in resource productivity but also growth in metabolic rates. The results indicate that the transition to an industrial metabolic profile proceeds largely irrespective of economic and political conditions. An improved understanding of the evolution of socio-economic systems and the material flows that fuel them is increasingly relevant for designing new systems of production and consumption and facilitating a transition towards a more sustainable industrial metabolism.

More than wine: Cultural ecosystem services in vineyard landscapes in England and California

- Ecological Economics---2016---Klara J. Winkler, Kimberly A. Nicholas

Vineyard landscapes provide cultural ecosystem services (CES), which have been little studied in previous ecosystem services research. To fill this gap, we assess perspectives of wine producers and residents regarding CES provided by vineyards in two wine regions: Southeast England, an emerging wine area, and the counties of Sonoma and Napa, California (hereafter: Sonoma and Napa), a more traditional wine area. We used Q-methodology to reveal the perspectives expressed by participants from both areas, each of whom ranked 44 Q-statements. We found that wine producers and local residents have different perceptions. In Southeast England, wine producers are more positive about vineyard landscapes than residents. Wine producers in Sonoma and Napa value CES directly connected with wine production, while residents emphasize CES that benefit nature conservation or entertainment. Comparing the regions, we conclude that Southeast England vineyards represent sometimes unwelcome development to residents, while in Sonoma and Napa they represent conservation of nature and tradition. Our findings show that perspectives on CES are experience- and

context-dependent, as the perspectives on vineyards of residents and wine producers are strongly held but vary widely. Understanding these perspectives will help land use planners and regional politicians make better decisions for optimizing available CES.

Does hurricane risk affect individual well-being? Empirical evidence on the indirect effects of natural disasters

- Ecological Economics---2016---Michael Berlemann

While natural disasters might have numerous direct (typically negative) effects, the effect of an increase of natural disaster risk on individual well-being is often neglected. In this paper we study the effects of natural disaster risk on self-reported happiness and life satisfaction at the example of tropical storms. Combining several waves of the integrated European/World Values Survey and appropriate storm data we find a systematically negative effect of hurricane risk on both measures of individual well-being in relatively poor countries in which the population has little possibilities to take protective measures against storms. In highly developed countries, we find a systematic negative and much smaller effect only for life satisfaction. Altogether we conclude that disaster risk tends to play a role for individual well-being, especially on low levels of development.

Measuring environmental inequality

- Ecological Economics---2016---James K. Boyce, Klara Zwickl, Michael Ash

This study presents alternative measures of environmental inequality in the 50 U.S. states for exposure to industrial air pollution. We examine three methodological issues. First, to what extent are environmental inequality measures sensitive to spatial scale and population weighting? Second, how do sensitivities to different segments of the overall distribution affect rankings by these measures? Third, how do vertical and horizontal (inter-group) inequality measures relate to each other? We find substantive differences in rankings by different measures and conclude that no single

indicator is sufficient for addressing the entire range of equity concerns that are relevant to environmental policy; instead multiple measures are needed.

A rural myth? Sources and implications of the perceived unfairness of carbon taxes in rural communities

- Ecological Economics---2016---Marisa Beck,Nicholas Rivers,Hidemichi Yonezawa

Since British Columbia's carbon tax was implemented in 2008, local interest groups and municipal politicians have claimed that the tax places an unfair burden on rural communities. We investigate the sources of this perception of unfairness and its implications for policymaking. We examine the distributive effects of British Columbia's carbon tax using a computable general equilibrium model of the Canadian economy. We find that the rural population would indeed have experienced a disproportionate burden had the carbon tax been introduced without redistributive measures, but that the revenue recycling program introduced in parallel with the tax was sufficient to balance the inequity. Hence, the Northern and Rural Homeowner Benefit Program, a transfer program introduced later in response to public protests, was unnecessary. Additionally, analysis of polling data shows that the new program failed to increase support for the carbon tax in rural communities, despite making these households better off on average than households in large urban centers. We therefore conclude that this ongoing opposition is based on a rural myth. Policymakers should carefully investigate distributive impacts of carbon policies and address evidential inequities. Yet, before overcompensating groups that still feel disadvantaged, policymakers should address the myth of unfairness at its source.

Hurricane damage risk assessment in the Caribbean: An analysis using synthetic hurricane events and nightlight imagery

- Ecological Economics---2016---Luisito Bertinelli,Preeya Mohan,Eric Strobl

History has shown that hurricanes can cause catastrophic destruction and impede economic growth in the Caribbean. Nevertheless, there is essentially as of date no comprehensive quantitative risk and anticipated loss assessment for the region. In this paper we use synthetic hurricane tracks and local income proxies to estimate expected risk and losses if a climate similar to the last 30years prevails. We show that on average, the annual fraction of expected property damage and subsequent impacts on income are nonnegligible, with large variations across islands.

The accounting push and the policy pull: balancing environment and economic decisions

- Ecological Economics---2016---Michael Var-don,Peter Burnett,Stephen Dovers

The use of information in environmental and economic policy has been a theme for over 100years but standards for integrating environmental and economic information were not adopted until 2012, through the System of Environmental-Economic Accounting (SEEA). For 20years the technical 'push' to develop accounts proceeded largely independently of the 'pull' from the intended or likely end-users of accounts. Consequently governments have little knowledge of the accounting or how it might be used. We examine why public policy imperatives have not yet pulled environmental accounting into the mainstream and explain how accounting can help reshape government decision-making. As part of this a model showing the place of accounts in the information system and the policy cycle is presented along with a research agenda and principles for the decision-centred design of accounts. We conclude that a phased implementation of the accounts as well as additional research into their applications will be needed to build practical understanding and political acceptance of the accounts.

Institutional adaptation to cooling water scarcity for thermoelectric power generation under global warming

- Ecological Economics---2016---Klaus Eisenack

This article studies adaptation of institutional arrangements for water regulation to climate change. Power plants occasionally need to curtail production during heat waves, causing economic losses and putting power quality at risk. To avoid exacerbation of this problem due to climate change, the regulation of heat emissions from power plants may require adaptation. The analysis abstracts a mathematical model from a case study of the German Rhine catchment. The model compares three options for regulation with an analysis of transaction costs, and balances them with costs from environmental externalities. First, long-term and site-specific temperature caps lead to the comparatively lowest sum of social transaction and production costs if heat waves only increase in intensity. Second, a dynamic heat load plan performs better if heat waves only increase in frequency. Third, if both intensity and frequency of heat waves increase substantially, a specific contract between the environmental regulator and electricity producers (the minimum power plant concept) performs comparatively best. The article highlights economies of scale in transaction costs, and shows how institutional adaptation can depend on the speed of climate change.

The economic value of wetlands in developing countries: A meta-regression analysis

- Ecological Economics---2016---Mayula Chaikumbung,Chris Doucouliagos,Helen Scarborough

This paper presents the first comprehensive synthesis of economic valuations of wetlands in developing countries. Meta-regression analysis (MRA) is applied to 1432 estimates of the economic value of 379 distinct wetlands from 50 countries. We find that wetlands are a normal good, wetland size has a negative effect on wetland values, and urban wetlands and marine wetlands are more valuable than other wetlands. Wetland values estimated by stated preferences are lower than those estimated by market price methods. The MRA benefit transfer function has a median transfer error of 17%. Overall, MRA appears to be useful for deriving the economic value of wetlands at policy sites in developing nations.

Political competition and renewable energy transitions over long time horizons: A dynamic approach

- Ecological Economics---2016---Marion Du-mas,James Rising,Johannes Urpelainen

Climate change mitigation requires sustainable energy transitions, but their political dynamics are poorly understood. This article presents a general dynamic model of renewable energy policy with long time horizons, endogenous electoral competition, and technological path dependence. We calibrate the model with data on the economics of contemporary renewable energy technologies. In doing so, we discover transition dynamics not present in economy-energy models, which ignore politics, or in formal political economy models, which ignore long-term technological dynamics. We show that the largest effects of partisan ideology on policy occur when the competing parties disagree on the importance of energy policy. In these cases, the less ideological party appeases the more ideological one, while the more ideological party attempts to appease the electorate. The results demonstrate that political dynamics could have large effects on the development of renewable energy and carbon dioxide emissions over time, influencing the ability of countries to reach various climate mitigation trajectories.

The inclusive wealth index. A critical appraisal

- Ecological Economics---2016---Philippe Roman,G r aldine Thiry

Among recent high-profile propositions to revise national accounts and to provide new indicators of sustainability and well-being, the inclusive wealth framework and the related inclusive wealth index (IWI) undoubtedly stand out as one of the most promising endeavours. Built up at the confluence of welfare, development and sustainability economics, the indicator has been designed to bring information about the wealth of nations and their sustainability, in a comprehensive way. The inclusive wealth framework is nevertheless fraught with limitations, due to questionable theoretical assumptions, gaps in data availability, unrealistic

assumptions about the future and inability to account for distributional issues. We propose a non-exhaustive critical appraisal of the index and its underlying framework. We conclude that these limitations undermine its capacity to fulfil the requirements of a satisfactory sustainability indicator. We argue that most problems lie in the substantial discrepancy between the inclusive ambition of the indicator and the scarce means to implement it. Whereas the interconnectedness of the various assets that constitute wealth as well as their complex evolution through time are acknowledged by the proponents of inclusive wealth, the way the IWI is computed is rather a mere addition of layers of actuarial-like monetary values for a (not inclusive yet) range of capital assets. Caution is thus warranted while using such an approach, and shorter-range alternatives to pursue similar goals are proposed.

Shifting demand for winter outdoor recreation along the North Shore of Lake Superior under variable rates of climate change: A finite-mixture modeling approach

- Ecological Economics---2016---Jordan W. Smith, Erin Seekamp, Allie McCreary, Mae Davenport, Mark Kanazawa, Kerry Holmberg, Bruce Wilson, John Nieber

Many communities located in natural resource rich landscapes have transitioned to tourism-based economies. This transition might not be sustainable, as climate and environmental change have unknown effects on the visitation patterns of outdoor recreationists and tourists. We address this uncertainty by estimating shifts in the demand for outdoor recreation destinations along Minnesota's North Shore region of Lake Superior under a range of projected climatic and environmental conditions. We also employ a finite-mixture modeling approach to capture the preference heterogeneity across North Shore visitors. Our findings indicate projected climate and environmental changes are not likely to significantly affect visitation patterns in the next 20 years. However, utilizing a finite-mixture modeling approach enabled us to identify distinct types of visitors with divergent visitation behaviors under

altered climate and environmental conditions. Our findings suggest that the demand for outdoor recreation along the North Shore will be relatively stable in the near future, however different types of visitors will respond to warming winter conditions in divergent ways. Shifting visitation patterns under climate and environmental change may have more drastic alterations to the economic well-being of the region under a longer planning horizon.

Potential and economic efficiency of using reduced tillage to mitigate climate effects in Danish agriculture

- Ecological Economics---2016---Marianne Zandersen, Sisse Liv Jørgensen, Doan Nainggolan, Steen Gyldenkerne, Anne Winding, Mogens Humlekrog Greve, Mette Termansen

Soil organic carbon (SOC)¹¹ SOC: Soil Organic Carbon. plays a crucial role in regulating the global carbon cycle and its feedbacks within the Earth system. Compelling evidence exists that soil carbon stocks have reduced in many regions of the world, with these reductions often associated with agriculture. In a Danish context, research also suggests that soil carbon stocks are declining. The scope of Payment for Ecosystem Service (PES) approaches to effectively and efficiently address climate regulation will depend on the spatial distribution of the carbon assimilation capacity, current land use, the value of avoided emissions and land owners' objectives and preferences in terms of participating in initiatives to increase SOC. We map the carbon sequestration potential under different scenarios, value the potential sequestered carbon in terms of marginal costs of using voluntary agreements with agricultural land managers and compare these to the marginal abatement costs curve used in Danish climate policy. The cost effectiveness of reduced tillage as a climate mitigation PES scheme critically depends on the current debate on the net effects of carbon sequestration in reduced tillage practices. Based on existing IPCC guidelines, we find that reduced tillage has considerable potential for contributing to a cost effective climate mitigation policy.

Basic capability effect: Collective management of pastoral resources in southwestern Kenya

- Ecological Economics---2016---Evelyn Nyathira Kihiu

Collective action, such as common resource user groups, has gained importance in the management of pastoral natural resources. This study aims at analyzing the effects of basic capabilities, among other factors, on households' decisions to participate in collective management of pastoral resources in Narok County, Kenya. A zero-inflated beta model, in addition to alternative econometric model specifications, is applied on cross-sectional data collected through a household survey. The results confirm the key role of the capability concept in explaining the management of natural resources. Increased basic capabilities, that is, the ability to achieve some minimally acceptable levels of functioning reduce cooperation levels in collective management of pastoral resources. Social capital, neighborhood social influences, resource system characteristics, socioeconomic factors and institutional factors also emerge as key determinants of collective management of pastoral resources. Policy implications drawn by this study encourage strategies to build social capital and facilitate adoption of improved range management technologies where communal management of land is likely to be abandoned for exclusive property rights.

Spatial impacts of the CAP post-2013 and climate change scenarios on agricultural intensification and environment in Austria

- Ecological Economics---2016---Mathias Kirchner, Martin Schönhart, Erwin Schmid

We assess impacts of the latest CAP reform and regional climate change scenarios on agricultural land use intensification and environment in Austria for the period 2025–2040. A spatially explicit integrated assessment based on sequentially coupled models quantifies the impacts at a 1km grid resolution in order to take into account the heterogeneity of agricultural production and environment. The CAP post-2013 will lead to a shift in direct payments from cropland to grassland

dominated production regions as well as to a slight decrease in regional producer surpluses in Austria. The economic impact of climate change scenarios depends on the spatial location and the precipitation scenario. The CAP post-2013 will lead to intensification of agricultural land use in favorable cropland and grassland regions as well as to extensification in marginal areas. Regional climate change amplifies land use intensification with increases in crop and forage yields, e.g. in Alpine regions, and land use extensification with declining crop yields, e.g. in eastern cropland regions. Environmental indicators deteriorate at national level in all scenarios. Spatially highly diverging impacts call for more targeted policy measures.

Exploring group dynamics in deliberative choice experiments

- Ecological Economics---2016---Marc Völker, Nele Lienhoop

Deliberative monetary valuation has emerged as a promising alternative to conventional stated preference studies of ecosystem services. It promises to give respondents a better basis for decision-making by exposing them to a more diverse set of knowledge, arguments and opinions through group discussion. However, under certain conditions, small groups may fail to effectively pool the individual knowledge of their members. This paper examines the impact of the initial distribution of individual preferences in discussion groups on the outcome of deliberative choice experiments. Drawing on a deliberative monetary valuation study of forest ecosystem services in West Saxony, Germany, it is shown that the initial preference distribution in groups influences both the diversity of arguments exchanged during group discussions and respondents' consideration of the costs of environmental policies. Furthermore, results indicate that respondents' post-discussion willingness-to-pay is affected by the initial preference distribution in groups, though these changes were not statistically significant. The choice certainty of respondents was found to remain largely unaffected. Overall, the empirical findings of this study provide preliminary evidence about the need to conduct future deliberative mone-

tary valuation studies with groups with heterogeneous initial preferences as this may provide respondents with a more complete set of decision-relevant information.

Influential publications in ecological economics revisited

- Ecological Economics---2016---Robert Costanza,Richard B. Howarth,Ida Kubiszewski,Shuang Liu,Chunbo Ma,Gaël Plume-cocq,David Stern

We revisit the analysis of Costanza et al. (2004, Ecological Economics) of influential publications in ecological economics to discover what has changed a decade on. We examine which sources have been influential on the field of ecological economics in the past decade, which articles in the journal Ecological Economics have had the most influence on the field and on the rest of science, and on which areas of science the journal is having the most influence. We find that the field has matured over this period, with articles published in the journal having a greater influence than before, an increase in citation links to environmental studies journals, a reduction in citation links to mainstream economics journals, and possibly a shift in themes to a more applied and empirical direction.

Mining corporations and air pollution science before the Age of Ecology

- Ecological Economics---2016---Juan Diego Pérez Cebada

Smelter smoke was the origin of great social conflicts from the 19th century. Institutions, mining companies, and affected groups hired scientists to back their arguments in these disputes. The main objective of the experts was to determine the influence of dust, fumes and especially gases, such as sulfur dioxide, on health and vegetation.

Complementarity vs substitutability in waste management behaviors

- Ecological Economics---2016---Alessio D'Amato,Susanna Mancinelli,Mariangela

Zoli

Both the economic and psychological literature suggest that household waste reduction and recycling behaviors are driven by different motivators. In this article, we investigate whether any relationship exists between waste reduction and recycling efforts and, in this case, if they turn out to be complements or substitutes in individuals' preferences. Our theoretical results, supported by empirical evidence for England, suggest that waste policies and environmental motivations may affect recycling and waste reduction both directly and indirectly, through their reciprocal interactions.

Optimal forest species mixture with carbon storage and albedo effect for climate change mitigation

- Ecological Economics---2016---Brent D. Matthies,Lauri T. Valsta

Accounting for carbon storage and the albedo effect through Payments for Ecosystem Services (PES) or mandatory offset permits aims to internalize the environmental externalities of forest management. This can shift the economically optimal rotation age, and incorporate rents for a wider range of ecosystem service offerings. A mixed stand economic optimization model was used to determine the optimal stand mixture and inter-species climate regulation trade-offs. Mixed forest dynamics between deciduous silver birch (*Betula pendula* Roth.) and coniferous Norway spruce (*Picea abies* Karst.) were evaluated. The sensitivity of our results to the absolute species-specific differences in albedo parameter values was also conducted. Results indicated that a synergistic climate regulation trade-off between the two species exists. The optimal rotation for the combined carbon storage and albedo effect was equivalent to that of the carbon storage only case. Differences in absolute albedo impacts were most sensitive at high discount rates, for 'climate only' management, and over increasing offset prices. These results demonstrate the importance of parameter certainty in the promotion of PES in forestry. They also show that mixed stands can promote more efficient trade-offs

between forest ecosystem service offerings and provide a basis for diversifying between ecosystem functions.

Incorporating measures of grassland productivity into efficiency estimates for livestock grazing on the Qinghai-Tibetan Plateau in China

- Ecological Economics---2016---Wei Huang, Bernhard Bruemmer, Lynn Huntsinger

Incorporating an ecological variable for the productive capacity of the grassland into the production function is a new step toward conducting technical efficiency analysis for livestock grazing. This variable is generated using remotely sensed net primary productivity (NPP) data and available grassland area, and entitled as grassland total NPP capacity. With the one-step approach of using a multi-output, multi-input stochastic input-oriented distance function based on field survey data combined with NPP data, we estimated the technical efficiency of livestock grazing on the Qinghai-Tibetan Plateau using two measurements related to ecological performance, an environmental performance indicator and environmental efficiency. The average technical efficiency is estimated to be 0.837 when considering grassland total NPP capacity, implying that livestock grazing inputs can be decreased by 16.3% without any reduction in outputs. The average environmental performance indicator is estimated to be 0.013, representing the effects in association with NPP per unit grassland. Environmental efficiency is about 0.123, meaning there might be overuse of grassland total NPP capacity in livestock grazing, in terms of overuse of grassland size or overuse of NPP per unit grassland. Understanding relationship between technical efficiency and ecological performance would be helpful for balancing local economic development and environmental protection.

Taking account of governance: Implications for land-use dynamics, food prices, and trade patterns

- Ecological Economics---2016---Xiaoxi Wang, Anne Biewald, Jan Philipp Dietrich, Christoph

Schmitz, Hermann Lotze-Campen, Florian Humpenöder, Benjamin Leon Bodirsky, Alexander Popp

Deforestation, mainly caused by unsustainable agricultural expansion, results in a loss of biodiversity and an increase in greenhouse gas emissions, as well as impinges on local livelihoods. Countries' governance performance, particularly with respect to property rights security, exerts significant impacts on land-use patterns by affecting agricultural yield-related technological investment and cropland expansion. This study aims to incorporate governance factors into a recursive agro-economic dynamic model to simulate governance impacts on land-use patterns at the global scale. Due to the difficulties of including governance indicators directly into numerical models, we use lending interest rates as discount rates to reflect risk-accounting factors associated with different governance scenarios. In addition to a reference scenario, three scenarios with high, low and mixed divergent discount rates are formed to represent weak, strong and fragmented governance. We find that weak governance leads to slower yield growth, increased cropland expansion and associated deforestation, mainly in Latin America, Sub-Saharan Africa, South Asia and Southeast Asia. This is associated with increasing food prices, particularly in Sub-Saharan Africa and Southeast Asia. By contrast, strong governance performance provides a stable political and economic situation which may bring down deforestation rates, stimulate investment in agricultural technologies, and induce fairly strong decreases in food prices.

Dredging versus hedging: Comparing hard infrastructure to ecosystem-based adaptation to flooding

- Ecological Economics---2016---Adam Daigneault, P. Brown, D. Gawith

Efforts to ameliorate flooding have historically centred on engineered solutions such as dredging rivers, building levees, and constructing spillways. The potential for ecosystem-based adaptation (EbA) options is

becoming increasingly apparent; however, implementation is often limited by a poor understanding of their costs and benefits.

Democratic valuation (DV): Using majority voting principles to value public services

- Ecological Economics---2016---Felix Schlöpfer

The now dominant survey approaches to value public services remain contentious. A common explanation is that stated preferences are generally difficult to measure. I argue that the key problems of the dominant survey approaches can be explained more specifically by their ambition to measure individuals' (maximum) willingness to pay (WTP). To estimate WTP researchers need to ask questions involving counterfactual prices, to specify doubtful implementation rules, and to aggregate preferences in a way that is inconsistent with political rights. The procedures engender problems with scenario credibility, incentive compatibility, adequate information provision, and democratic legitimacy. As an alternative to the standard stated preference paradigm I propose a democratic valuation approach (DV). DV measures the exchange value of public services in the political domain in terms of the aggregate valuation implied by the median preferred expenditure level for public services. The blueprint for survey design is the public finance referendum with multiple proposals. I suggest that empirically straightforward and democratically legitimate exchange values may be a more powerful input to public policy decisions than theoretically correct but empirically problematic estimates of mean willingness to pay.

The effects of government spending on deforestation due to agricultural land expansion and CO2 related emissions

- Ecological Economics---2016---Gregmar Galinato,Suzette Galinato

This paper examines the effect of changes in government spending level and composition on deforestation due to agricultural land expansion and related carbon dioxide emissions. Our theoretical model shows an

unintended consequence from increased government spending and widening social safety nets in developing countries where agricultural land expansion significantly affects forest cover: there is an increase in deforestation and carbon dioxide emissions from land use change. Our empirical tests show that an increase in total government spending significantly increases forest land clearing for agricultural production in the short run leading to more carbon dioxide emissions. However, there is no long-run statistically significant effect on the steady-state forest cover and carbon dioxide emissions.

Price premium of organic salmon in Danish retail sale

- Ecological Economics---2016---Isaac Ankamah-Yeboah,Max Nielsen,Rasmus Nielsen

The year 2016 will be pivotal for organic aquaculture producers in EU, because it represents the deadline for implementing the complete organic life cycle in aquaculture production. Depending on the sturdiness of farms already producing, such a shift in the industry may affect production costs of exclusively using organic fry for production. If the profitability of the primary organic aquaculture producers should be maintained, then farmers must be able to correspondingly receive higher prices, transmitted through the value chain from the retail market. This study identifies the price premium for organic salmon in Danish retail sale using consumer panel scanner data from households by applying a random effect hedonic price model that permits unobserved household heterogeneity. A price premium of 20% was identified for organic salmon. The magnitude of this premium is comparable to organic labeled agricultural products and higher than that of eco-labeled capture fishery products, such as the Marine Stewardship Council. This indicates that the organic label also used for agricultural products may be better known and trusted among consumers than the eco-labels on capture fishery products.

Voodoo versus fishing committees: The role of traditional and contemporary institutions in fisheries management

- Ecological Economics---2016---Elena Briones Alonso,Romain Houssa,Marijke Verpoorten

We study the co-existence of two community-based institutions for fisheries management in Benin: a traditional institution embedded in the Voodoo religion and a recent secular institution in the form of fishing committees. Using household survey data on fishing activities, we find that rules of both institutions have a statistically significant but small impact on the use of unsustainable fishing gear. We further find that Voodoo fishers who break the traditional Voodoo-based rule follow the fishing committee rule to the same extent as other fishers. This finding is consistent with a possible transition from the traditional Voodoo-based institution to the secular fishing committee institution. More research is needed to fully assess the effectiveness of, and interactions between, the two institutions.

Inferences from sparse data: An integrated, meta-utility approach to conservation research

- Ecological Economics---2016---Hayley Chouinard,Philip Wandschneider,Tobias Paterson

Current behavioral research in conservation adoption has been unable to clearly identify the key characteristics of successful adoption. Most conservation studies employ a theory which focuses on one feature (e.g., profits, attitudes, information, norms, or technology). We propose an integrated, three-component framework to model conservation comprising: 1) motives (including stewardship) and meta-utility, 2) firm practices and technology choice, and 3) impacts. We justify this model and compare its use with others in an empirical setting. We build two empirical conservation measures and apply them to a sparse primary data set. Our results show links between the measures and underlying motives—financial and non-financial. We conclude that research and data interpretation using a multiple-motive, integrated framework can improve future research efforts and conservation policy.

A survey of decision-making approaches for climate change adaptation: Are robust methods the way forward?

- Ecological Economics---2016---Ruth Ditch,Anita Wreford,Dominic Moran

Applying standard decision-making processes such as cost–benefit analysis in an area of high uncertainty such as climate change adaptation is challenging. While the costs of adaptation might be observable and immediate, the benefits are often uncertain. The limitations of traditional decision-making processes in the context of adaptation decisions are recognised, and so-called robust approaches are increasingly explored in the literature. Robust approaches select projects that meet their purpose across a variety of futures by integrating a wide range of climate scenarios, and are thus particularly suited for deep uncertainty. We review real option analysis, portfolio analysis, robust-decision making and no/low regret options as well as reduced decision-making time horizons, describing the underlying concepts and highlighting a number of applications. We discuss the limitations of robust decision-making processes to identify which ones may prove most promising as adaptation planning becomes increasingly critical; namely those that provide a compromise between a meaningful analysis and simple implementation. We introduce a simple framework identifying which method is suited for which application. We conclude that the ‘robust decision making’ method offers the most potential in adaptation appraisal as it can be applied with various degrees of complexity and to a wide range of options.

Environmental taxation and the double dividend in decentralized jurisdictions

- Ecological Economics---2016---Alexander Alexeev,David H. Good,Kerry Krutilla

This research explores the implications for jurisdictional welfare of sharing environmental rents between private and public consumption. An integrated model is developed from research literatures on jurisdictional competition, the “double dividend,” and on the

design of tax-refund instruments. This model shows that jurisdictional welfare increases as environmental rents are initially allocated towards public consumption, yielding a “double dividend”, but that this dividend may or may not continue as all rents are shifted to public finance. When the double dividend occurs, the rent allocation both improves the efficiency of the tax system and reduces the private–public consumption distortion that decentralized jurisdictional decision-making creates. In some parameter configurations, there is an optimal rental allocation between the private sector and the local government. At this optimum, environmental and fiscal policies are set at their first-best levels and decentralized jurisdictional decision-making is globally efficient. If less rents are allocated to public finance than this optimum, fiscal and environmental policies will be suboptimal, whereas, if too much rent is allocated for public consumption, fiscal and environmental policies will be set at levels above the global efficiency standard. These results illustrate the crucial importance of environmental rent sharing for the efficiency of jurisdictional decision-making.

Global patterns of metal extractivism, 1950–2010: Providing the bones for the industrial society’s skeleton

- Ecological Economics---2016---Anke Schaffartzik, Andreas Mayer, Nina Eisenmenger, Fridolin Krausmann

During the second half of the 20th century, mining expanded globally and must be considered one of the dominant forms of human intervention into the environment. Metals are strategically important resources for industrialized and industrializing societies. In 2010, the five BRICS countries (Brazil, the Russian Federation, India, China, and South Africa) consumed 54% of the metals mined globally. The analysis of material flow data offers a biophysical perspective on mining as a resource frontier and allows for the identification of patterns in global metals extraction and trade. Since 1950, metal extraction has shifted from the early industrializing countries into the emerging economies. In 2010, only 6% of metals mined stemmed

from Europe or North America while 76% were extracted in four countries (Australia, China, India, and Brazil). In the countries hosting large-scale mining operations, socio-ecological pressure ensues the so-called extractivist development path is common. High rates of metal deposit depletion mean that today’s metal extractors and exporters may depend on imports of metal from anthropogenic deposits (stocks in buildings, infrastructure, and durable products) in the future. The extractivist path and the shifting of metals from natural to anthropogenic deposits are both associated with potential for conflict.

Economic and ecological trade-offs of agricultural specialization at different spatial scales

- Ecological Economics---2016---Stephan Klasen, Katrin M. Meyer, Claudia Dislich, Michael Euler, Heiko Faust, Marcel Gatto, Elisabeth Hettig, Dian N. Melati, I. Nengah Surati Jaya, Fenna Otten, César Pérez-Cruzado, Stefanie Steinebach, Suria Tarigan, Kerstin Wiegand

Specialization in agricultural systems can lead to trade-offs between economic gains and ecosystem functions. We suggest and explore a conceptual framework in which economic gains can be maximized when production activities are specialized at increasingly broader scales (from the household to the village, region or above), particularly when markets for outputs and inputs function well. Conversely, more specialization likely reduces biodiversity and significantly limits ecosystem functions. When agricultural specialization increases and moves to broader scales as a result of improved infrastructure and markets or other drivers, ecosystem functions can also be endangered at broader spatial scales. Policies to improve agricultural incomes may influence the level of specialization at different scales and thus affect the severity of the trade-offs. This paper takes Jambi province in Indonesia, a current hotspot of rubber and oil palm monoculture, as a case study to illustrate these issues. We empirically show that the level of specialization differs across scales with higher specialization at household and village lev-

els and higher diversification towards the province level. We discuss ways to resolve trade-offs between economic gains and ecological costs, including landscape design, targeted policies, and adoption of long-term perspectives.

Economic returns of groundwater management sustaining an ecosystem service of dust suppression by alkali meadow in Owens Valley, California

- Ecological Economics---2016---John J. Gutrich, Keith Gigliello, Kimberly Vest Gardner, Andrew J. Elmore

This paper addresses the economic tradeoff between pumping groundwater and maintaining a native plant community that provides an ecosystem service of dust suppression. A dynamic ecological economic simulation model was created to assess net benefits of production (i.e., economic rent) from groundwater management while requiring a producer to maintain or restore native groundwater dependent vegetation in a well-field in Owens Valley, California. Historic groundwater withdrawal during dry conditions followed by recharge during wet conditions has reduced vegetation cover, soil stability and contributed to the drying of springs and seeps. Findings indicate adaptive management that pumps less water, but high volumes in wet years and low volumes in dry years, generates greater economic rent while supplying water, sustaining alkali meadow and maintaining dust suppression. Adaptive management generates economic rent of \$82.6 million (in 2011 \$) compared to status quo management of \$30.5 million over 50 years pumping less annual groundwater than status quo at respective levels of 73% (6830 acre-ft; baseline conditions) and 56% (4952 acre-ft; climate change scenario). Under a climate change scenario and a 2.0m root-zone or less, it would be cost effective to cease groundwater pumping rather than incur substantial restoration costs of the native plant community.

The changing climate of climate change economics

- Ecological Economics---2016---Pettersen Vale

Climate change economics is now four decades old. Much of what it has achieved as a field of academic enquiry can be linked back to issues of integrated assessment modelling. This paper shows that the standard approach is going through a major change in scope as of the last five years. The conventional focus on determining optimal mitigation paths based on modelling the social cost of carbon is being enlarged to embrace promising new waves of research. These are: (1) the economics of insurance against catastrophic risks; (2) the economics of trade and climate; and (3) the economics of climate change adaptation. The paper helps to bridge the gap between economics and climate policy by showing that the analytical toolkit of climate change economics has shifted towards more realistic representations of climatic policy.

Community currency (CCs) in Spain: An empirical study of their social effects

- Ecological Economics---2016---Esther Oliver Sanz

Despite its sudden proliferation along the economic crisis period, no previous study has investigated the social effects of the community currency (CCs) experiences in Spain. Previous research on CCs experiences from different countries provided evidences about social capital improvement, introducing CCs as sustainability tools. This research uses the theoretical frameworks of social capital and complex adaptive systems to approach concepts like sustainability, networks, trust, norms, participation and cooperation. Statistical analysis of the data collected in June 2013 through online survey explores social capital and resilience indicators among the Spanish exchange community users, concluding that Spanish CCs systems improve community social capital through the proposed dimensions, although they are in an early stage and several weakness need to be corrected. The values, motivations, attitude and positive perception of their members suggest that CCs could be appropriate tools for sustainability due its potential to improve social capital and resilience. Detected weakness may affect the interests and commitment of their members. Therefore experience from senior currency systems may help them to face adversities and fully

develop their potential for sustainability.

Integrating ecology and economics in understanding responses in securing land-use externalities internalization in water catchments

- Ecological Economics---2016---G.J. Sanga,E.D. Mungatana

Securing sustainable upstream land-use externalities internalization in developing countries' water catchments continues to be a serious challenge. Uluguru water catchment in Tanzania presents a compelling case for analysis. The catchment is currently under downstream-upstream conservation subsidy arrangement. However, lack of information on the long-term impacts of the approach on the functioning and distribution of benefits threatens its sustainability. Based on system dynamics framework, this study developed an integrated ecological-economic model to evaluate the long-term impacts of this arrangement on the functioning and distribution of benefits. The model was also used to compare the arrangement with other economic instruments in the same respect. Simulation results indicate that the scheme has a potential of securing conservation goals without compromising upstream well-being. Taxing crop inputs and outputs also has a potential securing conservation goal, but at the expense of upstream well-being. Tax cuts on inputs to tree fruit and basic domestic goods also secure conservation goals without compromising upstream well-being. These results show that a downstream-upstream subsidy scheme is better for achieving upstream land use externalities internalization without compromising distribution of benefits among beneficiaries and well-being of upstream land holders than taxing crop inputs and outputs.

An integrative analysis of energy transitions in energy regions: A case study of ökoEnergieland in Austria

- Ecological Economics---2016---Maria Hecher,Ulli Vilsmaier,Roya Akhavan,Claudia R. Binder

'Energy regions' are regional initiatives, which are

engaged in becoming energy self-sufficient by using regionally available energy sources. They support the overall transition towards renewable-based energy and are of key interest to understand how the energy systems and institutional settings in these energy regions changed over time. In this article, a historical and integrative perspective is employed in analyzing the transition process of an Austrian energy region towards energy self-sufficiency. Specifically, (i) an Energy Flow Analysis (EFA) was performed for three points in time (1990, 2000, and 2010); (ii) the institutionalization process was analyzed in terms of the key actors, key milestones, and key factors influencing the transition process; and (iii) an integrative analysis was performed to indicate how the technical and social systems are interrelated. It was found that the most significant changes in the energy region were the efforts made in setting up a decentralized energy system. The co-action of actors from all spheres of society is crucial for aiding energy transition while this process needs to be supported by activities fostering awareness, generate acceptance, and engage the public at large. While there is a clear correspondence between improvements in energy self-sufficiency and the requisite effort at institutionalization, there is also a noticeable time delay between the development of an 'energy vision' and the subsequent impact on energy infrastructure.

The effect of climate change and adaptation policy on agricultural production in Eastern Africa

- Ecological Economics---2016---Goytom Kahsay,Lars Hansen

We estimate the production function for agricultural output in Eastern Africa incorporating climate variables disaggregated into growing and non-growing seasons. We find a substantial negative effect of within growing season variance of precipitation. We simulate predicted climate change for the region and find a resulting output reduction of between 1.2% and 4.5%. Our simulation also demonstrates substantial potential for economic benefits from mitigating the effects of within growing season precipitation variability through

conventional technologies such as flexible planting and rainwater harvesting on the same scale as the potential loss from predicted climate change.

Shifting Chinese organizational responses to evolving greening pressures

- Ecological Economics---2016---Qinghua Zhu,Yong Geng,Joseph Sarkis

Organizations are facing various evolving pressures to green their practices. These pressures range from obligatory forces to voluntary measures. Environmental pressures traditionally influenced organizations to seek reactive and internal practices. The adopted environmental management (EM) practices have evolved to be more proactive and external as the focus has shifted to supply chains. This paper aims to further understand the driving mechanisms for EM practices under various external pressures. To meet this research goal, this study extends the theory of dynamic incentives of environmental policies and institutional theory to develop environmental pressures. Using an empirical study of 422 Chinese manufacturers covering all 31 provinces and provincial cities, an exploratory factor analysis reveals four EM practices factors and four pressures (drivers) factors. Results of a hierarchical regression analysis show that coercive pressures positively relate to more reactive, internal EM practices. Less coercive pressures positively relate to more proactive, external, and green supply chain management practices. The empirical findings provide further support that voluntary regulatory measures can help motivate companies in extending their EM efforts to supply chains. The work also provides insights into how organizations may respond to evolving regulatory regimes, dynamic incentives of environmental regulatory policy, and various institutional pressures.

Monetary valuation of forest ecosystem services in China: A literature review and identification of future research needs

- Ecological Economics---2016---D'Amato, D.,M. Rekola,N. Li,A. Toppinen

We propose a review of empirical studies dealing with the monetary valuation of forest ecosystem services in China. The analysis focuses on: assessing methodological differences between studies; highlighting the variation of monetary values across different ecosystem service types; and identifying and discussing future research needs. Based on a systematic search, our data set consists of 12 studies published in peer-reviewed journals in English, dealing with 72 forest ecosystem services. Our results suggest that domestic literature is affected by elusive categorization of ecosystem services and methodological inconsistencies. The wide variation in monetary values of Chinese forest ecosystem services, a phenomenon also observed in global level reviews, can be partially explained by the methodological heterogeneity of the studies. Future research could benefit from a strengthened and more standardized methodological approach, drawing from relevant methods and indicators employed in the reviewed domestic articles, as well as from insights and solutions proposed in the international empirical and conceptual literature. The exceptional forest restoration policy landscape coupled with the increasing establishment of commercial plantations offer important research opportunities for monetary valuation in China. Efforts should be directed towards assessing marginal values of ecosystem services in land-use changes over time, and benefit flows among different stakeholders.

Relationship between openness to trade and deforestation: Empirical evidence from the Brazilian Amazon

- Ecological Economics---2016---Weslem Rodrigues Faria,Alexandre Almeida

One of the objectives of this paper is to investigate how international trade has affected the dynamics of deforestation in the Brazilian Amazon at the level of the municipality. This analysis focuses on the expansion of crop and cattle activities, and other determinants of deforestation such as GDP per capita, conservation areas and property rights. We combine standard econometrics with spatial econometrics to capture the socioeconomic interactions among the agents in their

interrelated economic system. The data used in this study correspond to a balanced panel of 732 municipalities from 2000 to 2010. The main findings suggest that as openness to trade in the Amazon increases, deforestation also increases. We also find that it is the production of soybeans and beef cattle that drives deforestation in the region. The property rights indicator also has a significant impact in deforestation. Moreover, as the GDP per capita goes up, deforestation increases. The conservation areas have a negative impact on deforestation.

Does resilience have a culture? Ecocultures and the politics of knowledge production

- Ecological Economics---2016---Seema Arora-Jonsson

Culture, that for long had been a neglected concept in resilience thinking, has gained prominence in recent times, especially in the notion of ecocultures/ecocultural resilience to be achieved through transdisciplinary projects. In this paper, I conceptualize the relation of science with society and culture that resilience scholars propose as part of a larger agenda of the integration of science with different knowledge and epistemologies. In order to understand how resilience thinking relates to culture, I investigate the culture of resilience itself. Using the lens of cultural and science studies, I go back to the history and context of resilience and transdisciplinarity, examine some of the central tools and concepts in resilience thinking and its entanglements in the politics of the past and present. In light of the discussion, I argue that we need to ‘situate’ rather than ‘integrate’ our knowledge production. This entails not only recognizing our own culture but also being open to different ways of knowing and to be able to transgress resilience. Moving away from integration and embracing ambivalence and humility can open up to experimental practices and ‘trading places’ in order to engage with nature and others justly.

Measuring impacts of extreme weather events using the life satisfaction approach

- Ecological Economics---2016---Charlotte von Möllerndorff, Jesko Hirschfeld

Extreme weather events cause harm among the aggrieved party that often goes beyond material damages. This paper studies the impact of extreme weather events on measures of self-reported life satisfaction. Focusing on Germany, we use representative panel data for 2000–2011 to study the effect of seven storm & hail events and five floods on subjective well-being in the affected NUTS 3 regions. Our results indicate that both weather experiences bear statistically significant negative externalities. Following an extreme weather event, life satisfaction is reduced by 0.020–0.027 on the 11-point scale. While the effect of storm & hail events is rather immediate in nature, the effect from floods persists much longer.

The greener, the happier? The effect of urban land use on residential well-being

- Ecological Economics---2016---Christian Krekel, Jens Kolbe, Henry Wüstemann

We investigate the effect of urban land use on residential well-being in major German cities, using panel data from the German Socio-Economic Panel and cross-section data from the European Urban Atlas. We reduce concerns about endogeneity by employing fixed-effects (within) estimators, with individual and city of residence fixed effects, while controlling for a rich set of observables. The results show that access to green urban areas, such as gardens and parks, is positively associated with, whereas access to abandoned areas, such as waste or leftover land, is negatively associated with life satisfaction. The effects are strongest for residents who are older, accounting for up to a third of the size of the effect of being unemployed on life satisfaction. We calculate the marginal willingness-to-pay of residents in order to have access to green urban and abandoned areas in their surroundings, as well as the life-satisfaction maximising amounts of them. Fi-

nally, we provide a policy case study, while discussing limitations and avenues for future research.

Interpreting bargaining strategies of developing countries in climate negotiations. A quantitative approach

- Ecological Economics---2016---Valeria Costantini, Giorgia Sforna, Mariangela Zoli

Despite the efforts made during the last climate conferences (COPs), countries participating in the negotiation process are still far from reaching an agreement on the implementation of a new Post-Kyoto climate regime. The growing role played by developing countries in negotiations is one of the main causes behind the deadlock. Further attention should therefore be paid to the composition of the alliances formed by developing countries in order to better understand the key structural features driving their bargaining positions. By applying a cluster analysis, this paper aims to investigate the role played by heterogeneity in specific characteristics of developing countries in explaining divergent costs and benefits associated with alternative climate negotiation outcomes. By clustering developing countries according to their economic, geographic, environmental, energy, and social characteristics, the paper presents some considerations on climate political economy strategies in these countries with respect to existing bargaining coalitions.

Value-based adaptation to climate change and divergent developmentalisms in Turkish agriculture

- Ecological Economics---2016---Ethemcan Turhan

There is an increased recognition and attention on human values with respect to their role in shaping climate change adaptation policies. Furthermore, as the recent literature suggests, values held by policy actors are centrally located in the debates linking adaptation to development. However, different values tend to give way to diverging adaptation policy preferences, which often appear as a dichotomy of adjustment (incremental change) versus transformation. This study enquires the

assumptions and values in adaptation policy by using Q-methodology and advances value-based approach to adaptation policy with an empirical case from Turkey, a developing country with key vulnerabilities in its agricultural system. By exploring the narratives of 29 policy actors who participated in the making of Turkey's climate change adaptation strategy, the analysis suggests that assumptions regarding an economic growth-driven development agenda often shape adaptation concerns. Further analysis of the 4 emerging discourses (productivism, techno-managerialism, eco-localism, and authoritarianism) suggests that while discourses agree that the ultimate goal of adaptation is safeguarding a developmentalist vision in agriculture, they differ on the means and agents for reaching this goal. I argue that this divergence can enhance the transformative potential of adaptation by bringing "how," "for whom," and "why" questions back to policymaking.

The sharing economy: A pathway to sustainability or a nightmarish form of neoliberal capitalism?

- Ecological Economics---2016---Chris J. Martin

The sharing economy seemingly encompasses online peer-to-peer economic activities as diverse as rental (Airbnb), for-profit service provision (Uber), and gifting (Freecycle). The Silicon Valley success stories of Airbnb and Uber have catalysed a vibrant sharing economy discourse, participated in by the media, incumbent industries, entrepreneurs and grassroots activists. Within this discourse the sharing economy is framed in contradictory ways; ranging from a potential pathway to sustainability, to a nightmarish form of neoliberalism. However, these framings share a common vision of the sharing economy (a niche of innovation) decentralising and disrupting established socio-technical and economic structures (regimes). Here I present an analysis of the online sharing economy discourse; identifying that the sharing economy is framed as: (1) an economic opportunity; (2) a more sustainable form of consumption; (3) a pathway to a decentralised, equitable and sustainable economy; (4) creating unregulated market-

places; (5) reinforcing the neoliberal paradigm; and, (6) an incoherent field of innovation. Although a critique of hyper-consumption was central to emergence of the sharing economy niche (2), it has been successfully reframed by regime actors as purely an economic opportunity (1). If the sharing economy follows this pathway of corporate co-option it appears unlikely to drive a transition to sustainability.

Opening the black box of energy throughputs in farm systems: A decomposition analysis between the energy returns to external inputs, internal biomass reuses and total inputs consumed (the Vallès County, Catalonia, c.1860 and 1999)

- Ecological Economics---2016---E. Tello,E. Galán,V. Sacristán,G. Cunfer,G.I. Guzmán,M. González de Molina,F. Krausmann,S. Gingrich,R. Padró,I. Marco,D. Moreno-Delgado

We present an energy analysis of past and present farm systems aimed to contribute to their sustainability assessment. Looking at agroecosystems as a set of energy loops between nature and society, and adopting a farm-operator standpoint at landscape level to set the system boundaries, enthalpy values of energy carriers are accounted for net Final Produce going outside as well as for Biomass Reused cycling inside, and External Inputs are accounted using embodied values. Human Labour is accounted for the fraction of the energy intake of labouring people devoted to perform farm work, considering the local or external origin of their food basket. In this approach the proportion of internal Biomass Reused becomes a hallmark of organic farm systems that tend to save External Inputs, whereas industrial farming and livestock breeding in feedlots tend to get rid of reuses replacing them with inputs coming from outside. Hence, decomposing the internal or external energy throughputs may bring to light their contrasting sociometabolic profiles. A Catalan case study in 1860 and 1990 is used as a test bench to show how revealing this decomposing analysis may be to plot the energy profiles of farm systems and their possible improvement pathways.

Debunking trickle-down ecosystem services: The fallacy of omnipotent, homogeneous beneficiaries

- Ecological Economics---2016---Raoul Wieland,Sarah Ravensbergen,Edward J. Gregr,Terre Satterfield,Kai M.A. Chan

Ecosystem services research broadly assumes that an increased supply of nature's goods and services will yield increased benefits. We challenge this 'trickle-down' assumption by explicitly investigating the factors that might impede ecosystem services yielding benefits to different stakeholder groups, based on a targeted literature review of First Nations' access to shellfish on Canada's Pacific Coast. Our review revealed four sets of barriers to realizing benefits from ecosystem services despite their abundance within many First Nation territories. The barriers highlight problems of access, particularly as driven by geographic location, technical capacity, markets and user conflicts, and management (of harvest and access), all of which limit First Nations' procuring of resources linked to key services. Our findings demonstrate that simply increasing ecosystem service supply does not necessarily increase benefits for individuals or groups. Realizing the promise that ecosystem services research will enhance human well-being through improved management depends on the explicit consideration of how access mediates the distribution of benefits.

Towards post-Keynesian ecological macroeconomics

- Ecological Economics---2016---Giuseppe Fontana,Malcolm Sawyer

The paper starts with a brief criticism of macroeconomic analyses of different schools of thought for their focus on economic growth and maximisation of output. This applies to the traditional Keynesian approach, which has focused on the achievement of sufficient aggregate demand to underpin full employment and full capacity utilisation, down-playing aggregate supply constraints. This also applies to the neoclassical approach, including the current New Consensus

Macroeconomics approach, which asserts the dominant role of aggregate supply in the long run, and where growth is set by the so-called ‘natural rate of growth’, with no concerns over environmental and ecological issues. The paper then proposes a different approach to macroeconomic analysis. It explicitly acknowledges that economic growth is a double-edged sword. Growth can help to alleviate persistent levels of high unemployment, but it can also lead to potentially catastrophic environmental problems. Building on the Monetary Circuit theory and the Demand-led growth theory, the paper offers an analysis of the interconnections and interdependence of the economic, biophysical and social worlds and by doing it hopes to provide the building blocks for the establishment of post-Keynesian ecological macroeconomics.

An integrated approach to climate change, income distribution, employment, and economic growth

- Ecological Economics---2016---Lance Taylor, Armon Rezai, Duncan K. Foley

A demand-driven growth model involving capital accumulation and the dynamics of greenhouse gas (GHG) concentration is set up to examine macroeconomic issues raised by global warming, e.g. effects on output and employment of rising levels of GHG; offsets by mitigation; relationships among energy use and labor productivity, income distribution, and growth; the economic significance of the Jevons and other paradoxes; sustainable consumption and possible reductions in employment; and sources of instability and cyclicity implicit in the two-dimensional dynamical system. The emphasis is on the combination of biophysical limits and Post-Keynesian growth theory and the qualitative patterns of system adjustment and the dynamics that emerge.

Does slow growth lead to rising inequality? Some theoretical reflections and numerical simulations

- Ecological Economics---2016---Tim Jackson, Peter A. Victor

This paper explores the hypothesis (most notably made by French economist Thomas Piketty) that slow growth rates lead to rising inequality. If true, this hypothesis would pose serious challenges to achieving ‘prosperity without growth’ or meeting the ambitions of those who call for an intentional slowing down of growth on ecological grounds. It would also create problems of social justice in the context of a ‘secular stagnation’. The paper describes a closed, demand-driven, stock-flow consistent model of Savings, Inequality and Growth in a Macroeconomic framework (SIGMA) with exogenous growth and savings rates. SIGMA is used to examine the evolution of inequality in the context of declining economic growth. Contrary to the general hypothesis, we find that inequality does not necessarily increase as growth slows down. In fact, there are certain conditions under which inequality can be reduced significantly, or even eliminated entirely, as growth declines. The paper discusses the implications of this finding for questions of employment, government fiscal policy and the politics of de-growth.

Beyond carbon pricing: The role of banking and monetary policy in financing the transition to a low-carbon economy

- Ecological Economics---2016---Emanuele Campiglio

It is widely acknowledged that introducing a price on carbon represents a crucial precondition for filling the current gap in low-carbon investment. However, as this paper argues, carbon pricing in itself may not be sufficient. This is due to the existence of market failures in the process of creation and allocation of credit that may lead commercial banks — the most important source of external finance for firms — not to respond as expected to price signals. Under certain economic conditions, banks would shy away from lending to low-carbon activities even in the presence of a carbon price. This possibility calls for the implementation of additional policies not based on prices. In particular, the paper discusses the potential role of monetary policies and macroprudential financial regulation: modifying the incentives and constraints that banks face when de-

ciding their lending strategy — through, for instance, a differentiation of reserve requirements according to the destination of lending — may fruitfully expand credit creation directed towards low-carbon sectors. This seems to be especially feasible in emerging economies, where the central banking framework usually allows for a stronger public control on credit allocation and a wider range of monetary policy instruments than the sole interest rate.

Economic growth, inequality, and well-being

- Ecological Economics---2016---Richard B. Howarth, Kevin Kennedy

In advanced industrial societies, rising levels of inequality have contributed strongly to the observed gap that has emerged between per capita income and the Index of Sustainable Economic Welfare (ISEW), which in its current versions is known as the Genuine Progress Indicator (GPI). Yet the ISEW/GPI approach to measuring the social costs of inequality has been criticized as ad hoc. The present paper reviews the literature on this topic and efforts to resolve it based on the construction of indicators grounded in: (a) a classical utilitarian ethical framework; and (b) empirical evidence on the relationship between income and well-being. In the United States, after-tax income per capita grew at an annual rate of 1.7% between 1979 and 2011. A growth rate of 1.2% per year arises when income is adjusted to account for the social costs of inequality. The most common adjustment used in ISEW/GPI studies yields a similar growth rate despite much smaller subtractions from baseline income.

Complementary system perspectives in ecological macroeconomics — The example of transition investments during the crisis

- Ecological Economics---2016---Inge Røpke

Globally, societies are facing a number of interrelated environmental, economic and social crises. This paper is intended to contribute to the development of an ecological macroeconomics that addresses these multiple crises in combination. Insights from different research

communities will be included in this effort. Taking an ecological economic understanding of sustainability as the point of departure, and inspired by systems thinking, it is discussed which economic sub-systems should be in focus for sustainability transitions, and whether relevant guides for sustainability can be formulated for these systems. In particular, the focus is on systems that are decisive for resource consumption and pollution although their influence on these is indirect. A simple typology of sub-systems is suggested and applied in relation to an example that highlights the importance of the interplay between macroeconomic, provision and distribution systems. The example concerns investments in sustainability transitions of provision systems and demonstrates the complexities of implementing such transformations during the economic crisis. It also addresses the need for ecological macroeconomics to develop a third position beyond austerity policies and Keynesian approaches.

Work-sharing for a sustainable economy

- Ecological Economics---2016---Klara Zwickl, Franziska Disslbacher, Sigrid Stagl

Achieving low unemployment in an environment of weak growth is a major policy challenge; a more egalitarian distribution of hours worked could be the key to solving it. Whether work-sharing actually increases employment, however, has been debated controversially. In this article we present stylized facts on the distribution of hours worked and discuss the role of work-sharing for a sustainable economy. Building on recent developments in labor market theory we review the determinants of working long hours and its effect on well-being. Finally, we survey work-sharing reforms in the past. While there seems to be a consensus that work-sharing in the Great Depression in the U.S. and in the Great Recession in Europe was successful in reducing employment losses, perceptions of the work-sharing reforms implemented between the 1980s and early 2000s are more ambivalent. However, even the most critical evaluations of these reforms provide no credible evidence of negative employment effects; instead, the overall success of the policy seems to depend

on the economic and institutional setting, as well as the specific details of its implementation.

Environmental value of green spaces in Japan: An application of the life satisfaction approach

- Ecological Economics---2015---Tetsuya Tsurumi, Shunsuke Managi

This study applies the Life Satisfaction Approach to evaluate green spaces in terms of its affluence, people's preference for greenery, and distance from people's houses. Data are derived from a survey of 2158 respondents in the two largest regions of Japan (Kanto and Kansai) and the green coverage rate is derived from Geographic Information System (GIS) data. The estimation results show that (1) people's marginal willingness to pay (WTP) for green space decreases as the current amount of green space increases; (2) they show how people's marginal WTP increases in proportion with their affection for it, the amount of interaction they have with it, their knowledge of its multiple functions, and the quality of greenery with which they normally come in contact; and (3) the results reveal the various marginal WTP values for green spaces in terms of distance from respondents' houses.

Comparing different attitude statements in latent class models of stated preferences for managing an invasive forest pathogen

- Ecological Economics---2015---James Meldrum

To better interpret preference data, environmental economists often measure two different types of attitudes: general environmental attitudes, and attitudes specific to an issue. Although methods such as joint latent class modeling can relate these measures to stated preference data, economics literature offers limited guidance on important details, including the relative merits of the two attitude types. This paper analyzes survey data about the management of the invasive, non-native fungus that causes the lethal disease white pine blister rust in high-elevation forests, a problem characterized by long time scales and potentially costly interventions of uncertain efficacy. The

paper uses novel techniques for comparing across latent class model specifications to evaluate the relative contribution of general and specific attitude measures to the analysis of contingent valuation data. These demonstrate insights from investigating heterogeneity in respondents' perspectives and superior model performance with specific attitude statements versus with general attitude statements. In addition to the practical content, these results offer novel insight into ongoing debate on the meaning of stated preference valuation measures.

The ICT/electronics question: Structural change and the rebound effect

- Ecological Economics---2015---Ray Galvin

ICT and related electronic appliances consumed 4% of global electrical energy in 2007, growing to 4.7% in 2012, with projections of continued increase in coming decades. This is despite an average annual increase in energy efficiency of about 30% in ICT/electronics throughout the last 5 decades. Mainstream studies of energy-related rebound effects have yet to produce a conceptual framework that adequately encapsulates a unique feature of ICT/electronics: its tendency to induce changes in social practice and socio-technical structures. This study attempts to fill this gap. Surveying rebound effect literature, it builds on studies which explore 'transformational' change caused by energy efficiency increases. It identifies structural changes in business, education, the military and households caused by energy efficiency increases in ICT/electronics, which lead to a proliferation of ICT/electronic devices and consequently increased energy consumption. It shows the cause-and-effect logic between energy efficiency and energy consumption in ICT/electronics, and tentatively estimates rebound effects ranging between 115% and 161% in eight diverse empirical examples. The history of ICT/electronics shows that energy efficiency increases inevitably lead to increases in energy consumption, hence firm controls on CO₂e emission allowances may offer the best hope of curbing energy consumption and CO₂e emissions in this sector.

Does credit create a ‘growth imperative’ ? A quasi-stationary economy with interest-bearing debt

- Ecological Economics---2015---Tim Jackson,Peter A. Victor

This paper addresses the question of whether a capitalist economy can ever sustain a ‘stationary’ (or non-growing) state, or whether, as often claimed, capitalism has an inherent ‘growth imperative’ arising from the charging of interest on debt. We outline the development of a dedicated system dynamics macro-economic model for describing Financial Assets and Liabilities in a Stock-Flow consistent Framework (FALSTAFF) and use this model to explore the potential for stationary state outcomes in an economy with balanced trade, credit creation by banks, and private equity. Contrary to claims in the literature, we find that neither credit creation nor the charging of interest on debt creates a ‘growth imperative’ in and of themselves. This finding remains true even when capital adequacy and liquidity requirements are imposed on banks. We test the robustness of our results in the face of random variations and one-off shocks. We show further that it is possible to move from a growth path towards a stationary state without either crashing the economy or dismantling the system. Nonetheless, there remain several good reasons to support the reform of the monetary system. Our model also supports critiques of austerity and underlines the value of countercyclical spending by government.

A hydro-economic model for the assessment of climate change impacts and adaptation in irrigated agriculture

- Ecological Economics---2015---Paloma Esteve,Consuelo Varela-Ortega,Irene Blanco-Gutiérrez,Thomas E. Downing

Recent research has demonstrated the multidimensional and multi-scalar nature of climate change, evidencing the need to develop integrated tools for the analysis of impacts and adaptation. This research presents a hydro-economic model of the Middle-

Guadiana basin, Spain, to assess potential effects of climate change on irrigated agriculture and options for adaptation. It combines a farm-based economic optimisation model with the hydrologic model WEAP, and represents the socio-economic, agronomic and hydrologic systems in a spatially-explicit manner covering all dimensions and scales relevant to climate change. Simulated scenarios include a severe A2 climate change scenario up to 2070, two policy-based adaptation scenarios, and autonomous adaptation. Results show that climate change may impact severely irrigation systems reducing water availability and crop yields, and increasing irrigation water requirements. The risk faced by farmers is determined by technology and water use efficiency but also by spatial location and decisions made in neighbouring irrigation areas. The analysis of adaptation strategies underscores the role of current EU water policy in facilitating adaptation. Overall, the applied framework proved to be a useful tool for supporting water and climate change policy-making. It contributes to improve understanding about potential impacts of climate change, multi-scale vulnerability and the scope for adaptation.

National well-being policy and a weighted approach to human feelings

- Ecological Economics---2015---O'Donnell, Gus,Andrew Oswald

Governments are becoming interested in the concept of human well-being and how truly to assess it. As an alternative to traditional economic measures, some nations have begun to collect information on citizens' happiness, life satisfaction, and other psychological scores. Yet how could such data actually be used? This paper is a cautious attempt to contribute to thinking on that question. It suggests a possible weighting method to calculate first-order changes in society's well-being, discusses some of the potential principles of democratic ‘well-being policy’ , and (as an illustrative example) reports data on how sub-samples of citizens believe feelings might be weighted.

Behind the life cycle of coal:

Socio-environmental liabilities of coal mining in Cesar, Colombia

- Ecological Economics---2015---Andrea Cardoso

Open-pit coal mining in Cesar, Colombia increased by 74% between 2000 and 2012, generating environmental and social damages unacknowledged by companies and the state. This study aims to identify and value socio-environmental liabilities from coal mining at different stages of the coal life cycle. Environmental liabilities can be operationalized under three types of responsibilities: moral, legal, and economic. The identification of environmental liabilities allocates moral responsibility; the legal responsibility is needed for effective reparation; and the economic valuation provides arguments to claim compensation, seek remediation, and mitigation of damages. To identify socio-environmental liabilities, interviews were conducted and environmental mining conflicts were analyzed. To estimate monetary values, data were linked to existing literature on costs associated with damages. Results show that the economic values of socio-environmental liabilities per ton of extracted and exported coal are higher than the market price of coal. The main socio-environmental liabilities arise from pollution, local health deterioration, water table depletion, land and ecosystem services losses, damages from transportation and shipping, and coal reserve loss. A comparison with studies in China and the United States indicates that values increase when other health impacts and climate change on a global scale are included.

Quantifying the relationship of resilience and eco-efficiency in complex adaptive energy systems

- Ecological Economics---2015---Jouni Korhonen, Juha-Pekka Snäkin

The concepts of efficiency and resilience are important in complex adaptive systems. Efficiency and resilience have been compared in complex systems, but the data and materials have mainly been derived from natural ecosystems. The actual environmental impacts of

this comparison with data and materials from human economic systems is an important research theme for ecological economics. Furthermore, efficiency defined as eco-efficiency is missing from resilience research. This paper studies resilience and eco-efficiency in societal energy systems. Eco-efficiency is defined as energy produced per CO₂ emissions and incineration ash generated. For resilience, we use the diversity of fuel types in energy systems, in particular the evenness of fuels in each fuel type category. Empirical materials from the district heating energy system of Southern Lapland in Finland encompassing six municipalities are presented. What if-scenarios show that, in general, diversity and eco-efficiency seem to support each other, i.e., there is a correlation. This is different from food web studies in ecology where the material flows are primarily biomass. In human energy systems, lithosphere derived materials are used alongside biomass, in our case study fossil coal, oil as well as peat, which is a semi-fossil fuel. The difference might also be explained due to the role of technology in human economic systems. For policy and business strategy implications, it is important to study the case system with two interdependent system boundaries; the subsystem level of the capital city Rovaniemi and the larger six municipality regional system to which Rovaniemi belongs. Policy planning and business strategy development would gain if the actors involved would approach the system with enlarged spatial and temporal system boundaries. Long-term strategic thinking and inter-municipality cooperation may help the region to mitigate the risks related to the development of the district heating energy system.

The economic impacts of positive feedbacks resulting from deforestation

- Ecological Economics---2015---Christiane W. Runyan, D'Odorico, Paolo, William Shobe

Forests can affect environmental conditions in ways that enhance their survival. This effect may contribute to a positive feedback whereby deforestation could degrade environmental conditions and inhibit forest re-establishment. Sudden changes in forest functioning can be attributed to the existence of multiple stable

states with one high and one low vegetation state. Multiple factors govern whether a transition between states will occur following deforestation. One such factor is strategic behavior and whether communities or stakeholders with an interest in the forest cooperate to maintain the forest in the fully vegetated state by reducing extraction levels or choose their own extraction rates without considering the collective effect of this behavior. We examine how the effect of a positive feedback and strategic behavior affect the optimal quantity of vegetation, V^* . A clear hysteresis exists for logged forests exhibiting a positive feedback whereby an increase in extraction rates leads to a shift to the low vegetation state. An increase in the ecological value of the forest increases V^* whereas the opposite is true for an increase in the value of timber. V^* is also higher under cooperative conditions than non-cooperative conditions. Notably, accounting for the effect of a positive feedback substantially increases V^* .

Local taxation and urban development. Testing for the side-effects of the Italian property tax

- Ecological Economics---2015---Salvatore Bimonte, Arsenio Stabile

Land is an essential yet limited natural resource. Its current unsustainable use asks for a better understanding of the main determinants of urban expansion. A heuristic approach is used to analyze urban development in Italy. In particular, the paper estimates an econometric model to test the impact of the Italian property tax (ICI) on the local authorities' behavior and, in particular, on urban planning and development. It tests whether its introduction has fostered rather than dampened construction activity. The hypothesis put forward is that, because of the concurrent market conditions, the introduction of the tax has facilitated urban development. The structure of the tax and the devolution process that began in the '90s induced local municipalities to adopt less tight (accommodative) urban policies to offset budgetary needs. A more elastic urban policy reduces price volatility. However, its overall welfare effect is not clearly determined. Indeed, *ceteris paribus*, geographical areas with more elastic

housing supply witness larger land consumption. The land use changes we witnessed in the last decades could be the combined effect of financial and fiscal aspects. If this is so, careful attention should be given to the issue of whether leaving urban planning and the power to levy property taxes under the same jurisdiction.

Using REDD+ to balance timber production with conservation objectives in a mangrove forest in Malaysia

- Ecological Economics---2015---Ammar Abdul Aziz, Paul Dargusch, Stuart Phinn, Adrian Ward

In this paper we evaluate if REDD+ initiatives might be financially viable to be used to achieve a more sustainable balance between timber production and ecosystem health in a mangrove forest area in Malaysia. The focus of our study is on a 40,466ha mangrove forest in Malaysia known as the Matang Mangrove Forest Reserve. The Matang Mangrove Forest Reserve has been used for charcoal and pole production for over 100 years and is often described as a good example of a sustainably managed multi-use mangrove forest. However, recent research shows that the health of various components of the ecosystem is in decline (notably some bird species and the blood cockle fishery). We use opportunity cost analysis to determine that the minimum compensation required to offset the production revenue currently derived from timber production in the forest is less than US\$0.83 tCO₂e. At these relatively low costs we demonstrate that REDD+ is financially viable to be strategically used to support the conservation of some parts of the Matang Mangrove Forest Reserve which could result in better sustainable outcomes for the forest area and its stakeholders as a whole.

Towards a power-sensitive and socially-informed analysis of payments for ecosystem services (PES): Addressing the gaps in the current debate

- Ecological Economics---2015---Gert Van Hecken, Johan Bastiaensen, Catherine Windey

In this article, we analyse key issues in the Payments

for Ecosystem Services (PES) debate. We argue that, despite recent advances, PES research remains weakly theorized in social and political terms, resulting in a merely superficial understanding of the role of culture, agency, social diversity and power relations in the shaping of PES institutions and their outcomes. Building on critical insights from the social sciences, we qualify some of the common assumptions underlying current mainstream and alternative conceptualizations of PES and identify crucial topics for future research. More specifically, we explore three key challenges in current PES research, associated with prevailing tendencies (1) to assume that institutions can be designed to ‘fit’ specific human-nature problems; (2) to oversimplify culture and social diversity through the apolitical concept of ‘social capital’; and (3) to conceptualize human agency, collective action, and institutional change either through overly-rational or overly-structuralist models. We argue that an expanded actor-oriented, socially-informed and power-sensitive conceptualization of PES can help generate novel insights in the power geographies underlying institutional logics, and the complex ways in which PES policies are shaped and experienced in the field.

Integrating methods for ecosystem service assessment and valuation: Mixed methods or mixed messages?

- Ecological Economics---2015---Caroline Hat-
tam, Anne Böhnke-Henrichs, Tobias Börger, Daryl
Burdon, Maria Hadjimichael, Alyne De-
laney, Jonathan P. Atkins, Samantha Gar-
rard, Melanie C. Austen

A mixed-method approach was used to assess and value the ecosystem services derived from the Dogger Bank, an extensive shallow sandbank in the southern North Sea. Three parallel studies were undertaken that 1) identified and quantified, where possible, how indicators for ecosystem service provision may change according to two future scenarios, 2) assessed members of the public’s willingness-to-pay for improvements to a small number of ecosystem services as a consequence of a hypothetical management plan, and 3) facilitated a pro-

cess of deliberation that allowed members of the public to explore the uses of the Dogger Bank and the conflicts and dilemmas involved in its management. Each of these studies was designed to answer different and specific research questions and therefore contributes different insights about the ecosystem services delivered by the Dogger Bank. This paper explores what can be gained by bringing these findings together post hoc and the extent to which the different methods are complementary. Findings suggest that mixed-method research brings more understanding than can be gained from the individual approaches alone. Nevertheless, the choice of methods used and how these methods are implemented strongly affects the results obtained.

The role of urban green space for human well-being

- Ecological Economics---2015---Christine
Bertram, Katrin Rehdanz

Most people in Europe live in urban environments. For these people, urban green space is an important element of well-being, but it is often in short supply. We use self-reported information on life satisfaction and two individual green space measures to explore how urban green space affects the well-being of the residents of Berlin, the capital city of Germany. We combine spatially explicit survey data with spatially highly disaggregated GIS data on urban green space. We observe a significant, inverted U-shaped effect of the amount of and distance to urban green space on life satisfaction. According to our results, the amount of green space in a 1km buffer that leads to the largest positive effect on life satisfaction is 35ha or 11% of the buffer area. In our sample, 75% of the respondents have less green space available.

Measuring the biophysical dimension of urban sustainability

- Ecological Economics---2015---Zeev Stos-
sel, Meidad Kissinger, Avinoam Meir

An ecological economics perspective on urban sustainability embraces a biophysical view which emphasizes

the dependence of cities on vast quantities of natural capital from various sources and spatial scales, and the generation of urban wastes which impact the local, regional and global systems. In recent years, several sets of urban sustainability indicators and indices have been developed. However, only a few consider the complex multi-scale interactions between the urban activities and the environment. Furthermore, most existing indices use a relative evaluation approach instead of an absolute approach that is needed when dealing with ecological thresholds. The paper introduces a new urban biophysical sustainability index whose framework includes: the city environmental quality, use of natural resources, and GHG emissions. Each contains topics for assessment related to local, regional and global scales and associated indicators. Standard and optimum values were determined for each indicator and a formula is provided for grading each indicator measurement. The integration of those grades allows for generation of a compound score of each topic, category, spatial scale and the entire urban biophysical sustainability performance. It then demonstrates the index in three major Israeli cities.

A bio-economic analysis of the benefits of conservation agriculture: The case of smallholder farmers in Adami Tulu district, Ethiopia

- Ecological Economics---2015---Yohannis Tessema, John Asafu-Adjaye, Daniel Rodriguez, Thilak Mallawaarachchi, Bekele Shiferaw

This study analyses the potential impact of conservation agriculture (CA) and its binding constraints for adoption in smallholder farming systems in a drought-prone district of central Ethiopia. We develop a dynamic household bio-economic model by taking into account the existing farming system, resource constraints and market imperfections. Climate-induced production risk is introduced into the model by estimating a weather-specific production function using data generated from a crop simulation model. It is found that the full package of CA, which consists of minimum tillage, mulching and crop diversification, does

not appear to be in the best interest of smallholder farmers. However, loosely defined CA practises such as sole maize production with conservation tillage and maize-bean intercropping with conventional tillage, which are not currently practised in the study area, are likely to be adopted by the farmers. The results further demonstrate that time preference, risk aversion, limited credit and market access are key constraints to CA uptake. However, merely addressing these constraints may be insufficient incentives for smallholder farmers to fully adopt CA practises. It is important to identify conditions under which the full package CA can be effectively adopted before it is widely promoted.

The emergence of Southern standards in agricultural value chains: A new trend in sustainability governance?

- Ecological Economics---2015---Greetje Schouten, Verena Bitzer

The objective of this paper is to understand and trace the emergence of Southern standards in global agricultural value chains. While the trend towards private standards established by developed country or 'Northern' actors has received significant attention in the literature, recently an emergent counter-trend can be observed which manifests in the development of standards by Southern producer country actors. This may be attributed to the perceived lack of legitimacy of global standards, especially from a Southern perspective. The paper therefore applies a legitimacy perspective to analyse the emergence of new Southern standards in Indonesian and Malaysian palm oil, Brazilian soy and South African fruit production. The analysis reveals that Southern standards both target different audiences to obtain legitimacy and rely on different sources of legitimacy as compared to established Northern standards. This is done explicitly in order to create cognitive and moral distance to Northern standards and ultimately to reclaim the issue areas occupied by Northern standards. The paper discusses and reflects on the implications of the emergence of Southern standards for sustainability governance and concludes with the identification of future research

opportunities on Southern standards.

Back to the past: Burning wood to save the globe

- Ecological Economics---2015---Craig John-
ston,Gerrit van Kooten

In an effort to reduce CO₂ emissions from fossil fuel burning, renewable energy policies incentivize use of forest biomass as an energy source. Many governments have assumed (legislated) the carbon flux from burning biomass to be neutral because biomass growth sequesters CO₂. Yet, trees take decades to recover the CO₂ released by burning, so assumed emissions neutrality (or near neutrality) implies that climate change is not considered an urgent matter. As biomass energy continues to be a significant strategy for transitioning away from fossil fuels, this paper asks the question: To what extent should we value future atmospheric carbon removals? To answer this, we examine the assumptions and pitfalls of biomass carbon sequestration in light of its increasing use as a fossil-fuel alternative. This study demonstrates that the assumed carbon neutrality of biomass for energy production hinges on the fact that we weakly discount future removals of carbon, and it is sensitive to tree species and the nature of the fuel for which biomass substitutes.

From Lotka's biophysics to Georgescu-Roegen's bioeconomics

- Ecological Economics---2015---Roxana Bobulescu

Alfred Lotka was one of the founders of modern ecology. This paper explores Lotka's contribution to biophysical economics resulting from the marriage of the three disciplines: biology, physics and economics. Lotka founded the concept of "exosomatic evolution" to characterise the economic activities in their biophysical environment as a continuation of biological processes. Like Vernadsky, he adopted a holistic perspective of planet-system — the biosphere.

Modeling heterogeneous fleet in an ecosystem based management context

- Ecological Economics---2015---Barbara Hutniczak

Multispecies fisheries pose a considerable management difficulty with respect to quota allocation between species. The distribution of total allowable catches (TACs) between species without considering fish community structure is altering the trophic interactions in the ecosystem and consequently impacts the natural productivity and the profitability of fishing. This paper aims to develop a methodological framework for assessing the composition and distribution of TACs within a heterogeneous fleet in a multispecies interaction system. The advantage of the presented approach combining a multispecies biological model with an economic model of individual vessel decisions is a possibility to analyze the harvest choice in the context of dynamic and changing conditions, where each action has a consequence for the future.

Simple-but-sound methods for estimating the value of changes in biodiversity for biological pest control in agriculture

- Ecological Economics---2015---Deborah K. Le-
tourneau,Amy Ando,Julie A. Jedlicka,Anita Nar-
wani,Edward Barbier

Recent meta-analyses indicate that an increase in the number of natural enemy species raises the overall effectiveness of biological control of insect pests in agricultural settings. Although economic valuations of biological pest control in agriculture show an impressive cost savings from this ecosystem service, no direct estimate of the value of biodiversity for biological control has been attempted. We apply a basic microeconomic model for estimating the value of changes in the richness of arthropod natural enemies or in functional diversity for biological pest control for two sample crops using experimental results reported in the ecological literature. Market-based outcomes were driven by changes in crop yields associated with experimental reductions in natural enemy species richness, and modified by supply shifts and price elasticities. We show how our simple model differs from common approaches used in the ecological literature, and explain why this alternative model more accurately estimates societal well-being for consumers and producers participating

in these crop markets. We conclude by discussing the additional research and data needed to make economic valuation of ecosystem services in agricultural settings more feasible, rigorous, and realistic in the future.

Efficient water management policies for irrigation adaptation to climate change in Southern Europe

- Ecological Economics---2015---Mohamed Taher Kahil,Jeffery D. Connor,Jose Albiac

This paper evaluates economic and environmental effects of two incentive-based water management policies to address climate change impacts on irrigated agriculture: water markets and irrigation subsidies. A Southern European case study assesses farmers' long and short-run adaptation responses under climate change and policy interventions with a discrete stochastic programming model. Results indicate that climate change will likely have negative impacts on irrigation activities and water-dependent ecosystems in Southern Europe. However, the severity of impacts depends on government policy settings and farmers' adaptation responses. The comparison between water market and irrigation subsidy policies shows the advantages of water markets over irrigation subsidies in terms of both private and social benefits. These findings could guide policymakers on the design of efficient water institutions and policies to address climate change in the irrigated agriculture of Southern Europe.

Hurricane watch: Battening down the effects of the storm on local crop production

- Ecological Economics---2015---Nekeisha Spencer,Solomon Polachek

This study utilizes a panel fixed effects model to explore the economic impact of hurricanes on local crop production in Jamaica using quarterly 1999–2008 microlevel data. We find, in general, that hurricanes have a negative impact on production but not for crops grown below ground. The exceptions for underground crops being negatively affected are yams and potatoes for which water saturated soil reduces output. From

these results, implications are obtained regarding issues such as food security, export expansion, and earnings.

Environmental effects of sustainability management tools: An empirical analysis of large companies

- Ecological Economics---2015---Jacob Hörisch,Eduardo Ortas,Stefan Schaltegger,Igor Álvarez

Given the huge global environmental problems and their political and economic impacts, companies are challenged to improve their performance with regard to issues such as climate change. To successfully reduce corporate environmental impacts, management not only needs to develop environmental strategies, it also has to use effective sustainability management tools for their implementation. There are many studies reported in the literature on sustainability management tools such as life cycle assessments or sustainability reports. However, with few exceptions little is known about the efficacy of these tools. We address this research gap by analyzing survey data from the largest companies of five industrialized countries and empirically test the impact of implementing sustainability management tools on key dimensions of corporate environmental performance. The findings show that the implementation of sustainability management tools does reduce environmental impacts per unit of revenue. However, different groups of tools are found to be effective for different purposes.

Optimizing agricultural land-use portfolios with scarce data—A non-stochastic model

- Ecological Economics---2015---Thomas Knoke,Carola Paul,Fabian Härtl,Luz Maria Castro,Baltazar Calvas,Patrick Hildebrandt

The theory of portfolio selection has often been applied to help improve economic decisions about the environment. Applying this theory requires information on the covariance of uncertain returns between all combinations of the economic options and also assumes that returns are normally distributed. As it

is usually difficult to fulfill all data requirements and assumptions, this paper proposes a variant of robust portfolio optimization as an alternative that needs less pre-information. The approach considers future uncertainties in a non-stochastic fashion through possible deviations from the nominal return of land-use alternatives. Maximizing the economic return of the land-use portfolio is conditional on meeting an inclusive set of constraints. These demand that a pre-defined return threshold is achieved by the robust solution for each uncertainty scenario considered. Based on data for eight agricultural crops common in the Ecuadorian lowlands, a comparison with portfolios generated by classical stochastic mean-variance optimization shows greater land-use diversification (through increased Shannon indices), but only moderate expected economic loss of non-stochastic robust land-use portfolios. We conclude that non-stochastic derivation of land-use portfolios is a good alternative to the classical stochastic model, in situations where information on economic input parameters is scarce.

Measuring rural–urban disparity with the Genuine Progress Indicator: A case study in Japan

- Ecological Economics---2015---Takashi Hayashi

Japan, often regarded as one of the world's most egalitarian societies, has faced increasing rural–urban disparity since the late 1980s. However, even if the wages and income levels of rural populations are lower than those of urban residents, some people will remain in the rural areas or, in some cases, return from the cities. These observations imply the necessity of measuring the rural–urban disparity in Japan as well as the need for an alternative indicator to the conventional economic tools for taking this disparity measurement. The objective of this paper is to measure rural–urban disparity with GPI based on a case study in Japan. The results of this analysis present two key findings. First, the rural–urban disparity measured by the GPI is much smaller than that measured by GDP. Second, the GPI disparity has been an increasing trend, particularly after the 2000s, due to the increased cost of climate

change in rural areas. GPI can identify some strengths of rural areas that are not captured by GDP, but these advantages are cancelled out by the increasing cost of climate change.

Economic valuation of the nitrogen content of urban organic residue by the agricultural sector

- Ecological Economics---2015---Pierre-Alain Jayet, Elvire Petel

Urban organic residues (UOR), often perceived as environmental problems, could be valuable for the environment and agriculture. Spreading of UOR on agricultural lands functions as a disposal solution as well as a source of organic nitrogen, thereby enabling cropping systems to decrease mineral fertilization. The study shows the beneficial effect of two types of UOR on crop yields and the abatement of greenhouse gases. It culminates in an estimate of the economic shadow value of UOR, according to its nitrogen content, while accounting for various farm system characteristics and UOR availability. It is conducted for the densely populated Ile-de-France region, which has large amounts of UOR and agricultural acreage. Per tonne valuation of raw UOR for farming system use ranges from €1.5 to €7. Mineral fertilizer demand decreases by 18% in the case of optimal UOR sharing between regional farming systems, which leads to an 8.7% reduction in agricultural N₂O emissions. Moreover, the per hectare gross marginal output increases by €39 for the region's utilized agricultural area. We use an agricultural supply model, a crop model, and a tool for estimating changes in soil organic matter. The method can be easily extended to other regions of the European Union.

Rural livelihoods and environmental resource dependence in Cambodia

- Ecological Economics---2015---Trung Thanh Nguyen, Truong Lam Do, Dorothee Bühler, Rebecca Hartje, Ulrike Grote

Understanding rural livelihood strategies and environmental resource dependence can help to reduce and prevent livelihood stresses induced by environmental

resource degradation. This study identifies livelihood strategies of farm households in rural Cambodia and explores their determinants with a focus on environmental resource dependence. The data are derived from a survey of 580 households in 30 villages of Stung Treng province in Cambodia undertaken in 2013. An activity-based two-step cluster analysis is conducted to identify different livelihood clusters and regression models are performed to determine the major factors affecting the choice of livelihood strategies and the extraction of environmental resources. The results demonstrate how different levels of environmental and household capital influence livelihood strategies. Environmental resources contribute a significant portion of household income (27%) and act as a means to reduce income inequality (7%) among households. The absolute environmental income is positively correlated with the total income but the relative environmental income decreases with an increase in total income. Thus, it appears that low income households are not to be blamed for environmental degradation, because they are unable to undertake activities with high return. The findings of this study suggest that promoting off-farm employment, education and social networking reduces the extraction of environmental resources.

An economic valuation of mangrove restoration in Brazil

- Ecological Economics---2015---Carlos Eduardo de Rezende,James Kahn,Layra Passareli,William F. Vásquez

Mangrove forests are under considerable pressure in many developing countries and Brazil is not an exception to this problem. We investigate preferences for the restoration of mangrove areas in Brazil, using a choice experiment that varies the level and time of restoration. By interacting those attributes, we are able to identify nine potential scenarios that are expected to provide insight for policies and programs aimed to restore the threatened mangrove forest in the area. Conditional logit and scale heterogeneity multinomial logit models are estimated to analyze the respondents' choices. Our findings indicate that, out of the nine scenarios, respon-

dents prefer a moderate restoration (i.e. vegetation health improvement of existing mangrove forest area) in less than 10years. There also is a strong preference for complete restoration in 11 to 20years, with complete restoration entailing vegetation health improvements and extension of the mangrove forest area of 20%. Results suggest that respondents understand that there are tradeoffs between levels and time of restoration.

From famine foods to delicatessen: Interpreting trends in the use of wild edible plants through cultural ecosystem services

- Ecological Economics---2015---Victoria Reyes-García,Gorka Menendez-Baceta,Laura Aceituno-Mata,Rufino Acosta-Naranjo,Laura Calvet-Mir,Pablo Domínguez,Teresa Garnatje,Erik Gómez-Baggethun,Manuel Molina-Bustamante,Marta Molina,Ramón Rodríguez-Franco,Ginesta Serrasolses,Joan Vallès,Manuel Pardo-de-Santayana

The Millennium Ecosystem Assessment found a general decline in the consumption and gathering of wild edible plants, but some studies also observe a localized increase. Using information from interviews (n=1133) in seven sites in the Iberian Peninsula and one in the Balearic Islands, we 1) identify current trends in the consumption and gathering of wild edible plants (n=56 plant-uses) and 2) analyze how cultural ecosystem services relate to such trends. Our data show a generalized decrease in the consumption and gathering of wild edible plants, although the trend changes significantly across plant-uses. Specifically, we found that –despite the overall decreasing trend– uses of wild edible plants that simultaneously relate to foods with high cultural appreciation and the recreational function of gathering remain popular. Our results signal that cultural services and values associated to the gathering and consumption of some wild edible plants are important factors explaining divergent trends across plant species. This finding reinforces the notion that cultural ecosystem services are deeply intertwined with other categories of services which can combine in complex, non-linear ways producing a variety of interdependent

benefits.

Elephant poaching & ivory trafficking problems in Sub-Saharan Africa: An application of O'Hara's principles of political economy

- Ecological Economics---2015---Andrew John Brennan,Jaslin Kaur Kalsi

This paper examines the complex social problem of African elephant decimation using a political economy approach. This paper applies five principles of O'Hara's political economy (POPE): historical specificity; circular and cumulative causation; uneven development; heterogeneous agents; and contradiction. POPE provides a practical tool for scrutinising the interdependent aspects of a problem. The culture of conspicuous consumption for ivory is a key historical driver of demand. Yet a core, integrated factor that helps explain the current crisis relates to the principle of uneven development. The role of uneven development can be indirect, through lack of human development causing high crime and corruption rates, weak policy frameworks and conflicts in land ownership. Further, heterogeneity of agents adds to the complexity of the networks engaged in the decimation of elephants. Linked to the poaching-traffic circuit of heterogeneous agents, this paper identifies two specific elephant contradictions between the market forces of durable fixed capital and environment-elephant capital. This study contributes to the literature by analysing the interlinking, cumulative processes of elephant poaching and ivory trafficking networks, which previous studies in the economics literature tend to ignore.

Incorporating local visitor valuation information into the design of new recreation sites in tropical forests

- Ecological Economics---2015---Richard Carson,J.R. DeShazo,Kurt A. Schwabe,Jeffrey R. Vincent,Ismariah Ahmad

In rapidly industrializing countries, decisions need to be made as to what characteristics new tropical forest parks in or near urban areas should have. Using a

discrete choice experiment, we estimate prospective visitors' willingness-to-pay for a range of forest park characteristics for a representative sample of Malaysian households in the Kuala Lumpur-Selangor region. To enable park managers to adapt park designs to important types of heterogeneity among park visitors, we further identify how these estimates vary across geography (i.e., residential location: urban, suburban, rural), major ethnic groups, and patterns of recreational behavior. We show how a model that includes a wide array of visitor heterogeneity can be used to identify configurations of park characteristics that maximize social welfare across both the general sample and specific subgroups of prospective visitors.

The complexity of biodiversity: A biological perspective on economic valuation

- Ecological Economics---2015---K.D. Farnsworth,A.H. Adenuga,R.S. de Groot

To value something, you first have to know what it is. Bartkowski et al. (2015) reveal a critical weakness: that biodiversity has rarely, if ever, been defined in economic valuations of putative biodiversity. Here we argue that a precise definition is available and could help focus valuation studies, but that in using this scientific definition (a three-dimensional measure of total difference), valuation by stated-preference methods becomes, at best, very difficult.

What could 'mindful capabilities' be? A comment on Mabsout's 'mindful capability' (2015)

- Ecological Economics---2015---Christine Polzin,Felix Rauschmayer,Rachel Lilley,Mark Whitehead

2015

Reputation and household recycling practices: Field experiments in Costa Rica

- Ecological Economics---2015---Francisco Alpizar Rodriguez,E. Gsottbauer

Pro-environmental behavior is the willingness to cooperate and contribute to environmental public goods. A good understanding of why individuals undertake pro-environmental actions is important in order to construct policies that are aligned with preferences and actual behavioral patterns, such as concern for social esteem and reputation. In this paper, we present the results of a framed field experiment that explores reputation formation as a driver in support of household recycling practices. We use a “shame” and a “pride” treatment to test which is more effective, if at all, in increasing recycling effort. We find that reputational concerns indeed play a role in shaping individual pro-environmental behavior. Surprisingly, subjects cooperate more if the situation is framed as avoiding shame (bad reputation) rather than as acquiring pride and gratitude (good reputation). The actual experiment is based on a real recycling program, with participants who are heads of urban households in Costa Rica.

The perils of peer punishment: Evidence from a common pool resource framed field experiment

- Ecological Economics---2015---Gioia de Melo, Matías Piaggio

We provide experimental evidence on the effects of social disapproval by peers among communities of Uruguayan small-scale fishers exploiting a common pool resource (CPR). We combined this treatment with an in-group (groups from a single community)/mixed group (groups composed of fishers from different communities) treatment. Our aim is to compare the effects of social disapproval in a context in which individuals exploiting a CPR belong to different communities relative to the case in which only individuals from the same community are allowed to exploit the resource. We find that mixed groups—unlike in-groups—reduce their exploitation of the resource in response to the threat of punishment. We do not find any differences in behavior between in-groups and mixed groups when the possibility of being punished is not available. Both in in-groups and mixed groups there is substantial anti-social punishment, which leads to increased extraction

of the CPR by those who are unfairly punished. We interpret that the effectiveness of social disapproval is reduced because cooperation was not perceived as the unique social norm. These findings indicate that effective peer punishment requires coordination to prevent antisocial targeting and to clarify the social signal conveyed by punishment.

Unraveling the effects of payments for ecosystem services on motivations for collective action

- Ecological Economics---2015---Estelle Midler, Unai Pascual, Adam G. Drucker, Ulf Narloch, José Luis Soto

This paper addresses the differential impacts on decisions towards collective action in the context of payments for ecosystem services (PES) where individual and collective rewards are conditional on a minimum collective conservation level being achieved. Interactions between the different reward types, farmers' social preferences, social ties and communication are identified. A field game experiment is conducted with Andean farmers in Peru and framed around their decisions to conserve agrobiodiversity as an impure public good. The main results are that PES schemes could be effective in motivating collective action for agrobiodiversity conservation and that individual rewards are likely to be more effective and less sensitive to social factors than collective rewards. The latter might have a positive effect on conservation when they are shared within socially closely-related groups or in situations where communication and deliberation about collective action are possible.

Phasing out mercury through collective action in artisanal gold mining: Evidence from a framed field experiment

- Ecological Economics---2015---Adrián Saldarriaga-Isaza, Clara Villegas-Palacio, Santiago Arango, Adrián Saldarriaga Isaza

The application of practices such as mercury amalgamation makes small-scale gold mining an economic

activity with a high negative impact on health and the environment. Associative entrepreneurship – collective action – has been proposed as a scheme that would bring cleaner technologies to miners, in order to reduce the harmful effects of using mercury in the gold recovery. In this paper we investigate the extent to which miners can establish and sustain an association that aims to fulfill these goals. This is done by conducting a framed experiment with small-scale gold miners in Colombia. We test the effect of two institutional arrangements on associative entrepreneurship: exclusion and co-management. We found that miners made contributions that did not allow a sustained acquisition of the technology. However, we found that under co-management players could achieve long-lasting and efficient levels of individual contribution; but, conversely, exclusion did not trigger this kind of collective action. Policy implications of our results and avenues for further experimental research are discussed.

Framed field experiment on resource scarcity & extraction: Path-dependent generosity within sequential water appropriation

- Ecological Economics---2015---Alexander Pfaff,Maria Vélez,Pablo Andres Ramos,Adriana Molina

How one treats others is important within collective action. We ask if resource scarcity in the past, due to its effects upon past behaviors, influences current other-regarding behaviors. Contrasting theories and empirical findings on scarcity motivate our framed field experiment. Participants are rural Colombian farmers who have experienced scarcity of water within irrigation. We randomly assign participants to groups and places on group canals. Places order extraction decisions. Our treatments are sequences of scarcities: ‘from lower to higher resources’ involves four rounds each of 20, 60, then 100 units of water; ‘from higher to lower resources’ reverses the ordering. We find that upstream farmers extract more, but a lower share, when facing higher resources. Further they take a larger share of higher resources when they faced lower resources in earlier rounds (relative to when facing

higher resources initially). That is inconsistent with leading models of responses to scarcity which focus upon one’s own gain. It is consistent with lowering one’s weight on others to, for instance, rationalize having left them little. Our results suggest that facing higher scarcity can erode the bases for collective actions. For establishing new institutions, timing relative to scarcity could affect the probability of success.

Exogenous degradation in the commons: Field experimental evidence

- Ecological Economics---2015---Esther Blanco,Maria Claudia Lopez,Sergio Villamayor-Tomas

This article presents the results from framed field economic experiments in rural Colombia that aim to explore the behavioral responses of resource users to exogenous changes in the availability of a common-pool resource. In the first 10 rounds of the experiment, all subjects played at a baseline with the same initial resource availability. In the subsequent rounds, the experimenters exogenously changed the resource size, including mild and strong reductions in the resource size and rebounds to original size. Results show that subjects react to strong reductions in resource availability, by increasing appropriation from the resource. This behavior holds for intense and persistent as well as for progressive reductions in resource availability. In addition, subjects that experience a reduction in the resource availability followed by a rebound to the initial resource size appropriate more than those subjects who did not experience any change in the resource availability.

Quota compliance in TURFs: An experimental analysis on complementarities of formal and informal enforcement with changes in abundance

- Ecological Economics---2015---Oscar Santis,Carlos Chavez

We explore the effects of different enforcement mechanisms, including formal, informal, and both together, on individual compliance behavior under a system of

territorial use rights in fisheries (TURFs). Our design considers different stock abundance levels and the effect that such differences may exert on extraction decisions and compliance behavior. The analysis is based on a framed field experiment conducted with artisanal fishers in central-southern Chile. Our results indicate that, regardless of the level of biological productivity within the managed areas, the combination of formal and informal enforcement mechanisms reduced individual extraction and transgressions more than did formal enforcement alone. However, in the case of abundance, the use of a combination of enforcement mechanisms did not accomplish more than informal enforcement alone in reducing individual extraction and transgressions. We also found that while formal enforcement tends to complement informal enforcement, it may also crowd out efforts from the group to control peers under low biological productivity. We discuss the policy implications of our results for the proper design of TURFs-based fisheries management.

Estimates of the Genuine Progress Indicator (GPI) for Oregon from 1960–2010 and recommendations for a comprehensive shareholder’s report

- Ecological Economics---2015---Ida Ku-biszewski,Robert Costanza,Nicole E. Gorko,Michael A. Weisdorf,Austin W. Carnes,Cathrine E. Collins,Carol Franco,Lillian R. Gehres,Jenna M. Knobloch,Gayle E. Matson,Joan D. Schoepfer

The Genuine Progress Indicator (GPI) is a significantly more comprehensive approach to assessing economic progress than conventional measures, such as Gross Domestic Product (GDP). We estimated the GPI for the state of Oregon from 1960–2010. We found that it tracked the Gross State Product (GSP) for the period 1970–2000, but began to diverge and flatten out in 2000. The major reasons for this divergence were increasing inequality, loss of farmland, and decreasing personal consumption expenditures as a fraction of GSP. Oregon GPI/per capita leveled off in 2000, while the US GPI/capita leveled off in 1975. The GPI is not the

perfect indicator of economic and social well-being, but it is a better approximation than GDP. As more states and countries begin to recognize the inappropriateness of GDP as a policy goal we can expect to see much more emphasis on and use of alternative indicators like GPI. We recommend extending these indicators to include a comprehensive shareholder’s report that reflects all the state’s capital assets, including built, human, social, and natural capital.

Choice experiment assessment of public preferences for forest structural attributes

- Ecological Economics---2015---Marek Giergiczny,Mikolaj Czajkowski,Tomasz Zylicz,Per Angelstam

Combining the approach used in landscape research with non-market valuation techniques, the aim of this study is to document human habitat selection for recreational purposes in a gradient of forest naturalness. The results indicate that respondents prefer older stands with vertical layering, irregularly spaced trees and a greater number of tree species. Our study thus indicates that forests that are managed (or left unmanaged) for biodiversity purposes are also likely to be attractive to humans. To conclude, while greater management intensity was associated with higher disutility regardless of the model employed, we do not perceive a risk of conflict between forest management designed to protect biodiversity and management targeting recreational value. Consequently, there is a need for spatially differentiated forest management that discriminates among different functions. The state ownership of all larger Polish forest massifs makes this zoning approach feasible.

The role of network bridging organisations in compensation payments for agri-environmental services under the EU Common Agricultural Policy

- Ecological Economics---2015---Tom Dedeurwaerdere,Audrey Polard,Paolo Melindi-Ghidi

Compensation payments to farmers for the provision of

agri-environmental services are a well-established policy scheme under the EU Common Agricultural Policy. However, in spite of the success in most EU countries in the uptake of the programme by farmers, the impact of the scheme on the long term commitment of farmers to change their practices remains poorly documented. To explore this issue, this paper presents the results of structured field interviews and a quantitative survey in the Walloon Region of Belgium. The main finding of this study is that farmers who have periodic contacts with network bridging organisations that foster cooperation and social learning in the agri-environmental landscapes show a higher commitment to change. This effect is observed both for farmers with high and low concern for biodiversity depletion. Support for network bridging organisations is foreseen under the EU Leader programme and the EU regulation 1306/2013, which could open-up interesting opportunities for enhancing the effectiveness of the current payment scheme for agri-environmental services.

Ecoviability for small-scale fisheries in the context of food security constraints

- Ecological Economics---2015---A.A. Cissé,Luc Doyen,F. Blanchard,C. Béné,Jean-Christophe Pereau

This paper applies a stochastic viability approach to a tropical small-scale fishery, offering a theoretical and empirical example of ecosystem-based fishery management approach that accounts for food security. The model integrates multi-species, multi-fleet and uncertainty as well as profitability, food production, and demographic growth. It is calibrated over the period 2006–2010 using monthly catch and effort data from the French Guiana’s coastal fishery, involving thirteen species and four fleets. Using projections at the horizon 2040, different management strategies and scenarios are compared from a viability viewpoint, thus accounting for biodiversity preservation, fleet profitability and food security. The analysis shows that under certain conditions, viable options can be identified which allow fishing intensity and production to be increased to respond to food security requirements but with minimum

impacts on the marine resources.

Effect of agricultural economic growth on sandy desertification in Horqin Sandy Land

- Ecological Economics---2015---Xiaodong Ge,Yaoguang Li,Albert E. Luloff,Kaikai Dong,Jun Xiao

Using traditional methods, this paper gave assessment to the extent of sandy desertification and the changes of land use in eight counties in Horqin Sandy Land over the period 1980–2010. A coupling model was established on the base of general Environmental Kuznets Curve (EKC) model to better understand the roles of economic growth and other factors to sandy desertification in an integrated framework. To avoid the bias owing to the data discordance and the autocorrelation in time series data, Unit Root Test was applied and an ARDL model was established to improve the EKC model. The results showed that there was a positive linear correlation between the extremely severe sandy desertification per capita and the real agricultural GDP per capita in the short run, while there was a Kuznets Curve in the long run, showing the effect of economic growth as both the pressure on land and the capability to alleviate the risk of sandy desertification in different phases. The effect of economic growth on sandy desertification was greatly influenced by exogenous factors, including strategy factors, climatic factors and the extent of sandy desertification itself.

Preferences of locavores favoring community supported agriculture in the United States and France

- Ecological Economics---2015---Hikaru Hanawa Peterson,Mykel Taylor,Quentin Baudouin

Various retail outlets are available for consumers to access local foods including grocery stores, farmers’ markets, and community supported agriculture (CSA) programs. This study purports that consumers’ selection of retail outlets for local foods depends on a tradeoff between the degree of assurance on credence attributes offered at the outlet, and the associated time

and convenience costs. Empirically, survey responses from U.S. and French individuals are analyzed. Ordered logit model results suggest distinct motivators for local food consumption in our samples: support for local farmers among U.S. respondents and respect for the environment among French respondents. Latent class models identified consumer segments that valued CSA participation consisting of a quarter of the U.S. sample and three fifths of the French sample. Individuals within these CSA-inclined segments in both samples preferred bundle mixes with greater variety and the ability to provide input on the content of the bundle.

Social capital and willingness-to-pay for coastal defences in south-east England

- Ecological Economics---2015---Nikoleta Jones, Julian R.A. Clark, Chrisovaladis Malesios

Globally, it is widely acknowledged that constructing hard engineered coastal defences is both financially and environmentally unsustainable. Here we seek to investigate the willingness of residents in rapidly eroding coastal zones to contribute towards the costs of constructing and maintaining such structures. The originality of this paper is that it provides one of the first analyses of the influence of social capital parameters (social trust, institutional trust, social reciprocity and social networks) on respondents' willingness to pay (WTP). Fieldwork for the study was conducted in Romney Marsh, a low-lying coastal area of south-east England. The findings have substantive public policy implications for coastal management. First is that we demonstrate that while social and institutional trust exerts a positive influence on WTP, the presence of social networks militates against WTP. Secondly while the study found 45.6% of respondents were willing to pay an average monthly premium of £3.53, a high level of refusal to pay was evident among respondents. Thirdly even among those respondents willing to pay, disagreement was expressed over the political-administrative level at which a 'coastal defence tax' should be collected.

Socioeconomic metabolism as paradigm for studying the biophysical basis of human societies

- Ecological Economics---2015---Stefan Pauliuk, Edgar G. Hertwich

A wide spectrum of quantitative systems approaches such as life cycle assessment or integrated assessment models are available to assess sustainable development strategies. These methods describe certain aspects of the biophysical basis of society, which comprises in-use stocks and the processes and flows that maintain and operate these stocks. Despite this commonality, the methods are often developed and applied in isolation, which dampens scientific progress and complicates communication between scientists and decision makers. As research on socioecological systems matures, more structure and classification are needed. We argue that the concept of socioeconomic metabolism (SEM), which was developed in material flow analysis and material flow accounting, is a powerful boundary object that can serve as paradigm for studying the biophysical basis of human society. A common paradigm can facilitate model combination and integration, which can lead to more robust and comprehensive interdisciplinary assessments of sustainable development strategies. We refine the notion of SEM, clarify the relation between SEM and the economy, and provide a list of features that we believe qualifies SEM as research paradigm. We argue that SEM as paradigm can help to justify alternative economic concepts, suggest analogies that make the concept more accessible, and discuss its limitations.

Examining the efforts of a small, open economy to reduce carbon emissions: The case of Denmark

- Ecological Economics---2015---Clinton J. Levitt, Morten S. Pedersen, Anders Sørensen, Morten Saaby

It is generally understood that greenhouse gases produced by human activities are having a warming effect on the climate. Discussions concerning efforts to curb carbon dioxide emissions often focus on large countries.

However, considerable resources have been spent to reduce carbon dioxide emissions by relatively small, open economies. Although, these economies are small players in international markets, international trade has an important influence on their economies. Investigating the outcome of efforts to curb emissions by these small, open economies provides insights into the situation faced by a large set of the world's economies. This paper has three objectives: (1) investigate the outcome of Denmark's efforts to reduce its carbon emissions by characterizing the relationship between Denmark's macroeconomic activity and carbon emissions; (2) determine the carbon content of Danish trade and document the important effects that growing trade with China has had on Danish consumption emissions; and (3), investigate the robustness of measures of consumption emissions under varying information requirements. Our analysis of the outcomes of Danish efforts to reduce carbon emissions suggest two, related lessons. First, small, open economies, should track both production and consumption emissions when evaluating their progress towards reducing carbon emissions. Second, international trade should be considered in the design of environmental policy. The Danish experience indicates that increasing trade with a much larger and more emission intensive country can have substantial influence on consumption emissions.

Ethics and the choice of animal advocacy campaigns

- Ecological Economics---2015---James Waters

This paper examines how different ethical positions view various types of animal advocacy campaigns concerning a product made using animals as an input. The ethical positions represent common company, society, and animal advocate viewpoints. We adopt an industrial economics approach, modelling a market with a monopolistic supplier and subject to consumer-oriented, technological, collaborative, and direct action campaigns. We determine whether the ethical positions support or oppose each campaign, and in what conditions. We find that animal welfare and rights goals are simultaneously satisfied by three campaigns: negotia-

tion, targeted direct action, and awareness raising that condemns low welfare standards.

Trends in Japanese households' critical-metals material footprints

- Ecological Economics---2015---Yosuke Shigetomi, Keisuke Nansai, Shigemi Kagawa, Susumu Tohno

This study adopts the concept of material footprint (MF), an indicator for consumption-based material extraction via international trade, and identifies the relationship between the MFs of critical metals for low-carbon technologies – neodymium, cobalt, and platinum – and Japanese household consumption through a multiregional input–output approach using the global link input–output model. We focus solely on the impact of changes in consumption patterns caused by demographic change on the structures of the MFs from 2005 to 2035. As a result, the total MFs of neodymium, cobalt, and platinum in 2035 are estimated to be 11%, 6.6% and 4.7% lower than in 2005, respectively. In terms of commodity sectors, the MFs of the three metals induced by “passenger motor cars” are estimated to decrease most between 2005 and 2035. Finally, we carried out an assessment of the extent to which the products dealt with under current Japanese recycling laws cover the MFs calculated for 2035. This indicates that continued enforcement of the recycling laws can play an important role in alerting consumers to the MFs of critical metals, particularly neodymium. For improving the accuracy of the above estimates, further studies need to incorporate other future trends like technologies and trade.

Do protected areas reduce blue carbon emissions? A quasi-experimental evaluation of mangroves in Indonesia

- Ecological Economics---2015---Daniela A. Miteva, Brian C. Murray, Subhrendu K. Patanayak

Mangroves provide multiple ecosystem services such as blue carbon sequestration, storm protection, and

unique habitat for species. Despite these services, mangroves are being lost at rapid rates around the world. Using the best available biophysical and socio-economic data, we present the first rigorous large-scale evaluation of the effectiveness of protected areas (PAs) at conserving mangroves and reducing blue carbon emissions. We focus on Indonesia as it has the largest absolute area of mangroves (about 22.6% of the world's mangroves), is one of the most diverse in terms of mangrove species and has been losing its mangroves at a very fast rate. Specifically, we apply quasi-experimental techniques (combining propensity score and covariate matching, differences-in-differences, and post-matching bias adjustments) to assess whether PAs prevented mangrove loss between 2000 and 2010. Our results show that marine protected areas reduced mangrove loss by about 14,000ha and avoided blue carbon emissions of approximately 13 million metric tons (CO₂ equivalent). However, we find no evidence that species management PAs stalled the loss of mangroves. We conclude by providing illustrative estimates of the blue carbon benefits of establishing PAs, which can be cost-effective policies for mitigating climate change and biodiversity loss.

Workplace environmental conditions and life satisfaction in Spain

- Ecological Economics---2015---Inmaculada García-Mainar, Victor Montuenga, María Navarro Paniagua, María Navarro Paniagua

This paper expands the research on subjective well-being and outdoor environmental conditions by considering environmental conditions indoors. Specifically, we examine the impact on life satisfaction of self-perceived levels of air and noise pollution in the workplace. We provide a monetary valuation of these environmental conditions, using the life-satisfaction approach. Our results demonstrate that poor air quality and high noise levels in the workplace markedly diminish life satisfaction. This holds even after we control for potential endogeneity arising from simultaneity of self-perceived workplace environmental variables and life satisfaction, by employing an instrumental variable strategy.

Policy instruments for decentralized management of agricultural groundwater abstraction: A participatory evaluation

- Ecological Economics---2015---A.-G. Figureau, M. Montginoul, J.-D. Rinaudo

This paper proposes and analyzes three policy instruments which can be used to enhance farmers' compliance with individual water allocations in a decentralized management context. Three regulation strategies are proposed for the case of groundwater allocations for irrigation: the first relies on economic instruments; the second is based on tools designed to promote pro-social behaviors; and the third combines assumptions from the first two approaches. They are evaluated through 16 scenario workshops involving 124 stakeholders and farmers in five French groundwater basins. Stakeholders' perceptions are analyzed, disentangling the ethical, economic, institutional, social and technical perspectives underlying the stakeholders' arguments for or against the proposed instruments for groundwater-use regulation. The analysis reveals a preference for the strategy that combines economic and social incentives.

The relationships between CDM project characteristics and CER market prices

- Ecological Economics---2015---Ian Michael Trotter, Denis Antônio da Cunha, José Gustavo Féres

This study explores the relationship between key characteristics of Clean Development Mechanism (CDM) projects and Certified Emission Reduction (CER) prices. Using Multiple Correspondence Analysis, we show that the CER credit prices are likely to have had a greater influence than regional levels of economic development on the sectors, regions and sizes of CDM projects. There are comparatively few CDM projects in Sub-Saharan Africa (less South Africa) and the small-scale forestation projects that are characteristic for the region mainly entered the CDM pipeline when CER credit price levels were high. Latin America hosts a larger number of projects, and the small-scale methane, biofuel and hydro projects that are typical for this region generally also applied for validation under high

CER price levels. The large industrial gas and energy efficiency projects typical for the Middle East/Northern Africa region appear to have been largely insensitive to CER price levels. The large number and variety of projects in Asia have applied for registration under a broad range of CER price levels.

Predicting consumer demand responses to carbon labels

- Ecological Economics---2015---Sharon Shewmake, Abigail Okrent, Lanka Thabrew, Michael Vandenberg

Providing carbon footprint labels for all food products is a daunting and potentially infeasible project. Knowing how consumers substitute away from high carbon goods and what they choose as substitutes is essential for understanding which goods are likely to result in meaningful reductions in carbon emissions. This paper proposes a model to systematically estimate how consumers will respond to information from a carbon footprint label. Our model uses consumers' value of their individual carbon footprint with own- and cross-price elasticities of demand data on carbon emissions from life cycle analysis to simulate shifts in consumer demand for 42 food products and a non-food composite, and subsequent changes in carbon emissions from different labeling schemes. Our simulation results have several findings, including: (1) carbon labels can reduce emissions, but labeling only some items could lead to perverse impacts where consumers substitute away from labeled goods to unlabeled goods with a higher carbon footprint; (2) carbon labels can inform consumers such that their previous beliefs about carbon footprints matter; and (3) carbon labels on alcohol and meat would achieve the largest decreases in carbon emissions among the 42 food products studied.

The value of levee protection to commercial properties

- Ecological Economics---2015---Harrison Fell, Carolyn Kousky

Levees have historically been a dominant approach

to riverine flood control in the United States. Recent investigations have found many levees around the country are in substandard condition, however, and some communities are moving to upgrade and repair their levee systems. Little empirical work has examined how increasing flood protection from levees is valued. We present estimates of the capitalization of upgraded levee protection into commercial property prices in St. Louis County, Missouri. By using controls for surrounding land cover and coarsened exact matching to ensure close distribution between treatment and control on surrounding land cover, we attempt to isolate the price effect of the levee from agglomeration effects that may also be operating. We find that commercial properties protected by a 500-year levee do not have a statistically significant price discount as compared with properties not in a floodplain. We find the selling price of properties with levee protection to be higher (although also insignificant in many specifications) than those in a floodplain without levee protection.

Setting the limits to extraction: A biophysical approach to mining activities

- Ecological Economics---2015---Diana Velazquez Almeida, Grace Brooks, Nicolas Kosoy

While the mining industry is steadfastly committed to the goal of increasing extraction of minerals, the failure to recognize the existence of biophysical constraints to extraction results in massive degradation to socio-ecological systems. In this paper, we propose an innovative approach for analyzing mineral extraction which links the use and management of natural resources by means of the Stock-Flow/Fund-Service model developed by Georgescu-Roegen. Mining is a productive process that not only depletes mineral ores but also affects other natural resources that are needed to maintain life-supporting processes over time. The central claim is the need of recognizing the existence of biophysical limits to extraction in order to manage natural resources as irreplaceable providers of ecosystem services. By providing a new conceptualization for operationalizing the ecosystem services approach based on the Stock-Flow/Fund-Service model, we in-

tend to challenge the current extractivist narrative that assumes unregulated practices, monetary indicators, technological advancements and substitutable resources. We argue that limits to mining activities should depend on a biophysical evaluation of the effects of these activities on the environment. Furthermore, social deliberation is required to determine whether extraction should occur and to what extent it is socially acceptable while still maintaining the integrity of socio-ecological systems.

Assessing the cost-effectiveness of a biodiversity conservation policy: A bio-econometric analysis of Natura 2000 contracts in forest

- Ecological Economics---2015---Emeline Hily,Serge Garcia,Anne Stenger,Gengyang Tu

In France, the implementation of the EU biodiversity conservation policy within the Natura 2000 network combines regulatory tools and voluntary contracting. In this article, we empirically assess the cost-effectiveness of Natura 2000 contracts in forest areas. We simultaneously estimate a cost function for biodiversity conservation and the production set of biodiversity output and timber, while controlling for conservation measures. We show strong substitutability between biodiversity conservation and timber production. Estimate results on the cost-elasticity of biodiversity conservation also suggest the possibility of more ecologically ambitious contracts with lower average costs. Results also show that public owners are able to bear higher opportunity costs than private owners. Our findings may help to formulate policy recommendations in terms of contracts' targeting, likely to enhance the cost-effectiveness of the incentive scheme.

Can China achieve its carbon intensity target by 2020 while sustaining economic growth?

- Ecological Economics---2015---Bangzhu Zhu,Kefan Wang,Julien Chevallier,Ping Wang,Yi-Ming Wei

In 2009, the Chinese government announced its carbon

intensity target for 2020. Can China achieve this carbon intensity while sustaining economic growth? To address this essential issue, the contributions of this study lie in three aspects. First, we quantitatively capture the relationship between China's economic growth and energy consumption using the cointegration theory, and predict China's energy consumption by 2020 according to different economic growth targets. Second, we forecast China's energy structure in 2020 using compositional data and ARIMA models under different scenarios. Third, we deduce China's CO₂ emission and carbon intensity in 2020. Furthermore, we investigate whether (or not) China can realize the carbon intensity target in premise of ensuring economic growth, and evaluate the contribution of the energy structure's adjustment to meeting this target. Finally, we put forward some relevant policy implications for achieving China's carbon intensity target.

Sector aggregation bias in environmentally extended input output modeling of raw material flows in Finland

- Ecological Economics---2015---Pablo Piñero,Mari Heikkinen,Ilmo Mäenpää,Eva Pongrácz

This paper presents the impact of sector aggregation bias in Environmentally Extended Input Output (EEIO) models, focusing on raw material flows. Finnish industries are aggregated in different ways and causes of bias are studied. The results show that industries with high raw material use deserve special attention in EEIO models. For Finland, particularly problematic is the aggregation of biomass extractive sectors, since the relative importance of forestry causes noticeable deviations. Sources and strategies to prevent errors are described separately for biomass and mineral raw materials. A brief comparison between raw material flows and greenhouse gas emissions is also made. It is shown that aggregation of extractive sectors biases more in material flow analyses. This issue might be of significance in the near future, owing to the foreseeable changes in the European Union accounting framework.

Small-scale cooperative banking and the production of capital: Reflecting on the role of institutional agreements in supporting rural livelihood in Kampot, Cambodia

- Ecological Economics---2015---Arnim Scheidel, Katharine Farrell

This paper explores the ecological economics of small-scale cooperative banking (SSCB) through reference to the empirical case of a rice-farming village in Kampot, Cambodia. It combines Georgescu-Roegen's discussion of an economy's capacity to produce economic processes with Ostrom's concept of institutional performance, in order to address the implications and functioning of SSCB within a small-farmer economy. The local collective action situation of maintaining and making use of a SSCB system – a specific finance model – provides the studied community with access to a pooled capital fund that may play an important role in ensuring its capacity to produce and reproduce economic processes, according to its own specifications. The coordinated action among the villagers, which matches up well with Ostrom's criteria for effective institutional performance of common pool resource use governance, is found to include social and environmental dimensions, which we understand to be necessary for achieving transformations toward more sustainable economic activity. While we do not wish to suggest that the adoption of SSCB guarantees either improved ecological or social impacts, our results suggest that this finance model could play a supporting role in enhancing the potential of small-farming communities to improve both, should they wish to do so.

An empirical analysis of forest transition and land-use change in developing countries

- Ecological Economics---2015---Julien Wolfersberger, Philippe Delacote, Serge Garcia

Deforestation is a major environmental issue in developing countries, and agricultural land expansion is its main cause. The objective of this paper is twofold: (1) to identify the macroeconomic determinants of ending

deforestation; and (2) to explain cumulative deforestation and other land uses. To do this, we first study the probability of a turning point for deforestation (i.e., the switch from decreasing to expanding forest areas), based on the Forest Transition hypothesis. Second, we adapt a land-use model to explain the trade-off between forest and agriculture during development. To take the link between both phenomena into account, we estimate a dynamic panel seemingly unrelated regression (SUR) model along with a switching regression model, applied to a dataset of 57 developing countries observed over four time periods. The estimation results reveal that economic development and institutions play a significant role in long-term deforestation. Our results also suggest that after the first development stage, agriculture and forest are not always competing land uses. These results provide new insights into public policies such as REDD+.

Explaining forest transitions: The role of governance

- Ecological Economics---2015---Edward Barbier, Anteneh Tesfaw

We analyze how governance may influence competing land uses for forests, and thus the occurrence of forest transitions, across different low and middle-income countries. We develop a model of competing land uses that allows for governance to impact the risk of future versus current agricultural and forested land allocations. The resulting hypothesis on the relationship between governance and the likelihood of a forest transition is then tested using cross-country data. The empirical analysis offers strong support for the competing land use framework, and indicates that rule of law, forest policy and regulatory quality influence forest transitions. These findings inform not only the ongoing debate on forest transitions but also policy options for managing such transitions in developing economies.

Measuring the forest and income impacts of forest user group participation under Malawi's Forest Co-management Program

- Ecological Economics---2015---John Mazunda,Gerald Shively

We evaluate the impacts of forest user group participation under Malawi's Forest Co-management Program on forest clearing and household income. We use panel data collected in 2002 and 2009 in two districts of Malawi. We employ a two-step regression strategy to control for endogenous selection into the program. Using propensity score weighting and propensity score analysis with non-parametric regression, we find that the program lowered the rate and extent of forest clearing. We also find that the program had no discernible impact on household forest incomes, suggesting that the program helped achieve environmental goals without compromising household livelihoods.

Differences in demand for watershed services: Understanding preferences through a choice experiment in the Koshi Basin of Nepal

- Ecological Economics---2015---Rajesh Rai,Priya Shyamsundar,Mani Nepal,Laxmi Dutt Bhatta

In this study, we undertake a choice experiment in order to identify differences in local demand for watershed services in the Koshi basin of Nepal. We first examine the possibility of using a non-monetary numéraire to estimate household willingness-to-pay for watershed services. Survey results indicate that while some 50% of the population is willing to pay in monetary terms for environmental services, this number increases to 72% when asked to contribute in labor time. Social benefits from environmental services are 1.4 to 2.2 times higher in labor hours relative to benefits estimated in monetary terms. Our findings suggest that cash constrained rural households in developing countries are more likely to express their demand for local environmental services by offering their time, rather than making a monetary payment. Our results also suggest that locational differences matter. Downstream community members, who practice commercial vegetable

farming, have a higher demand for watershed services and are willing to pay a third more than upstream farmers for these services.

Perceptions on equity and responsibility in coastal zone policies

- Ecological Economics---2015---Valérie Clément,Hélène Rey-Valette,Bénédicte Rulleau

This paper studies public perceptions of fairness in managed retreat policies. We try to empirically test the acceptance of the following four principles of fairness: efficiency, need, responsibility and priority to property rights. Using responses from a questionnaire, the objective of the paper is to generate information on the issue of solidarity between people exposed to the risk of climate-change-induced flooding and those who are not, as regards to funding managed retreat policies and damage compensation. To that end two population zones (Coastal and Hinterland) were surveyed in order to characterise personal preferences of stakeholders and distributive preferences of third parties. Results show (i) a support for national solidarity in the funding of managed retreat policies, (ii) a difference in people's support for the responsibility principle depending on whether it is embedded in a general principle of justice or in a particular compensation scheme and (iii) a difference between distributional judgments of the coastal inhabitants (stakeholders) and those of the Hinterland (third parties) according to the choices of the funding principles of damages on private assets and the choices of the general principles of fairness in managed retreat policies.

Modeling and assessing scenarios of common property pastures management in Switzerland

- Ecological Economics---2015---Ivo Baur,Claudia R. Binder

Common property pastures (CPPs) in the Alps served as examples for successful self-governed resource use. During the past few decades, the situation has changed, and abandonment of marginal pastures with subsequent forest regrowth has been widely observed. To better

understand current drivers, challenges, and policy impacts on the sustainable governance of common property pastures, we present an application of Ostroms' general framework for analyzing social-ecological systems (SESs). We use system dynamics (SD) modeling to operationalize the SES framework for the case study region of Grindelwald, Switzerland. Based on formative scenario analysis, we identify four consistent simulation scenarios. The simulation results show that increasing loss of common property pastures and resulting afforestation can be expected. Scenario assessment shows that policy blueprints such as liberalization or increased government support do not halt but instead accelerate abandonment of common property pastures. We conclude by discussing options for sustainably governing CPPs.

Measuring the contribution of ecological composition and functional services of ecosystems to the dynamics of KwaZulu-Natal coast fisheries

- Ecological Economics---2015---R.M. Hassan,J.G. Crafford

This study extended a bio-economic fishery model to establish an explicit link between coastal and estuarine ecosystems ecological composition (biodiversity) and functional (nutrient supply) attributes and the dynamics and productivity of KZN coastal fisheries. Results confirmed the importance and strong contribution of the tested ecological attributes. In-sample simulation indicates that current fishing efforts and harvest rates are sustainable, but are sensitive to changes in nutrient influx and rainfall. This confirms the need to modify conventional fisheries models to include environmental variables as additional predictors of fish stocks in addition to historical catch records and catch effort for management and control of fishing efforts and permits. This study provided confirmation of the strong linkage between nutrient levels and productivity of coastal fisheries thus enabling investigation of runoff and rainfall related climate change effects on the KZN fisheries.

A systemic framework for sustainability assessment

- Ecological Economics---2015---Serenella Sala,Biagio Ciuffo,Peter Nijkamp

Sustainability assessment (SA) is a complex appraisal method. It is conducted for supporting decision-making and policy in a broad environmental, economic and social context, and transcends a purely technical/scientific evaluation. This paper focusses on the systematisation of knowledge on technical/scientific sustainability evaluation, by addressing critical decision-making elements focussed on by domain experts. We make a distinction between integrated assessment and SA. Our systemic approach outlines how to move from integrated assessment to SA. The fundamental differences involved concern three levels: ontological, methodological and epistemological. We present a novel methodological framework for SA, based on a literature meta-review of multi-scale and multi-purpose appraisal methodologies, models and indicators. SA is essentially a structured procedure encompassing different field-specific analytical methods and models, for specific applications and decision contexts. External inputs to the methodology are “values” considered in the analysis and boundaries defined, including the relevant sustainability framework. Internal methodological elements comprise approach to be adopted (e.g. “what-if” vs. “what-to”), scenario design and analytical models and measurable indicators for an operational analysis. Methods to quantify uncertainty are key ingredients of the assessment framework. The paper highlights the relevance of and policy challenges for SA development, with due attention for applicability in real-world decision contexts.

Global patterns and trends of wood harvest and use between 1990 and 2010

- Ecological Economics---2015---Anna Liza S. Bais,Christian Lauk,Thomas Kastner,Karlheinz Erb

Wood biomass forms the basis for a variety of products and it represents an important source of technical en-

ergy. Woodfuels and forests play an important role for climate change mitigation, by their ability to replace fossil fuel and sequester atmospheric carbon. At the same time, wood extraction is an important driver for deforestation. However, large uncertainties relate to the amount and spatio-temporal pattern of wood use. We here present a comprehensive assessment of wood biomass flows in 11 world regions from 1990 to 2010. We found that global total biomass appropriation (TBA) amounts to 1.81GtC/year in 1990 and 1.94GtC/year in 2010 (+7%). In 2010, TBA represents 4% of the global forest net primary production. Only 54% of TBA enters socioeconomic systems while 46% remain in forests or represent waste flows. About 56% of economically used wood biomass enters the energy sector. There are considerable regional variations in wood biomass flows among world regions, owing to differences in population, affluence, and area. Global demand for wood is expected to increase in the near future, putting additional pressure to forest ecosystems. We discuss the potential of cascading use of wood as a means to reduce impacts related to resource use.

The effect of within-season variability on estimates of recreational value for trout anglers in New Zealand

- Ecological Economics---2015---Lena Mkwara,Dan Marsh,Riccardo Scarpa

Recreational benefit estimates can be substantially improved by incorporation of data on attributes that are averaged over shorter periods of time so as to better represent within-season variability. This approach may be advantageous across a wide range of non-market valuation settings. We use angling survey data that includes bimonthly data on angler demand, water quality and fish weight in the Rotorua Lakes and compare our results with those obtained using attribute data averaged over the year. Estimates of marginal willingness to pay for catching fish based on annual data are 5 times higher than those based on bimonthly data. Likewise, the estimated welfare gain from a 1m increase in water clarity is 1.5 times higher in models using annual data. We find that within-season variability

in recreational site attributes can have a statistically significant effect on welfare estimates. The effect of seasonal variation in site attributes has rarely been accounted for in travel cost random utility models of recreation. We conclude that appropriate treatment of temporal variability can assist environmental managers to design more cost-effective policies based on improved estimates of welfare gains.

Adoption of modern varieties, farmers' welfare and crop biodiversity: Evidence from Uganda

- Ecological Economics---2015---Manuela Coromaldi,Giacomo Pallante,Sara Savastano

This paper assesses the impact of modern varieties adoption on farmers' welfare and crop biodiversity conserved in-situ. Using nationally representative data collected in 2009/2010 in Uganda, an endogenous switching regression model estimates the net economic and environmental effects of switching from local landraces to modern species. Results show that, after controlling for market and agro-ecological factors, the local varieties perform better than modern ones in marginalized and climatic vulnerable areas. Crop biodiversity shows to play a fundamental role in farmers' risk minimizing strategies when the available modern varieties are not adaptable to the local context and not supported by the required level of agro-intensification. Rural development policies should consider the heterogeneity in the adoption returns and support diversity conservation as a national strategic asset for a suitable bioprospecting and a best-fitting agricultural system implementation.

Sense and no(n)-sense of energy security indicators

- Ecological Economics---2015---Christoph Böhringer,Markus Bortolamedi

Energy security ranks high on the policy agenda of many countries. To improve on energy security, governments undertake regulatory measures for promoting renewable energy, increasing energy efficiency, or curbing carbon dioxide emissions. The impacts of such measures on energy security are typically monitored by

means of so-called energy security indicators. In this paper, we show that the common use of wide-spread energy security indicators falls short of providing a meaningful metric. Regulatory measures to improve on energy security trigger ambiguous effects across energy security indicators. We conclude that a major pitfall of energy security indicators is the lack of a rigorous microeconomic foundation.

The unequal exchange of Dutch cheese and Kenyan roses: Introducing and testing an LCA-based methodology for estimating ecologically unequal exchange

- Ecological Economics---2015---Martin Oulu

The theory of ecologically unequal exchange (EUE) posits that international trade is structurally organized in a manner that allows a net transfer of resources from peripheral developing to core industrialized countries. The consequence, it is argued, is under-development in the periphery and augmented productive capacity in the core. EUE thus challenges the neoliberal free-market argument that exchange at market prices is symmetric and fair. An LCA-based methodology for estimating EUE that holds constant the variable market price is introduced and tested on contemporary trade of Dutch cheese and Kenyan coffee and roses. Specifically, the exchange of embodied land, water, energy, global warming potential, and labor is assessed. The results confirm the theory's hypothesis. At a fixed market price, more embodied Kenyan resources are exchanged for less Dutch resources. However, Kenyan roses give different results from coffee. EUE between countries can only be conclusively determined by considering the total biophysical trade balance, but by calculating quantities of embodied resources per unit of exchange value, it is possible to detect unequal exchange even at the level of individual commodities. While integration of biophysical metrics alongside monetary valuation is recommended, ultimately, rethinking the structure, policies and politics of international trade is necessary.

Benefit transfer with limited data: An application to recreational fishing losses from surface mining

- Ecological Economics---2015---Marisa Mazzotta,Lisa Wainger,Samantha Sifleet,J.Todd Petty,Brenda Rashleigh

The challenges of applying benefit transfer models to policy sites are often underestimated. Analysts commonly need to estimate site-specific effects for areas that lack data on the number of people who use the resource, intensity of use, and other relevant variables. Here, we address issues of applying transfer functions to sites that have sparse or missing data. We present options for estimating data to apply meta-regression models (MRMs) in ways that are scale-appropriate and sensitive to local conditions. Using a case study of the potential lost welfare to freshwater anglers as a result of mountain top coal mining within West Virginia, we integrate: 1) an empirical ecological model of fish community changes; 2) an MRM that relates changes in catch rates to changes in anglers' utility; and 3) a spatial participation analysis that maps trip distribution using multiple survey datasets. We evaluate two scenarios: partial (20%) and full use of existing mine permits. Our conservative estimates of annual welfare loss are \$120,500 for the partial scenario and \$627,800 for the full scenario, due to changes in recreational fishing catches. These results are sensitive to catch rate assumptions and socio-demographic characteristics that varied widely depending on the spatial scale of measurement.

The total costs of soil degradation in England and Wales

- Ecological Economics---2015---A.R. Graves,J. Morris,L.K. Deeks,R.J. Rickson,M.G. Kibblewhite,J.A. Harris,T.S. Farewell,I. Truckle

There is growing concern that the way that soils are used often results in their degradation, giving rise to significant costs, both to direct users of soils and to society as a whole. This paper develops and uses an

approach to derive the total economic cost of soil degradation in England and Wales. An estimate was made of degradation costs at the national scale for dominant combinations of land cover and soils, defined as ‘soilscapes’. An ecosystem services framework was used to assess how degradation affects the capacity of soils to support a range of ‘final goods’, distinguishing between on-site and off-site costs, and market and non-market effects. Quantifiable soil degradation costs ranged between £0.9 bn and £1.4 bn per year, with a central estimate of £1.2 bn, mainly linked to loss of organic content of soils (47% of total cost), compaction (39%) and erosion (12%). Eighty percent of costs occur off-site and, as such, are often of limited concern to those whose actions may be causing soil degradation. The findings confirm that control of soil degradation has implications for a number of key policy areas such as flood risk management and climate change mitigation.

Energy, growth, and evolution: Towards a naturalistic ontology of economics

- Ecological Economics---2015---Carsten Herrmann-Pillath

In recent years new approaches to the integration of economics and thermodynamics have been developed which build on the physics of open non-equilibrium systems, the so-called ‘Maximum Entropy Production Principle’. I review these contributions in the light of the implications for economic ontology, i.e. the question what the fundamental constituents of real world economic phenomena are. I argue in favor of the ‘naturalization’ of economic ontology, using the phenomenon of economic growth as my workhorse, and I explore the implications for the cross-disciplinary foundations of ecological economics. The paper shows how economic growth can be conceived as a ‘natural’ process that is driven by fundamental physical forces. The argument proceeds in three steps. After a short review of recent research on the linkage between energy and growth, I establish the connection with bioeconomic theories about evolution that allow restating the role of Lotka’s Maximum Power Principle (MPP)

as a property of open non-equilibrium flow systems with sufficient degrees of freedom of structural adaptation. The MPP is then related to the recent literature on Maximum Entropy Production (MEP), especially as deployed in the Earth Sciences. Economic growth can be seen as resulting from evolutionary adaptations of flow gradients in economic systems that increase throughputs of exergy and generation of work, and which thereby enhance the capacity of the Earth System to maximize entropy production. This framework offers fresh perspectives on a number of issues in research and policy, which I discuss in the conclusion.

Linking ecological data and economics to estimate the total economic value of improving water quality by reducing nutrients

- Ecological Economics---2015---Nanette M. Nelson, John B. Loomis, Paul Jakus, Mary J. Kealy, Nicholas von Stackelburg, Jeff Ostermiller

Water quality impairment due to excess nutrients has prompted the U.S. Environmental Protection Agency to require that states develop nutrient criteria regulations to address this problem. Because regulation of nutrients can be expensive, the Utah Division of Water Quality (DWQ) wanted an estimate of the benefits of nutrient reduction. Natural scientists provided social scientists with detailed current and future water quality outcomes under proposed nutrient management alternatives. Current and future water quality outcomes were used to develop a mail contingent valuation survey. Results show that Utah households who recreate on Utah’s waters (‘Users’) are willing to pay up to \$13.63 monthly to prevent deterioration of water quality whereas nonusers are willing to pay up to \$8.31 per month. Furthermore, Users are willing to pay up to \$32 per month to improve water quality in areas that have already been—or are expected to be—degraded by excess nutrients. Our integrated natural science–social science survey design serves as a useful template for similar water quality studies, as well as providing results for benefit transfer by government entities unable to conduct an original benefits analysis as they develop numeric nutrient criteria.

Between economic loss and social identity: The multi-dimensional cost of avoiding deforestation in Eastern Madagascar

- Ecological Economics---2015---Sébastien Desbureaux,Laura Brimont

This paper exhibits the multiple dimensions of the cost of stopping the main driver of deforestation in Madagascar, slash-and-burn agriculture (tavy). As well as being a major component of the economic livelihoods of most local households living at the edge of forests, tavy has been described by anthropologists as an important cultural practice. In this paper, we show that stopping tavy does not only entail an economic cost for local households. The loss of the cultural dimension of tavy would come at an additional “cultural cost” for some. Our results suggest that a viable cessation of deforestation in Madagascar would require going beyond simple compensation of the opportunity costs of avoiding deforestation.

Tourists’ preferences for congestion, residents’ welfare and the ecosystems in a national park

- Ecological Economics---2015---Carmelo J. León,Javier de León,Jorge E. Araña,Matías M. González

The management of national parks and natural areas often faces a balance between the residents’ welfare, the tourist activity and the pressure on ecosystems. This paper assesses the benefits for a set of policies designed to address tourist congestion, the increase in the welfare of the local populations, and the improvements in the ecosystem services (coral reefs, mangroves, dry forests, and coastal and sandy ecosystems). We utilize a discrete choice experiment approach with the consideration of potential heterogeneity. Results show that there are three segments of visitors with different preferences for the proposed policies. Those tourists with higher values for the environmental policies and welfare of the local communities also share a preference for a lower level of congestion at the natural areas. The results have implications for managing natural areas at tourist destinations.

The building blocks of International Ecological Footprint inequality: A Regression-Based Decomposition

- Ecological Economics---2015---Jordi Teixido,Juan Duro

This paper carries out an empirical decomposition of International Inequality in the Ecological Footprint with a view to quantifying the extent of the contribution of explanatory variables such as countries’ affluence, economic structure, demographic characteristics, climate and technology. Using data for the period 1993-2007, the Regression-Based Inequality Decomposition methodology we use allows us to extend the results obtained in standard environmental impact regressions (STIRPAT models), and to deal with an often neglected aspect of such models, that of equity within generations. The results obtained point towards the prioritization of policies which take into account both future and present generations. In this regard, economic redistribution should be considered as a primary environmental policy.

Assessing environmental dependence using asset and income measures: Evidence from Nepal

- Ecological Economics---2015---Lindy Charlery,Solomon Zena Walelign

Understanding rural environmental dependence in a rural population is an important factor in the framing of environmental policy with the dual aim of tackling poverty and conserving nature. Firstly, this study compares the assessment of environmental dependence between poverty groupings based on income and asset measures. Using a composite asset index, we were able to distinguish the asset poor from the asset non-poor. We then combined income data with the asset index, enabling us to disentangle the stochastic and structural nature of poverty. The distribution of poor and non-poor households based on income measures was significantly different from that based on asset measures. The income poor are substantially more dependent on environmental resources than the income

non-poor (about 15% difference) while strikingly minimal difference was observed in environmental dependence between the asset poor and non-poor (less than 2% difference). The level of environmental dependence between the poor and non-poor households differs with the choice of welfare measure and combining two of these measures to identify wealth groups provides policy makers with better insight on the variations in environmental dependence.

Estimating the Genuine Progress Indicator (GPI) for Brazil from 1970 to 2010

- Ecological Economics---2015---Daniel Caixeta Andrade, Junior Garcia

This paper estimates the Genuine Progress Indicator (GPI) for Brazil from 1970 to 2010 as an alternative indicator to the Gross Domestic Product (GDP). After a growing disparity between these two indicators in the 1980s, when Brazil's per capita GPI featured a 35% decline, there was a relative catch-up in per capita GPI, but not one sufficiently strong enough to reduce the historical GPI-GDP gap. The recent trend of rapidly increasing environmental and social costs, along with the decline in unpaid labour and infrastructure services, poses concerns about the sustainability of an increasing GPI for Brazil into the future. Policies aimed at reducing environmental costs are necessary if Brazil is to enjoy a sustainable pattern of non-declining economic welfare. Brazil must pursue a higher rate of productivity in material and energy consumption in order to keep environmental pressures to a minimum level.

Investigating policy and R&D effects on environmental innovation: A meta-analysis

- Ecological Economics---2015---Claudia Ghisetti, Federico Pontoni

In the last decades, a wide research effort has been devoted at the analysis of the determinants of environmental innovation (EI). Whereas agreement seemed to emerge around a cluster of determinants, mainly “Technology push” , “Market pull” , “Policy

push-pull” and “firm specific factors” , empirical analyses have failed to provide strong confirmation on the relevance of some core variables. After a qualitative discussion of this literature, we empirically assess it by exploiting meta-regression-analysis techniques to test the effectiveness of two determinants: policy and R&D. Our findings are clear: as for the first, we show that only certain types of policy have proven to affect EI, in particular regulatory stringency. As for R&D, we show that the use of estimation methods is not neutral to the outcome of the primary studies.

Downscaling material flow analysis: The case of the cereal supply chain in France

- Ecological Economics---2015---Jean-Yves Courtonne, Julien Alapetite, Pierre-Yves Longaretti, Denis Dupré, Emmanuel Prados

The spatial reconstruction of the production, trade, transformation and consumption flows of a specific material, can become an important decision-help tool for improving resource management and for studying environmental pressures from the producer's to the consumer's viewpoint. One of the obstacles preventing its actual use in the decision-making process is that building such studies at various geographical scales proves to be costly both in time and manpower. In this article, we propose a semi-automatic methodology to overcome this issue: we describe our multi-scalar model and its data-reconciliation component and apply it to cereal flows. Namely, using official databases (Insee, Agreste, FranceAgriMer, SitraM) as well as corporate sources, we reconstructed the supply chain flows of the 22 French regions as well as the flows of four nested territories: France, the Rhône-Alpes region, the Isère department and the territory of the SCoT of Grenoble. We display the results using Sankey diagrams and discuss the intervals of confidence of the model's outputs. We conclude on the perspectives of coupling this model with economic, social and environmental aspects that would provide key information to decision-makers.

An institutional analysis of Payment for Environmental Services on collectively managed lands in Ecuador

- Ecological Economics---2015---Tanya Hayes,Felipe Murtinho,Hendrik Wolff

The application of Payment for Environmental Services (PES) programs on communal lands raises questions about how PES interacts with collective resource management institutions. We explore how an Ecuadorian payment program is associated with the development of rules to manage shared grazing lands. In addition, we assess the communal characteristics that make it more likely that a participant community will change their land-use rules. Our analysis draws from an almost complete census of participant communities in the Ecuadorian highlands ($n=44$), a survey of non-participant communities ($n=23$) and a household questionnaire ($n=420$). We find that the majority of participant communities have strengthened their land-use rules since program participation. Communities that craft new rules and apply their rules are more likely to be organized and have internal monitoring and enforcement mechanisms. Poorer communities are also more likely to have made a rule change in response to participation; wealthier communities are more likely to maintain existent land-use institutions. We find no association between rule change and level of payment. Our results highlight the need to disaggregate the role of payments and contract commitment and to further analyze how community characteristics may influence the effectiveness and equity of PES in communal contexts.

Crop choice as climate change adaptation: Evidence from Bangladesh

- Ecological Economics---2015---Shaikh Moniruzzaman

This paper examines whether crop choice is affected by climate change. I have used a sample of 11,389 farmers across Bangladesh from the years 2000, 2005 and 2010 and 30years moving average of rainfall and temperature against each year. Using multinomial logit model,

I regress climate variables and other household level socio-economic factors on crop choice. This regression result implies that crop choice is climate-sensitive. Households in the high rainfall areas choose rain-fed Aman rice as their dominant crop while farmers of low rainfall areas select irrigation based Boro rice. Using the estimated results, I simulate the impact of different climate change scenarios on crop choice and find that a shift in crop choices will take place in Bangladesh. Especially, temperature increase will upset rainfed Aman rice crop choice and make the farmers to choose irrigation based Boro, Aus and other crops. Unlike temperature, rainfall scenarios are not damaging for rain-fed rice crop choice. This paper also unveils a shortcoming of structural stability between different single cross-sectional models to simulate the effect of climate change scenarios on crop choice. Changes in future rice cropping pattern in Bangladesh come up as findings of this research, which indicate important policy implications for climate vulnerable developing countries.

Capabilities as justice: Analysing the acceptability of payments for ecosystem services (PES) through ‘social multi-criteria evaluation’

- Ecological Economics---2015---Vijay Kolinjivadi,Gonzalo Gamboa,Jan Adamowski,Nicolás Kosoy

‘Payments for ecosystem services’ (PES) is rapidly becoming a popular governance intervention within natural resource management to align land-use stewardship to conserve critical ecosystem services while simultaneously improving human well-being through the provision of incentives. This paper introduces two novel components for refining the legitimacy of PES in water resource management. Firstly, we broaden consideration of human well-being in PES beyond income effects by considering justice as the freedom or capability to ‘do and be’ whatever is desired. Secondly, this paper applies social multi-criteria evaluation as a decision-support framework to determine the acceptability and payment vehicle of PES within a set of

alternative policy considerations for a complex ecosystem management decision. Through both technical and social evaluations of different management options against a set of criteria, we highlight the legitimacy that different PES designs may have for improving water quality and capabilities for well-being.

Adapting institutions: exploring climate adaptation through institutional economics and set relations

- Ecological Economics---2015---Matteo Roggero

This paper looks at climate adaptation from the perspective of institutional economics, focusing on local administrations and exploring their role as bureaucratic organizations dealing with nature-related systems where climate change is creating new interdependencies. The central aim is to reveal under what circumstances such adaptation takes place in a coordinated fashion, as opposed to adaptation by individual administrative units within their respective competences. Applying the concept of integrative vs. segregative institutions, the paper draws upon evidence from fourteen climate-sensitive municipalities in North Rhine-Westphalia, Germany. The analysis, based on set-theoretic methods, finds that integrative institutions constitute a sufficient but not necessary condition for “integrative adaptation”. State administrations may thus avoid additional climate-related burdens for citizens and conflicts among resource users by providing local administrations with means for additional coordination.

Exploring socioeconomic drivers of environmental pressure on the city level: The case study of Chongqing in China

- Ecological Economics---2015---Yadong Yu,Hongtao Ren,Ali Kharrazi,Tieju Ma,Bing Zhu

Exploring the socioeconomic drivers of environmental pressures in cities is vital for national and global environmental management. The unique features of the mega-city of Chongqing make it a valuable case study

to examine environmental pressures from rapid economic development at the city level. This paper reveals the socioeconomic drivers of environmental pressures in Chongqing during the period of 2000–2010 for energy consumption and air, water, and land emissions. Results indicate that Chongqing’s environmental pressures increased for energy consumption and CO₂ emissions while decreased for SO₂, soot, waste water, and solid waste discharge. The main direct contributors, from the producer perspective, to the overall change of environmental pressures were the manufacturing, electricity and water, and construction sectors. From the consumer perspective, the most significant contributors were gross fixed capital formation and net export. In general, changes of per capita final demand and environmental pressure intensity were the most prominent drivers for increasing and reducing environmental pressure. Final demand structure and final demand composition also contributed towards stabilizing environmental pressures while production structure and residential population had a negligible effect. In this light, we suggest approaches for policymakers to systemically balance between different drivers and to reduce environmental pressures in cities.

Economy-wide rebound effects for non-energetic raw materials

- Ecological Economics---2015---Matthias Pfaff,Christian Sartorius

Material efficiency is increasingly being seen as a means to save resources and achieve greater security of supply. Whether these aims can be achieved to the desired extent depends, among other things, on the presence of rebound effects. This article estimates economy-wide rebound effects for non-energetic raw materials in the context of a set of material efficiency projects carried out in Germany. Under the assumption that the efficiency technologies developed in these projects are scaled up to the national level, input-output analysis is used to calculate changed material requirements and corresponding rebound effects. Reduced material flows in monetary terms, together with economic data, are aggregated to an economy-wide impulse, which can

cause re-increases in the demand for the considered raw materials. Depending on the project-specific framework conditions and subject to the modeling assumptions, our estimates suggest that individual materials display a wide range of rebound effects, ranging from close to zero to low double digit percentages. These results point towards the conclusion that economy-wide rebound effects do not make these efficiency measures obsolete. However, they also suggest that rebound effects should not be ignored in the assessment of the role of efficiency in future resource consumption.

Towards integrated social–ecological sustainability indicators: Exploring the contribution and gaps in existing global data

- Ecological Economics---2015---Odirilwe Selo-
mane,Belinda Reyers,Reinette Biggs,Heather
Tallis,Stephen Polasky

Sustainable development goals (SDGs), which recognise the interconnections between social, economic and ecological systems, have ignited new interest in indicators able to integrate trends in – and interactions between – nature and socio-economic development. We explore whether existing global data can be used to measure nature’s contribution to development targets and explore limitations in these data. Using Millennium Development Goal (MDG) 1– eradicate extreme hunger and poverty. We develop two indicators to assess the contribution of nature to progress in this goal. The indicators (based on income and employment data from nature-based sectors (NBS) represented by agriculture, forestry and fisheries) show large but declining contributions of nature to MDG 1: NBS contributed to lifting 18% of people out of poverty and provided 37% of global employment between 1991 and 2010. For low income countries, the contributions were 20% and 55% respectively. In exploring data gaps the study highlighted low reporting rates especially in low income countries, as well as lack of other measures of poverty alleviation beyond income and employment. If we are to move beyond target setting to implementation of sustainable development goals at national scales, these shortcomings require as much attention as the elabo-

ration and agreement on the post-2015 development goals.

Walk in my shoes: Nudging for empathy conservation

- Ecological Economics---2015---Natalia V.
Czap,Hans J. Czap,Gary D. Lynne,Mark E.
Burbach

The traditional policy approaches to encourage conservation, including offering monetary incentives and direct regulation, may lead to unintended consequences which may undermine their effectiveness. In this paper we experimentally test the effectiveness of complementing financial nudging/incentives with nudging for empathy. Our framed experiment models a situation in which an upstream farmer influences the water quality downstream by choosing the level of conservation. Financial nudging is represented by a crop insurance subsidy conditional on conservation compliance (consistent with the 2014 Farm Bill policy). Empathy nudging is represented by a downstream water user sending a message to the upstream farmer encouraging the latter to “walk-in-the-shoes” /take the perspective of the former. We found that empathy nudging can counteract the elimination of financial incentives. However, it is less effective than financial nudging. Empathy nudging coupled with financial incentives has a synergic effect and conservation increased significantly compared to using one of the nudges alone. Furthermore, the combination of empathy and financial nudging was particularly effective in low (initial) conservation cases. We argue that policy makers and the public should encourage empathy conservation and that the environmental policy narrative should appeal to empathy and call for farmers to “join the cause” for conservation and environmental protection.

Landowner preferences for agri-environmental agreements to conserve the montado ecosystem in Portugal

- Ecological Economics---2015---Rui Santos,Pedro
Clemente,Roy Brouwer,Paula Antunes,Rute Pinto

Landowner preferences are elicited for different contractual agri-environmental agreements (AEA) using choice experiments in the Portuguese montados, an agro-forestry ecosystem with high conservation value. The choice experiment is developed with the help of biologists from local environmental authorities and builds upon existing AEA in the Portuguese Rural Development Program ProDeR implemented at Natura 2000 conservation sites. Current uptake rates of AEA for montado conservation are very low. The study's main objective is to assess how varying the institutional-economic terms and conditions underlying current contract design can increase this uptake. We find demand for AEA inside and outside the currently designated protection areas, but there exist clear trade-offs between willingness to accept financial compensation and opportunity costs measured through varying cattle and oak tree density levels. Also contract duration plays a significant role. Minimum willingness to accept financial compensation for a hypothetical scenario representing the current contract conditions in the region is more than six times higher than the actual payment levels under the existing agri-environmental agreements.

Revealing ecological processes or imposing social rationalities? The politics of bounding and measuring ecosystem services

- Ecological Economics---2015---Marc Tadaki, Will Allen, Jim Sinner

Ecosystem service (ES) frameworks have been developed to characterize and model the relationships between ecological processes and human benefits. Some argue that these relationships should be specified through expert-derived analytical (i.e., top-down) frameworks, in order to organize accumulated knowledge and create ready-made framings for communities on the ground. In contrast, arguments for the participatory construction of ES assessments emphasize the need for place-sensitive and deliberative (i.e., bottom-up) approaches. In this paper, we draw on a novel water planning exercise in New Zealand to examine the tensions that arise when expert-produced cate-

gories intersect with diverse stakeholder worldviews and aspirations. Expert-derived ES categories and analyses intervene in local valuation contexts in a range of ways, narrowing the scope of which ecological processes might be considered as relevant or legitimate (bounding), as well as affecting how these processes are described and compared (measuring). The practices of bounding and measuring ES in scientific and planning assessments should thus be conceptualized as involving political work and not just scientific judgment. This reframes the role of ecological science and scientists in ES debates, and this presents cautions as well as opportunities for future ES work relating to policy.

The main characteristics of urban socio-ecological trajectories: Paris (France) from the 18th to the 20th century

- Ecological Economics---2015---Sabine Barles

For some years now, interactions between societies and the biosphere have been the subject of socio-ecological studies (SEs), which analyse socio-ecological regimes, trajectories and transitions. This article follows the approach, and seeks to contribute to the analysis of socio-ecological urban trajectories since the Industrial Revolution. It draws on some key notions which are tested and applied to Paris. The urban socio-ecological regime of the industrial era has three major characteristics: i) the near-total externalisation of a more intensive urban metabolism, associated with the breakup of supply areas and the deepening, urban footprint on the environment; ii) the importance of infrastructure to this metabolism, which fits into a process of generalised networking led by engineers and leads to urban technical inter-dependencies; and iii) the urbanisation of landscapes associated with the proliferation of extra-territorial urban influences, despite the loss of certain skills available to the French capital.

Public preferences for carbon tax attributes

- Ecological Economics---2015---Z. Eylem Gevrek, Ayse Uyduranoglu

The impacts of climate change are already visible

throughout the world. Recognizing the threats posed by climate change, the Durban Platform, the 17th Session of the Conference of Parties (COP 17), underscores that the global nature of climate change calls for the widest possible cooperation and ambitious action by all countries. A crucial starting point for the design of effective and publicly acceptable policies is to explore public preferences for climate policy instruments. Using a choice experiment, this study investigates public preferences for carbon tax attributes in a developing country context. The results account for heterogeneity in preferences and show that Turkish people prefer a carbon tax with a progressive cost distribution rather than one with a regressive cost distribution. The private cost has a negative effect on the probability of choosing the tax. Earmarking carbon tax revenues increases the public acceptability of the tax. Moreover, there is a preference for a carbon tax that promotes public awareness of climate change.

Mapping value plurality towards ecosystem services in the case of Norwegian wildlife management: A Q analysis

- Ecological Economics---2015---Yennie K. Bredin, Henrik Lindhjem, Jiska van Dijk, John D.C. Linnell

For many deep-rooted resource conflicts where the cultural component of ecosystem services (ES) is strong, standard monetary valuation may be methodologically difficult and not always meaningful. A deeper understanding of the value plurality of key stakeholders may be called for to develop acceptable policies. We use the Q method to analyse the perceived and actual trade-offs related to Norwegian wildlife management, a source of prominent conflict in Norway. We identify and classify distinct arguments in the wildlife management debate following the ES framework, and use the Q method to explore extant/prominent narratives characterising stakeholders' perceptions of the importance of arguments about biodiversity and ES. Finally, we reflect on whether and to what extent the Q method can contribute to our understanding of resource conflicts, underlying values, and ES trade-offs. Three clear

narratives appeared: Pro-sheep grazing (cultural), pro-carnivore conservation (intrinsic) and a middle position emphasising recreational hunting (utilitarian). Despite considerable disagreement among narratives, the Q analysis also revealed areas of common ground useful for developing acceptable policies. Given the inherent complexity of socio-ecological systems, it is useful to draw from a diverse toolbox of methods, including the Q method for ES analysis.

Estimating indigenous cultural values of freshwater: A choice experiment approach to Māori values in New Zealand

- Ecological Economics---2015---Sini Miller, Peter Tait, Caroline Saunders

Indigenous cultural values of freshwater resources are important in many communities, however, they are not always included in non-market valuations. While measuring cultural values can be challenging, the omission could lead to incomplete information for policy implications. This paper reports results of a choice experiment study which included a Māori cultural attribute. This attribute was considered alongside economic, recreational and environmental attributes of freshwater, all of which are impacted by the changing land-use in Canterbury, New Zealand. The results show positive willingness-to-pay for all attributes where change from poor to excellent habitat quality (\$123/year) was valued highest. The cultural attribute, specifically, was valued in mid-range between economic, recreational and environmental attributes. Estimated willingness-to-pay were \$40/year by Māori, and \$28/year by the general public, to enhance Māori cultural attributes, where Māori willingness-to-pay is indicative only due to a small number of respondents. Importantly, this demonstrates support for the management outcome for cultural attributes, which is valued not only by those who directly participate in this use. This suggests that non-market valuation practitioners should be aware of indigenous cultural values, the omission of which could have impacts on welfare estimates and subsequent decision making.

Sustainability labels on coffee: Consumer preferences, willingness-to-pay and visual attention to attributes

- Ecological Economics---2015---Ellen Van Loo,Vincenzina Caputo,Rodolfo Nayga,Han-Seok Seo,Baoyue Zhang,Wim Verbeke

Sustainability labels are important tools that help consumers assess the sustainability aspects of food. While past studies have focused on visual attention to nutrition information, no study has investigated the visual attention paid by consumers to the sustainability information on food. Our study contributes to the need to better understand consumers' attention to sustainability information when making food choices. The objective was to explore the importance that consumers attach to sustainability attributes and investigate how this relates to the visual attention paid to these attributes during the choice decision and to willingness-to-pay (WTP). Visual attention during the decision making process was measured in terms of fixation time and fixation count, which were then analyzed in relation to the stated attribute importance. Our results suggest that consumer segments with differences in stated attribute importance, visually attend differently to these attributes. Higher valued attributes also exhibited higher visual attention. Our results suggest that consumers who spend more time attending to and fixate more on sustainability attributes value them more.

Collective capability and collective agency for sustainability: A case study

- Ecological Economics---2015---Jérôme Pelenc,Didier Bazile,Cristian Ceruti

If the Capability Approach is to be a suitable framework for assessing sustainability, as is currently being discussed in Ecological Economics, it is crucial to grasp how the individual and collective levels are linked. The aim of this article is to investigate how individuals interact to create a collective actor. Thus, the article analyzes the process of setting up a grassroots organization that aims to make an active contribution to

sustainability implementation in a given locality. The article specifically examines the process involved in the development of collective agency and collective capabilities and identifies the tensions between the individual and collective levels. The empirical analysis along with the theoretical discussion enables us to put the concepts of collective capability and agency in the context of Ecological Economics. Finally, this article opens up new areas of research to further our understanding of how the individual and collective levels can be linked with a view to sustainability implementation at the local scale.

Commercial orientation in grassroots social innovation: Insights from the sharing economy

- Ecological Economics---2015---Chris J. Martin,Paul Upham,Leslie Budd

There is growing interest in the roles of the sharing economy and grassroots innovation in the transition to sustainable societies. Grassroots innovation research has tended to assume a sharp distinction between grassroots organisations and businesses within niches of socio-technical innovation. However, the non-profit sector literature identifies a tendency for non-profit organisations to actually become more commercially-oriented over time. Seeking to account for this tendency, we develop a conceptual model of the dynamics of grassroots organisations within socio-technical niches. Using a case study of Freegle, a grassroots organisation within the sharing economy niche, we apply the conceptual model to illustrate the causes, processes and outcomes of grassroots niche organisations becoming more commercially-oriented. We show that a grassroots organisation may be subject to coercive and indirect (isomorphic) pressures to become more commercially-oriented and highlight the ambiguities of this dynamic. Furthermore, we highlight that global niche actors may exert coercive pressures that limit the enactment and propagation of the practices and values of grassroots organisations. We conclude by highlighting the need for further research exploring the desirability and feasibility of protecting grassroots organisations from pressures to become more

commercially-oriented.

Pay for Performance: Optimizing public investments in agricultural best management practices in the Chesapeake Bay Watershed

- Ecological Economics---2015---John Talberth,Mindy Selman,Sara Walker,Erin Gray

Agricultural best management practices (BMPs) such as streamside buffer zones and cover crops are increasingly being used to reduce nutrient pollution into water bodies. Eutrophication from fertilizer runoff is the key driver behind growth of hypoxic “dead zones” where fish production comes to a standstill. Governments heavily subsidize BMPs, but do not generally allocate funds to maximize their environmental benefits. But with ever-increasing fiscal constraints, policy makers are searching for ways to enhance efficiency of BMP programs. Pay for performance presents an alternative platform based on nutrient reduction achieved. This paper compares a conventional subsidy approach with pay for performance for BMPs designed to reduce nutrient pollution into the Chesapeake Bay. We model four paired scenarios using a constrained optimization model. In the first pairing we held the level of nutrient reduction constant and compared cost effectiveness of the two subsidy allocation methods. In the second pairing we held the level of program investment constant and compared nutrient reduction outcomes. In both pairings, pay for performance was far superior — delivering identical nutrient reduction outcomes at less than half the cost in the first and delivering two to three times the amount of nutrient reduction for the same budget allocation in the second.

The growth paradigm: History, hegemony, and the contested making of economic growthmanship

- Ecological Economics---2015---Matthias Schmelzer

‘Economic growth’ is widely regarded as a key goal of national and international economic policies, not

only across the political spectrum but also in all countries, and it has been dubbed the most important idea of the twentieth century. Yet, how did the pursuit of economic growth become a key priority taken for granted among social scientists, politicians, and the general public? Building on studies of the so-called Post-Development school and focusing on the OECD, one of the least understood international organizations, the article offers a source-based and transnational study to chart the history of growth discourses. After setting this analysis in the context of the current debate about the relationships between GDP, welfare, and environmental sustainability and after introducing a definition of the growth paradigm, the article sketches its historical (re)making in postwar history by focusing on four entangled discourses. These claimed that GDP, with all its inscribed reductions and exclusions correctly measures economic activity, that its growth serves as a magical ward to solve all kinds of often changing key societal challenges, that growth was practically the same some of the most essential societal ambitions such as progress, well-being, or national power, and that growth is essentially limitless.

Flood risk, land use and private participation in embankment maintenance in Indian Sundarbans

- Ecological Economics---2015---Prasenjit Sarkhel

This paper analyzes the complementarities between land productivity and conservation investments in the context of river embankment maintenance in the Indian Sundarbans. The study finds that households whose principal occupation is aquaculture commit more resources to embankment maintenance relative to those in non-aquaculture employment. While conservation efforts are greater in all types of aquaculture plots irrespective of distance from the embankments, such efforts unambiguously decrease for agricultural plots that are located at a distance from the embankments. Private returns to traditional aquaculture are much higher than returns to agriculture, enabling aquaculture households to invest in managing their local public good. However, there is evidence of free riding in canal-based aquaculture when multiple users draw water from

a single source. Head-enders with greater wealth as well as intense social networks tend to free-ride while tail-enders with less land holdings contribute more towards canal maintenance. Furthermore, public intervention in embankment maintenance may be crowding out private efforts. Thus, in primarily agricultural areas, productivity-enhancing policies like adoption of salt tolerant crops with supportive extension activities may be more efficient than policies that fully subsidize public good maintenance.

Managing tourism in the Galapagos Islands through price incentives: A choice experiment approach

- Ecological Economics---2015---César Viteri Mejía, Sylvia Brandt

This study analyzes nature-based tourism in Ecuador's Galapagos National Park, which faces great risks of invasive species due to visitor contacts. The analysis uses visitors' preference data to evaluate the potential impacts of various pricing strategies on revenues. Data come from choice experiment surveys conducted in 2009, regarding four characteristics of a tour to the Galapagos: length of stay, depth of experience in the islands' ecosystem, level of protective measures taken against invasive species, and price. We found that the typical tourist would be willing to pay 2.5 times more for a tour with high-level of protection against invasive species than for a tour with the current level of protection and otherwise similar characteristics. The mean marginal willingness to pay for a tour with an in-depth natural experience is 1.8 times more than for a similar tour providing only an overview of the Galapagos' ecosystem. Further, we determined that differences in elasticity of demand between long and short tours suggest that a pricing strategy may be used to encourage tourists to take longer tours without affecting total revenue. Such a pricing strategy would decrease the number of unique island visitor contacts per year, thereby reducing the threat to the islands' unique ecosystem.

Profit fluctuations signal eroding resilience of natural resources

- Ecological Economics---2015---Andries Richter, Vasilis Dakos

A common pattern of environmental crises is a vicious cycle between environmental degradation and socio-economic disturbances. Here we show that while such feedbacks may give rise to critical transitions in social-ecological systems, at the same time they can offer novel opportunities for anticipating them. We model a community that has joint access to the harvest grounds of a resource that is prone to collapse. Individuals are tempted to overexploit the resource, while a cooperative harvesting norm spreads through the community via interpersonal relations. Both social and ecological collapses can be induced by environmental or socio-economic driving forces. Regardless of the type and cause of collapse we find that upcoming transitions may be detected using simple socio-economic response variables, such as individual profits. Our findings suggest that such alternative sources of information can be used to detect upcoming critical transitions in social-ecological systems. However, we also find that robust detection of critical transitions may be confounded by recovery attempts undertaken by resource users in the vicinity of an upcoming collapse, which may be falsely interpreted as a stabilization of the social-ecological system.

The role of natural capital in sustaining livelihoods in remote mountainous regions: The case of Upper Svaneti, Republic of Georgia

- Ecological Economics---2015---Robin J. Kemkes

In the Greater Caucasus of the Republic of Georgia, proponents of a new ski tourism zone and long-term timber concessions claim that new wage opportunities will benefit households. These developments will also limit access to common-pool resources (CPRs). This study uses the sustainable livelihoods framework to identify the conditions under which a development strategy will improve livelihood outcomes in the region.

Analysis of original household survey data, in-depth interviews, and field observation reveals that households depend on CPRs for a range of market and non-market benefits. Low-income households depend on CPRs for up to 60% of their total income. OLS regression estimates show that households in villages farthest from market centers have a higher income dependence on CPRs and are more likely to participate in forest use activities. A majority of households report that there are few available substitutes. To improve livelihood outcomes, a development strategy should secure access to market benefits from CPRs, or wage income must increase in proportion to lost CPR income and affordable substitutes must be provided. Access to non-substitutable components of CPRs must be secured, and the distribution of changes in access to natural capital and new wage opportunities must be accounted for.

Design principles for managing coastal fisheries commons in present-day Japan

- Ecological Economics---2015---Ashutosh Sarker,Toru Ikeda,Takaki Abe,Ken Inoue

Ostrom (1990) challenged the traditional belief that commons management inevitably requires state ownership or privatization and instead established the notion of user self-governance. This notion, a third policy option for managing the commons, entails little or no state involvement. Under this notion, Ostrom developed eight design principles to which self-governing institutional arrangements adhere, while the role of the state is minimal. This article seeks to establish whether design principles characterize such institutional arrangements when the role of the state is accommodated explicitly within the principles. Drawing on a case study of present-day management of Japan's community-based coastal fisheries commons, our study shows that the design principles can better characterize self-governing institutional arrangements when the state adopts a pro-user self-governance role that provides strategic support for users, but neither takes ownership of the commons nor participates in engineering the institutional arrangements.

The lack of strategic sustainability orientation in German water companies

- Ecological Economics---2015---Marlen Arnold

Water-supply and distribution companies (WSC) are dealing with one of the most crucial natural resources. That is why the German national sustainability strategy highlights water as one of the priority fields of action. In Germany, WSC show characteristics of natural monopoly. The distinct separation between public institutions and the private sector as well as municipal operators being responsible for practicing special functions is characteristic for the German water economy. From an evolutionary perspective it is of interest how German WSC implement sustainability strategically. Therefore, strategic concepts and tools facing sustainability (e.g. ISO 14001, Reporting, and Balanced Scorecard etc.) were analysed and evaluated in the context of the water industry. Using literature studies and web analysis the relevant data of 110 German WSC was put together. A cross-sectional design was used in order to find patterns. Possible gaps are highlighted and ongoing steps to foster sustainability are stressed. This study points out a sustainable management is just marginally implemented. The results obviously show that there are differences between large companies and SMEs facing sustainability requirements. WSC having own regenerative power generation and an integrative thinking of farming and water supply, are part of good practice.

Payments for ecosystem services and the gift paradigm: Sharing the burden and joy of environmental care

- Ecological Economics---2015---Neera M. Singh

In response to the limited success of command-and-control interventions to ensure environmental stewardship, policy makers and practitioners have turned to financial payments to incentivize conservation. Many scholars and practitioners, including ecological economists, have cautioned that market-based approaches might modify human ways of relating to nature that are counterproductive to long-term conserva-

tion goals. Moving beyond critique, this article invites attention to the reconceptualization of environmental care labor and human–environment relations using the ideas of gift, reciprocity, and affect. Using the case of forest conservation by rural communities in Odisha, India, I discuss how the paradigm of the gift helps us to rethink transactions in ecosystem services, which might lead to more equitable and empowering ways of sharing of the burden and joy of environmental care. I argue that instead of framing conservation as a burdensome activity that entails sacrifice and costs alone, we need to pay attention to the joyful and life-affirming aspects of conservation care labor and its transformative potential.

Assessing the contribution of ecosystem services to human wellbeing: A disaggregated study in western Rwanda

- Ecological Economics---2015---Neil Dawson, Adrian Martin

Lack of attention to social complexity has created a gap between current ecosystem service research and the kind of insights needed to inform ecosystem management in the tropics. To contribute to closing this gap, this study applies a methodology for exploring complex linkages between ecosystem services and human wellbeing. This builds on emerging frameworks for studying multiple dimensions of human wellbeing, drawing on Amartya Sen's capabilities approach to human development. The approach is applied to an empirical case study of three sites adjacent to native tropical forest in western Rwanda. The value of exploring social complexity in ecosystem services research is illustrated through its contribution to understanding a) different types of values; b) disaggregation of people; c) power relations and their influence on trade-offs; d) the importance of multiple land use types in the landscape; and e) changes and their drivers at multiple scales. The analysis reveals that the majority of services valued by forest-adjacent Rwandan inhabitants are not provided by tropical forests but by other habitats. We suggest that more integrated landscape governance may offer synergistic opportunities for conservation

and development.

Application of portfolio theory to asset-based biosecurity decision analysis

- Ecological Economics---2015---Sonia Akter, Tom Kompas, Michael Ward

A key challenge for biosecurity decision-making is how best to allocate scarce resources across multiple environmental assets. The allocation of funds for the best return from investment requires a careful assessment of expected return and uncertainty. In this paper, we applied a portfolio theory-based decision support tool that helps determine resource allocation in a way that maximizes expected return and minimizes uncertainty. Our framework offers three advancements to the literature. First, it helps in making resource allocation decisions across multiple pests that affect multiple environmental assets. Second, it incorporates multiple sources of uncertainty in the decision analysis including economic value uncertainty. Finally, it demonstrates a generic approach to design a choice experiment study to estimate monetary values of a broad group of environmental assets. We find that a portfolio-based framework applied in conjunction with a choice experiment study can be a useful tool to guide biosecurity resource allocation decisions. Our results show that disregarding value uncertainty may cause bias by underestimating true uncertainty in the opportunity set. The choice experiment study revealed substantial positive non-market values generated by environmental biosecurity in Australia. However, significant preference heterogeneity across respondents with regards to different biosecurity outcomes was observed.

Legitimizing farmers' new knowledge, learning and practices through communicative action: Application of an agro-environmental policy

- Ecological Economics---2015---Jean-Pierre Del Corso, Charilaos Kephaliacos, Gaël Plumecocq

This article examines the role of communication in the process that guides economic actors to integrate the moral obligations implied by adopting sustainability

principles in their action choices and to reexamine their practices. We analyze two approaches to implementing agro-environmental measures that encourage farmers to preserve water resources. Verbal interactions between farmers and agricultural advisors, who are part of these policy programs, are analyzed drawing on Jürgen Habermas's theory of communicative action. The discourse analysis used here shows that communicative action encouraged participants to re-examine the validity of the technical, experiential, and normative knowledge that legitimized their reasons for acting. This study brings to light the fact that, in the context of a business primarily oriented towards making a profit, committing to sustainable development does not only operate in technical terms; such a commitment also requires collective validation of the effectiveness of alternative farming practices.

Fracking and environmental (in)justice in a Texas city

- Ecological Economics---2015---Matthew Fry,Adam Briggie,Jordan Kincaid

Shale gas development (SGD) via horizontal drilling and fracking is touted for economic benefits and spurned for health and environmental impacts. Despite SGD's socioecological salience, few peer-reviewed, empirical studies document the distribution of positive and negative effects. The City of Denton, Texas has ~280 active gas wells and over a decade of SGD. Here we use an environmental justice framework to analyze the distribution of SGD's costs and benefits within Denton. Using data on mineral property values from 2002 to 2013 and gas well locations, we ask: who owns Denton's mineral rights (i.e. the greatest financial beneficiaries) and how does this ownership pattern relate to who lives near gas wells (i.e. those who shoulder the nuisances and health impacts)? Our results show that Denton's mineral wealth is widely distributed around the U.S., residents own 1% of the total value extracted, and the city government is a large financial beneficiary. In addition to distributional inequities, our analysis demonstrates that split estate doctrine, legal deference to mineral owners, and SGD's uniqueness in urban

centers create disparities in municipal SGD decision-making processes. The environmental justice issues associated with fracking in Denton also provide one possible explanation for residents' November 2014 vote to ban hydraulic fracturing.

The influence of contextual cues on the perceived status of consumption-reducing behavior

- Ecological Economics---2015---Jeremy S. Brooks,Charlie Wilson

The question of whether and when behaviors that reduce overall consumption are associated with low status has not been adequately explored. Previous research suggests that some low cost environmentally-friendly behaviors are stigmatized, but has not accounted for the impact of contextual information on perceived status. Here, we use costly signaling theory to describe why consumption-reducing behaviors may be associated with low status and when and how this perception might change. We report two empirical studies in the U.S. that use a large sample of graduate students (N=447) to examine the effects of contextual information on how consumption-reducing behaviors are perceived. We then explore the perceived appropriateness of consumption-reducing behavior for signaling status relative to alternative non-environmental behaviors. Using linear mixed-effects models, we find that information indicating that consumption-reducing behavior is a choice results in higher perceived status. However, we find that consumption-reducing behaviors are perceived to be less appropriate for conveying status than consumption-intensive behaviors. The environmental orientation of the respondent has little effect on perceptions of status in both studies. These results provide insights into the dynamic, evolutionary process by which sustainable consumption might become more socially acceptable and the social factors that may inhibit this process.

Cooperation for sustainable forest management: An empirical differential game approach

- Ecological Economics---2015---Pablo Andrés-Domenech,Guioimar Martin-Herran,Georges Zaccour

We model the role of the world's forests as a major carbon sink and consider the impact that forest depletion has on the accumulation of CO₂ in the atmosphere. Two types of agents are considered: forest owners who exploit the forest and draw economic revenues in the form of timber and agricultural use of deforested land; and a non-forest-owner group who pollutes and suffers the negative externality of having a decreasing forest stock. We retrieve the cooperative solution for this game and show the cases in which cooperation enables a partial reduction in the negative externality. We analyze when it is jointly profitable to abate emissions, when it is profitable to reduce net deforestation, and when it is optimal to do both (abate and reduce net deforestation). Assuming that the players adopt the Nash bargaining solution to share the total dividend of cooperation, we determine the total amount that the non-forest owners have to transfer to forest owners. Next, we define a time-consistent payment schedule that allocates over time the total transfer.

Developing a conceptual framework for the attitude–intention–behaviour links driving illegal resource extraction in Bardia National Park, Nepal

- Ecological Economics---2015---Shova Thapa Karki,Klaus Hubacek

This research investigates households' attitudes, and the association between attitudes and illegal resource extraction behaviour at Bardia National Park in Nepal. Despite facing a number of problems households held predominantly positive attitudes towards the park and wildlife. Attitudes were influenced by the respondents' values towards conservation rather than incentives received. However, positive attitude and their general agreement with conservation efforts did not stop households' involvement in illegal resource

extraction. We found that general factors, such as perception associated with the park and contextual variables, and behaviour-specific factors, such as perception of resource extraction, had an impact on behaviour. Behaviour-specific factors help to understand how individuals frame their behaviour and how this framing constrains or facilitates behavioural change. Similarly, general factor helps to understand why households engage in the behaviour. Therefore, it is important to consider both of these factors to understand actual behaviour. Our research shows that positive attitudes by themselves are not sufficient for changing behaviour. This indicates that interventions need to be directed to all parts of the causal chain from environmental awareness, to attitudes, to intention, and finally to actual behaviour; missing a link in the sequence will interrupt the whole process.

Investigating the impacts of technological position and European environmental regulation on green automotive patent activity

- Ecological Economics---2015---Nicolò Barbieri

Using patents data on environmental road transport technologies filed by 355 assignees over the period 1999–2010, the paper investigates under what conditions the European environmental transport policy portfolio and the intrinsic characteristics of assignees' knowledge boost worldwide green patent production. The findings suggest that post-tax fuel prices, environmental vehicle taxes, CO₂ standards and European emission standards, introduced into the empirical model through an innovative methodology based on Self-Organising Maps (SOM) (Kohonen, 1990, 2001), positively influence the creation of environmental inventions. Most importantly, the paper highlights that assignees anticipate the introduction of regulatory instruments (i.e. European emission standards and CO₂ targets) by filing patents before the effective implementation of regulations when legislation is announced. Furthermore, the paper provides evidence that in a technological space (which measures the applicants' technological proximity), closely located assignees enhance their patent output through the exploitation

of technological knowledge produced by others. This means that the greater the proximity between assignees, the higher their likelihood of gaining advantage from this potential spillover pool. Finally, the paper observes that dynamic changes in assignees' patent portfolios spur inventive performances.

What drives households to buy flood insurance? New evidence from Georgia

- Ecological Economics---2015---Ajita Atreya,Susana Ferreira,Erwann Michel-Kerjan

Benefiting from access to detailed data on the federally run National Flood Insurance Program for the entire state of Georgia, USA, we analyze residential flood insurance purchasing behavior in that state over more than three decades (1978–2010). The demand for flood insurance on an extensive margin, based on take-up rates, is found to be relatively price inelastic. Aligned with the behavioral economics literature, recent flood events temporarily increase purchases, but this effect fades after 3years. We also find that the proportion of developed area in floodplains has a significant positive impact on insurance take-up rates. Contrary to what is often assumed, we do not find evidence that insurance purchase and mitigation efforts are substitutes. Educated individuals, individuals over the age of 45, and African-Americans are, all else equal, more likely to purchase flood insurance.

Barriers and opportunities for alternative measures of economic welfare

- Ecological Economics---2015---Brent Bleys,Alistair Whitby

This paper explores a number of barriers and opportunities facing alternative measures of economic welfare by conducting semi-structured in-depth interviews with (potential) users in both Belgium and Germany. The barriers that they identified are grouped into three categories. Context factors are embedded in the policy context and agendas that shape the environment in which an indicator percolates, indicator factors depend on specific characteristics of the indicators, while user

factors relate to the level of experience and expertise of the users of indicators and the institutional culture in which they operate. Drawing on the different barriers that are reported, we identify four opportunities to increase the policy value of alternative measures of economic welfare: harmonizing and updating the methodological framework, extending macroeconomic models to include a wider range of welfare-related items, improving the communication around these indicators and promoting indicator and researcher entrepreneurship. These opportunities should be regarded as recommendations to the scientific community that works on these alternative measures. The process of overcoming the different barriers listed in this paper should not be insurmountable, as there is clear international public support for using health, social and environmental statistics as well as economic statistics to measure societal progress and human well-being.

Critique and transformation: On the hypothetical nature of ecosystem service value and its neo-Marxist, liberal and pragmatist criticisms

- Ecological Economics---2015---Andony P. Melathopoulos,Alexander M. Stoner

Ecosystem service valuation (ESV) attempts to transform the opposition of human economic necessity and ecological conservation by valuing the latter in terms of the services rendered by the former. However, despite a number of ESV-inspired sustainability initiatives since the 1990s, global ecological degradation continues to accelerate. This suggests that ESV has fallen far short of its goals of sustainable social transformation—a failure which has generated considerable criticism. This paper reviews three prominent lines of ESV criticism: 1) the neo-Marxist criticism, which emphasizes the “fictitious” character of ecosystem commodities; 2) the liberal criticism through Friedrich Hayek’s concept “scientistic objectivism” ; and 3) the pragmatist criticism of “value monism” . Although each form of criticism provides insight into the limitations of ESV, all share ESV’s inability to discern what kind of social transformation is possible. Unable to provide an account of their own immersion in social and

historical context, these approaches operate in the hypothetical. In light of these shortcomings, this paper advances a critical theory approach, which we contend provides conceptual tools uniquely well-suited to more adequately address the question of social transformation.

Determinants affecting farmers' willingness to cooperate to control pests

- Ecological Economics---2015---Heidi R. Stallman,Harvey S. James

Natural pest control is an important ecosystem service that is rapidly declining in the United States. Farmers may be able to increase the provision of natural pest control by working together. However, little is known about US farmers' willingness to cooperate to control pests. In this study, we survey 229 Missouri crop farmers to explore farmers' willingness to cooperate. We find that 91% say they are willing to cooperate to control pests, and that simple, local cooperative efforts may be more popular than formal, county-wide efforts. In addition, the determinants that affect willingness to cooperate follow those predicted by the collective action, agricultural adoption, and ecosystem management literatures. Specifically, farmers who believe that they will receive a net benefit, have farms similar to their neighbors', are active members of a community organization, have positive contact with agricultural extension agents, and are concerned about the effect that pesticides may have on the environment are more willing to cooperate than farmers who do not share these characteristics. This study provides valuable insights into the conditions that may foster cooperation between farmers in the provision of an ecosystem service. Plus, it may help facilitate the formation of pest control cooperatives in the United States.

Evaluation of land use based greenhouse gas abatement measures in Germany

- Ecological Economics---2015---Norbert Röder,Martin Henseler,Horst Liebersbach,Peter Kreins,Bernhard Osterburg

Agricultural production contributes 11% to the total German greenhouse gas (GHG) emissions. We compare the efficiency of three different land use based GHG abatement measures in combination and as separately applied measures: the production of short rotation coppices, of feedstocks for biomethane production, and peatland restoration. We evaluate these options with respect to the following criteria: cost efficiency (GHG abatement costs), abatement potential, and impact on agricultural production. We use the regional supply model RAUMIS to investigate the different abatement measures at the sector and regional level. Up to a reduction of GHG emission of 25 1012g CO2eq peatland restoration is the most cost efficient option. Short rotation coppice allow some cost-efficient mitigation also only at limited scale. Energy maize is only an option if high abatement targets should be met. The joint implementation of several abatement strategies allows meeting specified targets at lower costs. The crowding out effect between the options is limited. The spatial analysis indicates measure specific regional competitiveness and application e.g. short rotation coppice in Eastern and Southern Germany, peat restoration in Northern Germany and energy maize production in central Germany.

Forest reliance across poverty groups in Tanzania

- Ecological Economics---2015---Therese Dokken,Arild Angelsen

An emerging body of knowledge has established that poorer households in forest adjacent communities in developing countries are generally more forest reliant (higher forest income share) while richer households tend to extract more and generate higher absolute forest income. These studies commonly categorize households based on observed income in cross-section data, presenting a snap-shot reflecting both inter-household and inter-annual income variation. In this paper we introduce a new approach to categorize households based on a combination of the observed one-year income and predicted income by an augmented asset approach. Applying this approach on household data

from Tanzania, we find forest reliance to be high among structurally poor households (low observed income and assets). The highest forest reliance is found among the stochastically non-poor households (high income and low assets), and this group also has the highest absolute forest income.

Markets in environmental governance. From theory to practice

- Ecological Economics---2015---Arild Vatn

The aim of this paper is to clarify what is meant by ‘markets for ecosystem services (ES)’. The defining characteristic of markets is interaction through trade. Two main dimensions are identified as basis for classifying markets in ES. Firstly, we have markets with and without intermediaries. Secondly, some markets for ES are created by defined liabilities like caps on emissions while other trades come about voluntarily. Altogether six forms of markets are identified, with two being incomplete. The paper also offers an analysis of the most important existing markets for ES using the developed classification. Regarding payments for ecosystem services (PES), most are not markets, not even incomplete. This is so as most resources are raised through taxes or fees — command not trade. Moreover, most payments are best characterized as subsidies. Cap-and-trade systems like those for carbon qualify as markets, but depend crucially on the politically defined cap. Moreover, it is this cap that protects the environment. While the idea with markets in ES is to ‘escape’ command and control, it is observed that C&C is essential for these markets to work.

Revisiting the concept of payments for environmental services

- Ecological Economics---2015---Sven Wunder

This article revisits the payments for environmental services (PES) concept and reviews existing PES definitions. Based on Weberian philosophy of science, it is argued that an ideal PES type, strongly embedded in PES theory, is needed to understand their logic. Many broader, empiricist definitions fail to distinguish PES

from the larger generic family of positive environmental incentives, thus eroding their meaning by excessive vagueness. Arguably, PES definitions should focus on describing a functional tool, rather than normatively integrating desirable PES outcomes. A modified narrow PES definition is proposed, outlining conditionality as the single defining feature, avoiding the buyer-seller terms, and linking PES to offsite externalities. Extensive explanatory guidelines address many valid conceptual concerns raised in the recent PES literature.

Extending market allocation to ecosystem services: Moral and practical implications on a full and unequal planet

- Ecological Economics---2015---Joshua Farley, Abdon Schmitt, Matthew Burke, Marigo Farr

Both economists and conservationists are calling for expanded use of market-based instruments (MBIs) to address worsening environmental problems, but the lack of MBIs at the scale required to solve major global problems makes it difficult to empirically evaluate their effectiveness. This article indirectly evaluates MBIs for essential ecosystem services by examining market allocation of another essential resource that is allocated by markets and which has experienced dramatic price increases: food. In an unequal world, markets respond to price increases by reducing food allocations to the destitute and malnourished, but not for the affluent. MBIs would increase the prices of ecosystem services and the commodities whose production degrades them, forcing the impoverished to reduce consumption by more than the wealthy. Furthermore, most MBIs would be prone to speculation and price instability, be incompatible with the satisfaction of individual preferences, or would not maximize economic surplus. Most environmental problems can be characterized as prisoner’s dilemmas, which are best solved through cooperation, not competition. Society must create economic institutions that promote cooperation and ensure that the burdens of reducing throughput are not borne disproportionately by the poor.

Talking money: How market-based valuation can undermine environmental protection

- Ecological Economics---2015---Stijn Neuteleers,Bart Engelen

In this paper, we want to analyze conceptually whether and when merely using economic discourse – talking money – can crowd out people’s positive attitudes towards environmental goods and their reasons to protect them. We concentrate on the specific case of market-based or monetary valuation (MV) as an instance of ‘commodification in discourse’ and argue that it can have the same moral problems as real commodification. We aim to bring together insights from philosophy (pluralistic value theory), ethics (corruption), economics and psychology (crowding-out) to argue that there are good reasons to think about how and when to apply MV in environmental cases. On the basis of this interdisciplinary analysis and in order to promote further empirical research, we develop four empirically falsifiable hypotheses. (i) Commodification in discourse can bring about real commodification. (ii) MV can have framing and crowding effects on those who come into contact with it. (iii) Intrinsic motivation is more robust than extrinsic motivation and leads less to freeriding. (iv) MV’s framing and crowding effects can decrease (demand and support for) environmental protection.

Reprint of "Ecosystem services concepts and approaches in conservation: Just a rhetorical tool?"

- Ecological Economics---2015---Janet A. Fisher,Katrina Brown

Many commentators have raised questions about the recent focus on ecosystem services (ES) concepts in conservation, but little empirical analysis exists. We present a novel empirical analysis using interviews and Q Methodology to examine how conservation practitioners and organisations are interpreting and using ES concepts and associated approaches. We find that these concepts are being adopted for instrumental imperatives to broaden constituencies and with an expectation of extending funding sources. We uncover

concerns within conservation that the utilitarian emphases of ES concepts may compromise the ability to make non-utilitarian arguments for nature in the future. In relation to changing practice, we examine shifts in partnerships and funding, where ES ideas provide a shared language about flows of value, apparently accelerating the integration of conservation and the private sector. Whilst many respondents noted the significance of shifts related to ES ideas, some attempted to play these down, presenting their organisation’s adoption of these ideas as ‘just a rhetorical tool’. However, we argue that the adoption of ES concepts cannot be presented as solely rhetorical, given that these increasingly underpin and inform planning tools and policy instruments.

Motivation crowding by economic incentives in conservation policy: A review of the empirical evidence

- Ecological Economics---2015---Julian Rode,Erik Gómez-Baggethun,Torsten Krause

The paper seeks to advance our understanding of the extent to which the use of economic incentives can undermine (“crowd out”) or reinforce (“crowd in”) people’s intrinsic motivations to engage in biodiversity and ecosystem conservation. We first synthesize and classify the psychological mechanisms behind motivation crowding effects. Then we conduct a systematic review of empirical studies that test for motivation crowding effects triggered by economic incentives to encourage nature conservation. Based on eighteen empirical studies, we identify evidence of motivation crowding out and, to a lesser extent, crowding in effects. Finally, we discuss the implications for environmental policy and research. We note that the limited comparability of results across studies, the lack of baseline information about pre-existing intrinsic motivations, and a complexity stemming from cultural and contextual heterogeneity appear to be the main challenges when it comes to establishing more conclusive evidence. We conclude that, as economic instruments for conservation are increasingly being used worldwide, it is crucial to assess existing intrinsic motivations and expected

changes in people's motivational structures prior to large-scale implementation. We call for caution with economic incentives in situations involving considerable uncertainty regarding the detrimental impacts on intrinsic motivation.

Reprint of 'Yes-in-my-backyard' : Spatial differences in the valuation of forest services and local co-benefits for carbon markets in México

- Ecological Economics---2015---Arturo Balderas Torres,Douglas C. MacMillan,Margaret Skutsch,Jon C. Lovett

Forests provide many and large benefits, including cost-efficient climate change mitigation. However international carbon markets have not stimulated the demand for forestry offsets. Domestic market-mechanisms are emerging in many countries and forests could be highly valued through these policies as most of the benefits produced by forests are enjoyed locally. Here, a choice experiment explores drivers of valuation and willingness to pay for forest carbon services in voluntary markets in Mexico by comparing the valuation of citizens from four regions to test geographical preference for projects (n=645). Findings from multinomial-logit models show valuation of forest carbon services is transferable and citizens would pay more for offsets from projects closer to their homes. Proximate forests provide a range of co-benefits to local users, including environmental services and opportunities for recreation. Factors related to valuation include sense of responsibility, previous knowledge of carbon emissions, previous visits to the sites, regional identification and the valuation of local environmental services (e.g. improvements in local air quality). Knowledge of spatial heterogeneity in valuation of the use of forest services can help to design market-based instruments by identifying highly valued areas for environmental services programs and carbon markets.

Payments for environmental services and control over conservation of natural resources: The role of public and private sectors in the conservation of the Nima watershed, Colombia

- Ecological Economics---2015---J.C. Rodríguez-de-Francisco,J. Budds

In Latin America, payment for environmental services (PES) is a tool for watershed conservation that is becoming increasingly promoted by some government agencies, international development organisations and environmental NGOs. However, in pursuit of conservation, PES initiatives implemented at the watershed level may conceal the environmental impacts on local communities of private actors funding PES initiatives. Drawing on semi-structured interviews, focus groups and archival research in the Cauca Valley, Colombia, we present the case of a PES scheme in which several commercial water users paid for the conservation of the upper part of the Nima watershed as a means of securing the flow of water upon which they rely. We show how the scheme was predicated upon very selective interpretations of degradation and conservation, and the roles of those deemed responsible for them, that were mobilised by those groups paying for environmental services to the detriment of other water users.

Contesting legitimacy of voluntary sustainability certification schemes: Valuation languages and power asymmetries in the Roundtable on Sustainable Palm Oil in Colombia

- Ecological Economics---2015---Victoria Marin-Burgos,Joy S. Clancy,Jon C. Lovett

Voluntary certification schemes aimed at assuring producer compliance with a set of sustainability criteria have emerged as market-based instruments (MBIs) of sustainability governance. However, the impacts they tackle can be part of a complex arena of socio-environmental conflict, where values and powers of business and local actors compete. Legitimacy of these schemes not only results from compliance by business actors; but also depends on acceptance by local actors affected by, or resisting the industries that these

mechanisms aim to govern. This paper explores the influence of different local actors' values and powers on legitimacy granting or contestation by local actors during national processes of sustainability criteria development. We analyse the case of the Roundtable on Sustainable Palm Oil (RSPO) in Colombia using an approach that combines concepts of ecological economics and political ecology with the legitimacy literature based on critical sociology. In Colombia, the palm oil industry led the initiative to implement certification under national interpretation of RSPO principles and criteria. However, the national interpretation process revealed power asymmetries among stakeholders and clashes between their different values. This resulted in strong contestation of RSPO legitimacy by local actors who resist expansion of oil palm cultivation.

The development-driven forest transition and its utility for REDD+

- Ecological Economics---2015---Sean Sloan

Forest recovery is occurring in Panama and several other tropical countries following decades of deforestation. Theory on such 'forest transitions' describes urbanization and agricultural modernization as underlying factors. Tropical country governments may seek to harness these factors to promote a tropical forest transition within the REDD+ scheme. Yet tropical forest transitions remain poorly described due to limited data and inappropriate modeling. To determine the nature of a tropical forest transition I derive canonical correlations of (a) socio-agrarian transformation observed via respondent-level census records and (b) forest-cover change observed via satellite imagery, for 82% of Panamanian counties over 1980–1990–2000–2008. The Panamanian forest transition centered on multi-decadal in situ shifts in employment from agriculture to off-farm activity, particularly by women. Agricultural modernization and decline were coincident but of lesser importance. Urbanization entailed increasingly connected small urban centers in otherwise rural landscapes. Net forest gains per decade were ~1.5–2% of the area of influence of the socio-agrarian transformations, which concentrate in economically and agriculturally favored

regions. Governments may conceivably nurture forest transitions already underway via economic policies, but they cannot coordinate them. Even so, inefficiencies may be prohibitively high, and challenges significant. A history of failure of similar 'social engineering' endeavors urges caution in this respect.

The SES-Framework as boundary object to address theory orientation in social–ecological system research: The SES-TheOr approach

- Ecological Economics---2015---Tilman Hertz,Maja Schlüter

Social–ecological system (SES) research is inherently cross-disciplinary which can create multiple challenges for building knowledge of SES. Some of these challenges relate to differences in ontological commitments due to theory orientation of individual disciplines. Frameworks, understood as boundary objects, have been suggested as tools for dealing with this type of challenge. This paper investigates this capacity of frameworks taking Elinor Ostroms' SES-Framework as an example. To this aim, we developed a generic approach (the SES-TheOr approach) to promote disclosure and bridge differences in ontological commitments in SES research. We then applied it for examining the use of the SES Framework as boundary object within a small cross-disciplinary research team. We found that the SES Framework provided a useful common reference and starting point for discussing variables but could not fully deal with theory orientation. We conclude by suggesting that this may partly arise due to a tension between two competing SES Framework aims: on the one hand bridging differences in ontological commitments, and on the other hand ensuring a comparative function across cases.

Volunteer and satisfied? Rural households' participation in a payments for environmental services programme in Inner Mongolia

- Ecological Economics---2015---Sylvie Dé-murger,Adeline Pelletier

Using survey data from Inner Mongolia, this paper

explores the role of stakeholder engagement in the implementation of the Sloping Land Conversion Programme, a payments for environmental services (PES) programme designed to restore forest in degraded land. Based on the idea that volunteerism and satisfaction with the programme's outcome are two important components of the programme's viability, we successively analyse the intensity of households' participation in the programme and their reported satisfaction with its economic achievement, which we relate to their stated volunteerism. We show that households' participation intensity in the SLCP is primarily driven by land and location characteristics, and that these findings hold true whether or not the households voluntarily enrolled in the programme. Moreover, as far as participants' satisfaction can be interpreted as an indicator of potential long-term support for the programme, our findings also support plausible sustainability for the programme.

A transdisciplinary approach to the economic analysis of the European Water Framework Directive

- Ecological Economics---2015---Julia Martin-Ortega,Angel Perni,Leah Jackson-Blake,Bedru B. Balana,Annie Mckee,Sarah Dunn,Rachel Helliwell,Demetrios Psaltopoulos,Dimitris Skuras,Susan Cooksley,Bill Slee

The European Water Framework Directive (WFD) prescribes economic principles to achieve its ecological targets. The aim is to establish cost-effective measures to attain good ecological status and assess whether the costs of these measures are justifiable in view of the benefits they provide. The complex nature of water problems requires flexible decision-making embracing a diversity of 'knowledges'. Here, natural and social scientist worked together in an integrated approach 'ground-tested' through local stakeholders' knowledge and views. The aims were to: (1) develop a set of steps for implementing this transdisciplinary approach, and (2) critically reflect on the challenges of integrating different strands of knowledge to the specific context of the economics of the WFD. This was tested at a sub-catchment in Scotland. Hydro-chemical models were

used to simulate effectiveness of phosphorous pollution mitigation measures, which was then incorporated into a cost-optimization model. Costs were compared with benefits resulting from water quality improvements. This analysis was accompanied by an iterative local stakeholder consultation process. The research further analysed whether selected measures are 'future-proof' in view of climate and land-use changes. Results are used to help set the research agenda for more practical specification of economically sound and socially acceptable ways to deliver the WFD.

Designing REDD+ schemes when forest users are not forest landowners: Evidence from a survey-based experiment in Kenya

- Ecological Economics---2015---Marcella Veronesi,Tim Reutemann,Astrid Zabel,Stefanie Engel

This study contributes to the debate on Reducing Emissions from Deforestation and Forest Degradation (REDD+) and the relationship between land tenure and forest conservation. We investigate policies that create alternative livelihood options for people around REDD+ forests who are forest users but not forest landowners. We compare the performance of a conventional integrated conservation and development policy (ICDP) with an alternative hybrid policy that combines features of ICDP and payments for environmental services. Through a survey-based experiment in Kenya, we compare the effectiveness of different REDD+ payment schemes given rising opportunity costs of forest use. This study shows that hybrid approaches that provide alternative income opportunities to local people, target the local drivers of deforestation, are conditional on environmental outcomes, and account for changing opportunity costs could work as effective policy options.

The commodification of nature and socio-environmental resistance in Ecuador: An inventory of accumulation by dispossession cases, 1980–2013

- Ecological Economics---2015---Sara La-torre,Katharine Farrell,Joan Martínez-Alier

This article aims to advance understanding of the relationship between social metabolism, the commodification of nature, local regime changes, and patterns of resistance to accumulation by environmental dispossession during the most recent phase of global capitalism. Ecuador is a resource-rich periphery country that has moved after 2007 from a neoliberal to a post-neoliberal policy regime. By analyzing 64 socio-environmental resistance cases in the period 1980–2013, we focus on the continuities and changes in the relationship between environmental dispossession and resistance under the two regimes. We find that while resistance to agri-food projects has diminished, having enjoyed some success under during the post-neoliberal regime, resistance to infrastructure and mineral extraction projects has remained steady, with the impacts from environmental dispossession remaining much like those observed before 2007. At the same time, major social investments financed through natural resource extraction and export, combined with the introduction of constraints on the media and public assembly, have created a political climate in which the resistance observed during the neo-liberal period is now a socially deviant behavior.

Social construction of the environment and smallholder farmers' participation in 'low-carbon' , agro-industrial crop production contracts in the Philippines

- Ecological Economics---2015---Marvin Joseph F. Montefrio,David A. Sonnenfeld,Valerie A. Luzadis

Several studies have suggested that socio-economic factors and production site characteristics are primary determinants of farmers' participation in 'low-carbon' , agro-industrial (biofuels and oil palm) production contracts. In the Philippines, many smallholder farmers have expressed their intent to participate in intensive

production of biofuel crops and oil palm with state and private organizations; others have resisted or remained indifferent. This study looks into smallholders' social construction of the environment and how this may influence their decisions to participate in such production contracts. The study is based on a survey of 462 respondents in eight communities in the province of Palawan. Using regression analysis, it illustrates how smallholders' sense of place and environmental worldviews, together with demographic and socio-economic variables, play significant roles in their decisions to enter into new biofuels (jatropha) and oil palm production contracts. Environmental worldviews are significant when there are strong negative perceptions attached to a particular crop production contract, as in the case of oil palm.

Bio-basing society by including emotions

- Ecological Economics---2015---Susanne Sleenhoff,Laurens Landeweerd,Patricia Osseweijer

A bio-based economy needs a bio-minded society since the required actions are of a collective scale. Engagement of civic society is crucial but disregarded by some of the advocates of the bio-based turn. Connecting society to this complex transition is difficult and so far insufficient. Technocratic one-directional communication strategies that aim to nurture public trust and support for the transition to a bio-based economy often backfire. Besides, 'tamed' , institutionalised public participation approaches to legitimise policies may frustrate the public rather than facilitate engagement. What is needed is an approach that engages the public as active citizens, in an open-ended process. This pre-conditional 'state of engagement' can only exist when the public feels it holds a stake and has a voice. Initiating such engagement is not possible through rational deliberative processes. In this paper we consider and explore the value of emotions for strengthening public engagement. We argue for a mentality change with regard to the potential role of citizens in a bio-based economy.

Mandatory versus voluntary payment for green electricity

- Ecological Economics---2015---Elcin Akcura

Renewable energy sources have a critical role to play in contributing to the diversity, sustainability and security of energy supplies. The main objective of the paper is to gain an understanding of the support mechanism of renewable energy sources most preferred by households in the United Kingdom. This paper analyses households' preferences and willingness to pay under a mandatory scheme where all households contribute compared to a voluntary scheme where only those who wish to pay to support renewables do so (such as the green tariffs offered by electricity suppliers in the UK). Two contingent valuation method (CVM) surveys are used to explore whether the type of payment option has an impact on households' willingness to pay (WTP) for increasing share of renewable energy in electricity generation. The paper also investigates whether the type of payment mode affects respondents' self-reported certainty of paying their stated valuations. The results indicate that the likelihood of paying a positive amount for supporting renewable energy is higher under a mandatory scheme compared to a voluntary payment option in the UK. Respondents have a higher level of certainty in paying their stated WTP under a mandatory payment scheme.

What time to adapt? The role of discretionary time in sustaining the climate change value-action gap

- Ecological Economics---2015---Andreas Chai,Graham Bradley,Alex Lo,Joseph Reser

The considerable gap between the individuals level of concern about climate change and the degree to which they act on these concerns is a major impediment to achieving more sustainable consumption patterns. We empirically investigate how the amount of discretionary time that individuals have at their disposal influences both what type of sustainable consumption practices they adopt and the size of this value-action gap. We contend that discretionary time has a twofold effect.

Given fixed preferences, time-poor individuals tend to satisfy their preferences by adopting sustainable consumption practices that require relatively less time. Moreover, a lack of discretionary time also inhibits agents from developing preferences that actually reflect their underlying environmental concerns. Our findings support both of these hypotheses and suggest that increasing discretionary time is associated with significant reductions in the value-action gap. This suggests that policies which increase discretionary time, such as measures to improve the work-life balance, may thus help in fostering the emergence of pro-environmental preferences among consumers in the long run.

Does education increase pro-environmental behavior? Evidence from Europe

- Ecological Economics---2015---Andrew Meyer

It is often observed that individuals with higher education levels tend to be more environmentally friendly. Yet, the causal evidence is lacking because there may well be omitted variables that cause individuals to attain more education and also cause individuals to be environmentally conscious. We implement a regression discontinuity design to estimate the increase in educational attainment due to changes in compulsory education laws in 20th century Europe. This allows us to overcome the identification problem of endogenous educational attainment. Using two waves of Eurobarometer surveys, we find a positive local average treatment effect for 7 of the 8 pro-environmental behaviors. An analysis of related questions on the survey supports the notion that education causes individuals to be more concerned with social welfare and to accordingly behave in a more environmentally friendly manner.

The tragedy of bird scaring

- Ecological Economics---2015---Matthew Ainsley,Nicolas Kosoy

This paper examines crop raids by birds in semi-arid Kenya, highlighting the importance of bird scaring as a barrier to the greater adoption of drought-resilient,

High Value Traditional Crops (HVTCs) in the region. Using survey data from Tharaka-Nithi County, we find 100% of millet and sorghum farmers in the study area scare birds from their plot, devoting 43–66% of all labour time to this activity when these crops are grown in monocrop plots and 24–47% of labour time in plots where millet and sorghum are grown in combination with other crops. This labour allocation is in stark contrast to farmers of all other crops who dedicate almost no time to bird scaring. Individually scaring birds from their plot, farmers achieve a ‘momentary Pareto optimal’, perpetuating a ‘ripple effect’ whereby the negative cost of birds are continuously shifted from one farmer to the next. We systematically examine this cost-shifting behaviour as an externality, theoretically applying environmental and resource economics (ERE) policy prescriptions for externality internalisation. ERE, however, with its focus on self-interest, rational actors and technological interventions, falls short to present effective solutions to this so-called externality. Farmers in the region can address crop raids by birds through collective, coordinated action. At this scale, the negative cost of pests is deliberately distributed across all receptors, leading to long-term, community-wide social wellbeing improvements.

Refunded emission payments and diffusion of NOx abatement technologies in Sweden

- Ecological Economics---2015---Jorge Bonilla Londoño, Jessica Coria, Kristina Mohlin, Thomas Sterner

This paper studies how different NOx abatement technologies have diffused under the Swedish system of refunded emission payments (REP) and analyzes the determinants of the time to adoption. The policy, under which the charge revenues are refunded back to the regulated firms in proportion to energy output, was explicitly designed to affect investment in NOx-reducing technologies. The main finding is that REP had a significant effect on the adoption of post-combustion technologies. Moreover, we also find some indications that the effects of REP have been enhanced by the existing system of individual emission standards. In

particular, the effect of REP speeding up the pace of adoption of post-combustion technologies is considerably larger in those counties where stringent standards are in place.

Benefits of invasion prevention: Effect of time lags, spread rates, and damage persistence

- Ecological Economics---2015---Rebecca S. Epanchin-Niell, Andrew M. Liebhold

Quantifying economic damages caused by invasive species is crucial for cost-benefit analyses of biosecurity measures. Most studies focus on short-term damage estimates, but evaluating exclusion or prevention measures requires estimates of total anticipated damages from the time of establishment onward. The magnitude of such damages critically depends on the timing of damages relative to a species’ arrival because costs are discounted back to the time of establishment. Using theoretical simulations, we illustrate how (*ceteris paribus*) total long-term damages, and hence the benefits of prevention efforts, are greater for species that a) have short lags between introduction and spread or between arrival at a location and initiation of damages, b) cause larger, short-lived damages (as opposed to smaller, persistent damages), and c) spread faster or earlier. We empirically estimate total long-term discounted impacts for three forest pests currently invading North America — gypsy moth (*Lymantria dispar*), hemlock woolly adelgid (*Adelges tsugae*), and emerald ash borer (*Agrilus planipennis*) — and discuss how damage persistence, lags between introduction and spread, and spread rates affect damages. Many temporal characteristics can be predicted for new invaders and should be considered in species risk analyses and economic evaluations of quarantine and eradication programs.

Towards connecting green economy with informal economy in South Africa: A review and way forward

- Ecological Economics---2015---Suzanne Smit, Josephine K. Musango

The informal economy is a vibrant and growing phenomenon, offering both opportunities and lessons on resilience and innovation. When considering global social, economic and environmental challenges, resilience and innovation are valuable response strategies. The notion of a green economy has similarly inspired a number of ideological, geopolitical and institutional responses, yet a review of the dominant approach indicates the propensity to undervalue or ignore the informal economy. Within the context of sustainable development and poverty eradication, connecting the informal economy with the green economy is imperative. This paper explores possible connections between the green economy and the informal economy in South Africa and argues that by engaging the informal economy in discussions on the green economy, a more informed policy and planning environment may ensue, resulting in more socially equitable and environmentally sustainable development.

Community currencies and sustainable development: A systematic review

- Ecological Economics---2015---Arnaud Michel,Marek Hudon

Community or complementary currency systems have spread all around the world. Most often, they have been promoted as tools to foster sustainable development albeit they differ in terms of specific objectives. While many case studies have tried to assess the actual impact of these systems, there has been no global analysis summarizing their global impact.

Integrating multiple perspectives on payments for ecosystem services through a social–ecological systems framework

- Ecological Economics---2015---Drew E. Bennett,Hannah Gosnell

This article presents a new conceptual approach to understanding payments for ecosystem services (PES) through a synthesis of distinct perspectives using a social–ecological system (SES) framework. While the different perspectives on PES provide valuable insights,

each emphasizes different variables complicating comparisons across studies and contexts. We suggest that a more integrative conceptualization of PES—through synthesis with the SES framework—is necessary to take into account the broader social and ecological landscapes in which PES initiatives are embedded. The SES framework can provide insight into the multitude of factors that influence PES and facilitate the integration of knowledge from diverse disciplinary perspectives by providing a common language and consistency in the variables considered in analyses. This article also presents an initial effort in the development a taxonomy of key variables relevant to analyzing and understanding PES. With ongoing application of the SES framework, we expect the list of key variables to grow and be modified. We feel the SES framework will help scholars move beyond academic debates and towards a shared understanding of the potential and limitations of PES as a policy mechanism for addressing complex ecosystem service management problems in diverse SESs.

The carbon implications of declining household scale economies

- Ecological Economics---2015---Anthony Underwood,Sammy Zahran

In the United States, average household size decreased significantly over the past half century. From 1950 to 2010, the number of households increased 72% faster than population size. In this paper we consider how this drift toward more and smaller households, occurring alongside rising affluence, undermines efforts to curb carbon dioxide (CO₂) emissions by eroding household scale economies of consumption and associated CO₂ emissions. To estimate the household scaling of CO₂ emissions, we link consumer expenditure data to an economic input–output life-cycle assessment model. We find that the CO₂ scaling benefits of cohabitation are compellingly large, with the carbon footprint of a representative person cohabiting with others being 23% less, on average, than if that same person lived alone. Additionally, we find that household scale economies: 1) decrease in income, reflecting the rise in the percentage

of household expenditures devoted to more rival goods and services; and 2) increase intuitively in household size, reflecting the direct expenditure sharing benefits of cohabitation. The combined downward pressure on scale economies from declining household size and rising incomes, typifying the trajectory of developing societies toward more and smaller households and rising affluence, places significant upward pressure on CO₂ emissions globally.

Mechanisms explaining the impact of economic inequality on environmental deterioration

- Ecological Economics---2015---Alexandre Berthe,Luc Elie

Rising economic inequality, often considered intrinsically harmful, is increasingly being viewed as having a number of secondary impacts as well, including impacts on health and economic growth. The ongoing nature of today's environmental crisis also raises questions about inequality's role in environmental deterioration. Despite the large number of papers that have been written on this topic, no theoretical or empirical consensus presently exists. Firstly, our article identifies that authors' conclusions in this area depend on their hypotheses regarding 1) the relationship between individual income and individual environmental pressure, 2) the impact of inequality on the social norms that influence individual environmental pressure, 3) the interests that social groups have in degrading or protecting the environment, 4) how these interests play out in terms of political demands, and 5) how these political demands translate into political decisions. Secondly, the study shows that, despite enabling a general test of the causal relationship between inequality and the environment, the empirical methods utilised do not account for the full range of theoretical mechanisms in play. Hence the suggestion that a research programme be launched to conduct empirical studies of the five aforementioned hypotheses by applying a recursive approach.

A spatial bioeconomic model of the harvest of wild plants and animals

- Ecological Economics---2015---Anders Sirén,Kalle Parvinen

The intensity of harvest of wild plants and animals often varies with the distance from human settlements, processing facilities, markets, and transportation routes such as roads and rivers, resulting in marked spatial gradients in the abundance of such resources. Spatial modeling of the harvest of wild species has therefore emerged as an important research approach. The literature on such modeling is, however, fragmented between different resource types, and empirical validation of the models is often weak or absent. This paper presents a model that is intended to have validity for a wide variety of wild plant and animal resources. It combines a logistic model of resource growth with an economic model assuming that costs associated with harvest consist of three components, namely transport, search, and handling, and a one-dimensional spatial structure where resource harvesters are based at a "central place" surrounded by infinite extensions of habitat for the harvested resource. Model outcomes show that the spatial distribution of harvest heavily depends on the carrying capacity and the catchability coefficient, i.e. the ease of finding and harvesting a resource unit. An empirical study of wildlife hunting and palm leaf harvest in indigenous villages in Ecuadorian Amazonia confirmed the validity of model outcomes.

Measuring environmentally sensitive productivity growth: An application to the urban water sector

- Ecological Economics---2015---Jayanath Ananda,Benjamin Hampf

The energy use and greenhouse gas emissions in the provision of urban water and sewerage services have become an increasingly important issue in recent times. However, the impact of negative externalities such as greenhouse gas emissions on the productivity of urban water provision has received less attention in the literature. This paper applies the

global Malmquist–Luenberger (GML) productivity index, which accounts for undesirable outputs in order to evaluate the productivity trends in the Australian urban water sector. Results indicate that the inclusion of greenhouse gas emissions significantly influences the productivity measurement. Findings also indicate that the conventional index, which disregards undesirable outputs, over-states the productivity growth. Despite a declining trend in greenhouse emissions over the period, the overall productivity trend of the urban water sector experienced a downward trend while accounting for bad output. This productivity decline occurs in a period of prolonged drought, water security concerns and increased reliance on desalinization and water recycling.

Deforestation and seigniorage in developing countries: A tradeoff?

- Ecological Economics---2015---Pascale Motel Combes,P. Combes Motel,Alexandru Minea,Patrick Villieu,Jean-Louis Combes

Most of countries covered by natural forests are developing countries, with limited ability to levy taxes and restrained access to international credit markets. Consequently, they are amenable to draw heavily on two sources of government financing, namely seigniorage and deforestation revenues. First, we develop a theoretical model emphasizing a substitution effect between seigniorage and deforestation revenues. Second, a panel-data econometric analysis over the 1990–2010 period confirms our findings. Consequently, a tighter monetary policy hastens deforestation. Third, we extend the theoretical model and show that international transfers dedicated to forest protection can upturn the positive link between tighter monetary policies and deforestation, and then discuss the relevance of this finding with respect to recent institutional arrangements.

Value of adaptation in water protection — Economic impacts of uncertain climate change in the Baltic Sea

- Ecological Economics---2015---Lassi Ahlviik,Kari Hyytiäinen

Uncertain drivers of pollution hinder long-term planning of management of aquatic ecosystems. This paper presents a framework for adjusting optimal water protection in the long term when the true trend in nutrient loading is unknown to the decision maker but can be gradually learned by monitoring stochastic nutrient loads. The economic impacts of an unknown trend consist of (i) the damage caused by the worsened state of the sea, (ii) the cost of nutrient abatement to counter the development and (iii) the adjustment costs caused by uncertainty and imperfect learning. An integrated assessment model is designed and calibrated for quantitative results pertaining to the uncertain impacts of climate change on nutrient input to the Baltic Sea. Under certainty, the net economic impacts from the currently anticipated climate change are 15.0 billion euros, of which 23% comes from welfare losses caused by aggravated eutrophication and 77% from increased abatement costs. The expected adjustment costs due to uncertain future development range from 90 million euros in the case of adaptive management based on Bayesian learning to as much as 7960 million euros in the case of an extreme variant of inadaptive management based on constant abatement levels. If adaptive management is adopted, there is no need to account for future climate change when planning the current abatement targets.

Subsistence fishing in a 21st century capitalist society: From commodity to gift

- Ecological Economics---2015---Melissa R. Poe,Phillip S. Levin,Nick Tolimieri,Karma Norman

In this paper, we examine the extent, range, and diversity of noncommercial wild ocean seafood subsistence harvests among commercial operators in Washington and California, USA and test the relationship between

subsistence drivers and market behavior. Analyzing data from Pacific Fisheries Information Network between 1990 and 2010, we show that over 17millionkg of fish and shellfish were kept for personal use. We used general additive models to examine patterns in proportion of personal use versus price for the top 10 species retained over the 20-year period for each of the three population groups: Washington commercial tribal (indigenous) fishing operators, Washington commercial nontribal operators, and California commercial fishing operators. Out of the 26 species-price relationships tested, only one fits the market relationship with statistical significance and the model failed to predict personal use patterns for any of the other species. We conclude that market sensitivity is not a reliable predictor for subsistence behavior. Although a nominal figure in the overall seafood catch, the presence of subsistence practices among 21st century market-based commercial fishing operators reveals a more diverse array of economic systems than previously imagined. We suggest that alternative economies, including subsistence and associated community share systems, function to improve human wellbeing and strengthen community resilience by increasing food security and community food systems, engaging in a quality of life practice, and supporting social networks through seafood gifting and sharing.

Altruism, moral norms and social approval: Joint determinants of individual offset behavior

- Ecological Economics---2015---Julia Blasch,Markus Ohndorf

We provide a theoretical and empirical analysis of individual offset behavior, with environmental offsets as a specific form of voluntary public good provision. While existing theoretical models on the voluntary provision of public goods usually focus exclusively on single motivations for individual contributions, we explicitly account for various motivations in a unified framework, drawing on theories for public good provision such as pure and impure altruism, internalized norms and social approval. Such an approach is particularly useful when individual offset behavior is heterogeneous. The

applicability of our theoretical framework is supported by data from a choice experiment on voluntary carbon offsetting in Switzerland and the USA. We find that willingness to pay for offsets mainly depends on an individual's internalized norms to avoid environmental degradation as well as partly on income. The probability to offset, instead, is better explained by an individual's expected social recognition for offsetting.

The cost of climate change: Ecosystem services and wildland fires

- Ecological Economics---2015---Christine Lee,Claire Schlemme,Jessica Murray,Robert Unsworth

Little research has focused on the economic impact associated with climate-change induced wildland fire on natural ecosystems and the goods and services they provide. We examine changes in wildland fire patterns based on the U.S. Forest Service's MC1 dynamic global vegetation model from 2013 to 2115 under two pre-defined scenarios: a reference (i.e., business-as-usual) and a greenhouse gas mitigation policy scenario. We construct a habitat equivalency model under which fuels management activities, actions commonly undertaken to reduce the frequency and/or severity of wildland fire, are used to compensate for climate change-induced losses in ecosystem services on conservation lands in the contiguous U.S. resulting from wildland fire. The benefit of the greenhouse gas mitigation policy is equal to the difference in fuels management costs between the reference and policy scenarios. Results suggest present value ecosystem service benefits of greenhouse gas mitigation on the average of \$3.5 billion (2005 dollars, assuming a three percent discount rate). Our analysis highlights the importance of considering loss of ecosystem services when evaluating the impacts of alternative greenhouse gas mitigation policies.

The rebound effects of switching to vegetarianism. A microeconomic analysis of Swedish consumption behavior

- Ecological Economics---2015---Janina Grabs

Sustainable diets, in particular vegetarianism, are often promoted as effective measures to reduce our environmental footprint. Yet, few conclusions take full-scale behavioral changes into consideration. This can be achieved by calculating the indirect environmental rebound effect related to the re-spending of expenditure saved during the initial behavioral shift. This study aims to quantify the potential energy use and greenhouse gas emission savings, and most likely rebound effects, related to an average Swedish consumer's shift to vegetarianism. Using household budget survey data, it estimates Engel curves of 117 consumption goods, derives marginal expenditure shares, and links these values to environmental intensity indicators. Results indicate that switching to vegetarianism could save consumers 16% of the energy use and 20% of the greenhouse gas emissions related to their dietary consumption. However, if they re-spend the saved income according to their current preferences, they would forego 96% of potential energy savings and 49% of greenhouse gas emission savings. These rebound effects are even higher for lower-income consumers who tend to re-spend on more environmentally intensive goods. Yet, the adverse effect could be tempered by purchasing organic goods or re-spending the money on services. In order to reduce the environmental impact of consumption, it could thus be recommended to not only focus on dietary shifts, but rather on the full range of consumer expenditure.

Environmental damage evaluation in a willingness-to-accept scenario: A latent-class approach based on familiarity

- Ecological Economics---2015---Andrea Tabi, Salvador del Saz-Salazar

In this paper we report on the results of the application of a latent class model that was designed to identify and characterize unobserved preference heterogeneity in the context of a willingness-to-accept (WTA) framework involving negative environmental externalities stemming from the expansion of the Port of Valencia. We investigated the hypothesis that respondents with greater familiarity with the targeted good and any

related environmental damage would demand more compensation; that is, they would have a significantly higher WTA. Based on respondents' familiarity with the Port of Valencia and their pre-existing knowledge about the negative consequences of its potential expansion three clusters based on six indicators are identified. Results show that, contrary to what might be expected, familiarity with a public good does not in all cases have a significant effect on stated WTA.

Effect of aggregation and disaggregation on embodied material use of products in input-output analysis

- Ecological Economics---2015---Arjan de Koning, Martin Bruckner, Stephan Lutter, Richard Wood, Konstantin Stadler, Arnold Tukker

Consumption-based material footprints calculated with multi-regional input-output (mrIO) analysis are influenced by the sectoral, spatial and material aggregations used in the mrIO tables, and lack of disaggregation can be a source of uncertainty. This study investigated the effect of the resolution of mrIO databases on consumption-based material footprints. The effect of aggregation was investigated by constructing input-output tables with different spatial, product and material category resolutions and comparing the calculated material footprints. Our results indicate that the material footprints of countries calculated using the different spatial and product aggregations are in general in the order of a few percent, with outliers in the order of 25% difference. The use of IO models with a low product category resolution (e.g. 60 product categories) to calculate the embodied material use of individual products will likely result in inaccurate estimations of the total embodied material for some product categories. Aggregating the original 46 material categories into 16 categories changes the calculated material footprint of countries by about 30%. This result strongly suggests that the material data used to create the extensions for the IO framework should be collected at the highest resolution that is practically feasible.

Wildfires in Poland: The impact of risk preferences and loss aversion on environmental choices

- Ecological Economics---2015---Anna Bartczak,Susan Chilton,Jürgen Meyerhoff

This paper examines how risk preferences and loss aversion affect individual choices regarding environmental risks, specifically forest wildfires in Poland. We also examine how the same individuals make choices in the context of financial risks. Estimating risk, loss aversion and weighting probability parameters allows us to directly test whether Prospect Theory or Expected Utility Theory is the better underlying behavioural model in both domains. We find that in a sample consisting of a general population of Poles, the majority of respondents demonstrate behaviour consistent with Prospect Theory in both environmental and financial domains. This finding has significant implications for future non-market valuation studies. Additionally, in this study, we find evidence for similar risk preferences across those two domains.

Extreme weather experiences and climate change beliefs in China: An econometric analysis

- Ecological Economics---2015---Jing Dai,Martin Kesternich,Andreas Löschel,Andreas Ziegler

This paper examines the extent and the determinants of global climate change beliefs. In contrast to former studies for the U.S. and other western countries, we focus on China due to its crucial role in international climate policy in conjunction with its vulnerability to global warming. The empirical analysis is based on unique data from a survey among more than 1000 adults in five Chinese cities. In line with former studies, our results reveal that the vast majority of almost 90% of the Chinese respondents believes in the existence of global warming. This seems to be a convenient and necessary basis for the support of costly public adaptation activities in China. Our econometric analysis reveals that already perceived experiences with extreme weather events (and particularly heatwaves) alone are

strongly correlated with climate change beliefs and that physical or financial damages due to these events lead to even stronger relationships. Our estimation results additionally suggest females as well as people with a lower education, in medium ages, with higher household incomes, and from Chengdu or Shenyang to be more skeptical toward the existence of climate change.

Slow money in an age of fiduciary capitalism

- Ecological Economics---2015---Priyanka Jayashankar,Arvind Ashta,Mark Rasmussen

In the era of fiduciary capitalism, investors have begun fulfilling non-financial goals in order to address the concerns of a broader range of stakeholders. Socially responsible investors – who were part of fringe movements headed by non-profit organizations – have emerged as powerful fiduciaries with a strong focus on triple-bottom line based outcomes. The slow money movement, which has been spear-headed by non-profits in the developed world, places a strong emphasis on making capital circulate locally, especially within agricultural communities. Slow money investors across the US, some of whom are private investment funds and community development financial institutions, are striving to generate triple-bottom line based outcomes.

(De)growth and welfare in an equilibrium model with heterogeneous consumers

- Ecological Economics---2015---T. Heikkinen

This paper studies equilibrium growth and voluntary degrowth, allowing for heterogeneous and time-varying preferences. The approach is based on applying a dynamic equilibrium model with externalities in production, consumption, and leisure. Preference heterogeneity regarding status competition is modeled by asymmetric consumption externality parameters whereas heterogeneity regarding voluntary simplicity is incorporated by allowing for agent-specific restrictions on maximum consumption. Equilibrium is studied in terms of a balanced growth path (BGP). Numerical examples suggest that degrowth triggered by voluntary

simplicity by a subset of consumers less affected by status competition has a positive effect on the aggregate welfare under externalities in consumption and leisure. A reduction in status competition increases the aggregate welfare and reduces the equilibrium growth rate. Simulations suggest that a time-varying equilibrium in the heterogeneous preference model with two consumer classes is well approximated by a constant BGP.

Foreign direct investments, environmental externalities and capital segmentation in a rural economy

- Ecological Economics---2015---Angelo Antoci, Simone Borghesi, Paolo Russu, Elisa Ticci

This paper examines the possible effects of external investment inflows on the development of local rural economies, taking into account two recurrent features of many developing countries: capital market segmentation and environmental externalities. To investigate this issue, we examine a model with two sectors: the “local sector” and the “external sector”. Physical capital accumulation in the latter sector is driven by foreign direct investments, while in the former sector it follows a Solow-type accumulation mechanism. We assume that the production activity of the external sector damages the environment while the local sector relies on natural resources. In this context, we give the conditions under which capital inflows can promote diversification of host economy while improving welfare of local populations. If these conditions are not satisfied, external investments fuel a welfare reducing process (for the local community) and a self-enforcing growth of the external sector at the expense of the local one.

Natural capital in integrated assessment models of climate change

- Ecological Economics---2015---Stian B. Hackett, Erling Moxnes

In integrated assessment models (IAMs) economic activity leads to global warming, which causes future economic costs. However, typical IAMs do not explicitly

represent the role of natural capital. In this paper, the DICE model by Nordhaus (2008) is expanded with a natural capital variable that is affected both by climate change and by depletive effects of economic activity. Due to a synergy between the two effects, the optimal policy of the expanded model features more and earlier abatement of CO₂ emissions than DICE. Interestingly, the policy implications are different from what follows if one tries to capture the depletive effects on natural capital by simply reducing factor productivity growth in DICE. Acknowledging considerable uncertainty, simulations show that climate- and savings rate policies from the expanded model are more robust in the long term than policies that do not consider non-climatic depletion effects on natural capital.

Household carbon emissions from driving and center city quality of life

- Ecological Economics---2015---Matthew J. Hোলান, Matthew Kahn

In metropolitan areas with a vibrant center city, residents are more likely to live downtown, spend more time downtown and use public transit more. Due to these factors, we posit that household carbon emissions from the transportation sector will be lower in metropolitan areas with more vibrant center cities. We use metro-level and household-level data to test this hypothesis. In metropolitan areas where a larger share of college graduates live downtown, the center city’s population grows faster and more people use public transit and drive less. We document that carbon emissions for a standardized household are lower in metropolitan areas featuring a higher concentration of college graduates living downtown.

A structured war-gaming framework for managing extreme risks

- Ecological Economics---2015---Shuang Liu, Jean-Philippe Aurambout, Oscar Villalta, Jacqueline Edwards, Paul De Barro, Darren J. Kriticos, David C. Cook

Extreme risks are challenging to learn from, prepare for

and protect against, and they invite the development of new approaches to complement existing methods of risk management. We describe a systematic ex ante approach to support the strategic preparedness of risk management and apply it to a biosecurity case study. Our framework integrates a war-game model and a structured decision making approach. The model provides interactive maps that help stakeholders in visualizing the economic impacts of the extreme risk under different management scenarios, and it facilitates adaptive management by translating science-based results into stakeholder perspectives. The structured decision making approach not only offers an analytical structure to organize the multiple objectives of risk management, but also functions as a platform for group deliberation among alternative courses of management action with uncertain consequences. We found that this integration helped stakeholders develop a better understanding of the complexities and interconnectedness of the extreme risk management and reached a consensus regarding the most preferred management option.

Modeling adaptation in multi-state resource systems

- Ecological Economics---2015---Michele Baggio, Charles Perrings

A current concern in the economics of natural resources is the role of adaptation in moderating the economic impact of exogenous changes in the resilience of natural resource systems. We develop a bioeconomic model of the exploitation of a renewable resource that can exist in multiple states. We then use this to consider the value of adaptive over non-adaptive policies when there is a change in state, and there are fixed costs of starting or stopping extraction. We take adaptive policies to be those that base extraction on the current state of the system, and the conditioning effect that has on the expected future state of the system. We take non-adaptive policies to be those that base extraction on the long run average state of the system. We find that whether adaptive or non-adaptive policies dominate depends on the fixed costs of starting or stopping extraction. If the fixed costs of closure are

very low, non-adaptive policies dominate. However, if the fixed costs of closure are high, adaptive policies are preferred. We use a numerical example based on the Peruvian anchoveta fishery to illustrate the results.

On the mechanism and effects of innovation: Search for safety and independence of resource constraints expands the safe operating range

- Ecological Economics---2015---Stefan Bringezu

The paper reflects the hypothesis that those technological and institutional innovations survive which extend the safe operating range (SOR) of the Humans-Technologies-Institutions (HTI) system (e.g. companies, cities, regions and countries). The multidimensional SOR of a country comprises in particular safe livelihood, quality of life, security, monetary stability, supply security and quality of the environment. A “mechanism of progress” is described involving the search for higher safety and independence of constraints. With innovation and learning in a key role, the mechanism leads to a relative decoupling of resource use and economic value added and a growing share of knowledge generation in the economy. Competition of HTI systems for scarce resources may lead to independence strategies such as enhanced resource efficiency. It may also lead to cooperation of competing HTI systems facilitated by new institutions thus forming an HTI system at higher level of complexity. While the consortium could coordinate their resource consumption within the boundaries of safe operating space, the partner HTI systems would further expand their SOR. Data is provided that net resource importing countries have developed higher material productivity thus increasing their independence from resource supply, and countries with such capability have gained higher innovation capacity.

Ecosystem services and resource management: Institutional issues, challenges, and opportunities in the public sector

- Ecological Economics---2015---Lynn Scarlett, James Boyd

Application of ecosystem services measurement and analysis to natural resource planning, investment, and management decisions has gained momentum over the past decade. This momentum springs from a confluence of practical conservation challenges and conceptual developments. In particular, the ecosystem services focus emphasizes an appreciation of the social and economic values of natural resources and ecological systems. Despite a growing interest in ecosystem services and their incorporation into public-sector decisions and transactions, a number of institutional challenges complicate these efforts. These challenges include dispersed agency authorities and jurisdictional fragmentation that may constrain the geographic scale of public-sector transactions or cross-jurisdictional planning and actions. Challenges also include limitations on agency capacities to adjust decisions in the face of changing resource conditions and new information. Nonetheless, many agencies have flexibility to incorporate ecosystem services assessments into their planning, use them to inform spending choices, and develop markets based on ecosystem services concepts. Challenges are, thus, more instrumental and practical rather than legal and structural.

Notes from the field: Lessons learned from using ecosystem service approaches to inform real-world decisions

- Ecological Economics---2015---Mary Ruckelshaus, Emily McKenzie, Heather Tallis, Anne Guerry, Gretchen Daily, Peter Kareiva, Stephen Polasky, Taylor Ricketts, Nirmal Bhagabati, Spencer A. Wood, Joanna Bernhardt

While there have been rapid advances in assessments of biodiversity and ecosystem services (BES), a critical remaining challenge is how to move from scientific knowledge to real-world decision making. We offer 6 lessons from our experiences applying new approaches and tools for quantifying BES in 20 pilot demonstrations: (1) Applying a BES approach is most effective in leading to policy change as part of an iterative science-policy process; (2) simple ecological production function models have been useful in a diverse set of

decision contexts, across a broad range of biophysical, social, and governance systems. Key limitations of simple models arise at very small scales, and in predicting specific future BES values; (3) training local experts in the approaches and tools is important for building local capacity, ownership, trust, and long-term success; (4) decision makers and stakeholders prefer to use a variety of BES value metrics, not only monetary values; (5) an important science gap exists in linking changes in BES to changes in livelihoods, health, cultural values, and other metrics of human wellbeing; and (6) communicating uncertainty in useful and transparent ways remains challenging.

Determining the value of multiple ecosystem services in terms of community wellbeing: Who should be the valuing agent?

- Ecological Economics---2015---S. Maynard, D. James, A. Davidson

When multiple ecosystem services are derived from multiple ecosystems across different policy, planning or management jurisdictions, questions arise regarding the valuation of ecosystem services such as: who are the beneficiaries; how do they value ecosystem services; and who should be the valuing agent? In attempting to achieve an integrated approach to natural resource management in South East Queensland (SEQ), stakeholders have combined their knowledge to develop a framework to identify, measure and value ecosystem services provided by the region. This paper focuses on a methodology trialled to value the ecosystem services derived from the SEQ region in terms of the wellbeing of the SEQ community. The methodology allows flexibility of choice regarding whose values count and who should be the valuing agent. The methodology was trialled with community participants and scientific experts. The building blocks of the Framework can be used to construct different model variants, each of which reveals key characteristics of ecosystem services in SEQ. The approach adopted to value ecosystems and ecosystem services offers scope for decision makers to think more broadly about possible impacts of decisions on the wellbeing of the community and has fa-

cilitated the inclusion of ecosystem services in statutory planning policy in SEQ.

Adding ecosystem services to environmental impact analyses: More sequins on a “bloated Elvis” or rockin’ idea?

- Ecological Economics---2015---Carrie Presnall, Laura López-Hoffman, Marc L. Miller

Ecologists and economists have promoted the concept of ecosystem services as a means of assisting environmental decision-making. Currently, several U.S. federal agencies and international institutions are incorporating the ecosystem services approach into their decision-making processes. Since 1999, the concept has been included in guidance documents for environmental impact assessments under the U.S. National Environmental Policy Act (NEPA). More recently, the U.S. Forest Service approved a Planning Rule to include ecosystem services in Forest Plans. However, some people already describe the U.S. Forest Service NEPA process as cumbersome, which might be compounded by adding new layers of analysis. To assess the potential of incorporating ecosystem services into land management decisions, we surveyed over 500 U.S. Forest Service professionals about incorporating ecosystem services in environmental impact analysis processes. Our goal was to determine (a) whether and how the ecosystem services concept is currently used in Forest Service NEPA analyses, (b) staff perceptions about how influential NEPA guidance documents are, and (c) whether respondents think that the ecosystem services concept is useful in NEPA processes (and more broadly in environmental decision-making). Forty-one percent of respondents were unfamiliar with ecosystem services, but a majority of the respondents thought that ecosystem services could be helpful in the NEPA process. Opinions were divided about whether or not ecosystem services would improve communication with stakeholders. One finding with potentially broad implications for executive branch policy-making is that survey results indicate that U.S. Forest Service staff found Environmental Protection Agency and Council on Environmental Quality guidance documents less

influential than internal Forest Service directives. At the same time, the guidance documents that include ecosystem services language were the least influential among the guidance documents listed in the survey. Applying the results as a case study to advance ecosystem services scholarship, we suggest clarification of the ecosystem services framework, metrics, and guidance.

Developing scientific information to support decisions for sustainable coral reef ecosystem services

- Ecological Economics---2015---Susan Harrell Yee, John F. Carriger, Patricia Bradley, William S. Fisher, Brian Dyson

The U.S. Environmental Protection Agency (EPA) has recently realigned its research enterprise around the concept of sustainability, including improving understanding of benefits derived from ecosystems. We provide an example of how EPA is applying structured decision-making (SDM) as a framework for guiding development of scientific information, data, and models to support watershed and marine-based management in coastal communities. In particular, we have been using the Driver–Pressure–State–Impact–Response (DPSIR) model as a tool in the SDM process to identify and assemble a broadly applicable suite of information with relevancy for coastal management, including 1) development of conceptual models to clarify the decision context, 2) identification of measurements of ecosystem attributes, ecosystem goods and services, and their connection to stakeholder objectives, 3) elaboration of potential decision alternatives, and 4) identification of ecosystem production and valuation functions for modeling consequences of decision alternatives on benefits derived from coral reefs. Finally, we overview how this information is being applied for two case studies: development of water quality criteria and watershed management to protect coastal resources. We posit that applying a systems thinking framework, such as DPSIR, within a structured decision-making approach will better enable marine ecosystem managers to utilize scientific information toward more sustainable decision-making.

The role of benefit transfer in ecosystem service valuation

- Ecological Economics---2015---Leslie Richardson, John Loomis, Timm Kroeger, Frank Casey

The demand for timely monetary estimates of the economic value of nonmarket ecosystem goods and services has steadily increased over the last few decades. This article describes the use of benefit transfer to generate monetary value estimates of ecosystem services specifically. The article provides guidance for conducting such benefit transfers and summarizes advancements in benefit transfer methods, databases and analysis tools designed to facilitate its application.

Consumer and citizen roles and motives in the valuation of agricultural genetic resources in Finland

- Ecological Economics---2015---Annika Tienhaara, Heini Ahtiainen, Eija Pouta

This study analysed consumer and citizen roles in contingent valuation of a conservation programme of agricultural genetic resources and a native breed product. The willingness to pay (WTP) for the conservation programme (€48) was mainly driven by perceived taxpayer responsibility and existence and use motives, while the WTP for the product (price premium of 14%) was to a larger extent associated with perceived purchaser responsibility. We identified four respondent groups: those who emphasized citizens' or consumers' roles, indifferent and negative, which differed in terms of their conservation motivations, responsibility perceptions and WTP. Furthermore, the results emphasize that citizen and consumer roles overlap, and individuals may act as either or both in the context of a purchasing decision and a taxpayers' decision of policy support. Although the conservation programme received more support, future conservation could partly be based on the consumption of specialty products.

Measuring telecouplings in the global land system: A review and comparative evaluation of land footprint accounting methods

- Ecological Economics---2015---Martin Bruckner, Günther Fischer, Sylvia Tramberend, Stefan Giljum

In an increasingly globalized world with more and more distributed international supply chains, sustainability studies and policies need to consider socioeconomic and environmental interactions between distant places. Studies of the global biomass metabolism investigate physical flows between and within nature and human systems, thus providing a useful basis for understanding the interrelatedness of changes in one place with impacts elsewhere. Various methodological approaches exist for studying the human–nature metabolism and estimating the land embodied in international trade flows, a core element of assessing telecouplings in the global land system. The results of recent studies vary widely, lacking robustness and thus hampering their application in policy making. This article provides a structured overview and comparative evaluation of existing accounting methods and models for calculating land footprints. We identify differences in available accounting methods and indicate their shortcomings, which are mainly attributable to the product and supply chain coverage and detail, and biases introduced by the use of monetary flows as a proxy for actual physical flows. We suggest options for further development of global land footprint accounting methods, particularly highlighting the advantages of hybrid accounting approaches as a framework for robust and transparent assessments of the global displacement of land use.

From rational actor to efficient complexity manager: Exorcising the ghost of Homo economicus with a unified synthesis of cognition research

- Ecological Economics---2015---Jordan Levine, Kai M.A. Chan, Terre Satterfield

It is now commonplace to note that economics' canonical model of humans as rational, self-interested utility-

maximizers (*Homo economicus*) is both descriptively misleading, and often insufficiently predictive. However, certain outdated assumptions tied to *Homo economicus* persist, often influencing discourse and research design even in sustainability-oriented fields. We argue this ‘ghost’ of *Homo economicus* endures because the diversity of findings that confound the canonical model has surfaced across multiple behavioral and cognitive sciences, each with its own terminology and focus area. As such, a unified, accessible synthesis of this new information has yet to emerge. In this paper we review recent insights from across the behavioral and cognitive sciences, and propose an ‘efficient complexity manager’ (ECM) model (*Homo efficens*) as the best synthesizing option. The crux of this model is that our species works within biological limits to efficiently filter massive environmental complexity. This is achieved largely through analogical—or ‘case-based’—reasoning. We explain this synthesized model using a series of accessible metaphors. Finally, we speculate on how this model may enrich future sustainable development research insofar as it points to fruitful units of analysis, can stimulate methodological innovation, and provide a more explicit theoretical foundation for the field.

Monetary valuation of the social cost of CO2 emissions: A critical survey

- Ecological Economics---2015---Jeroen van den Bergh, Wouter Botzen

An expanding branch of research has estimated the potential costs of climate change, which are often expressed as the “Social Cost of Carbon” (SCC) or the costs of an additional ton of CO2 emissions. Estimates of the SCC can be used by policy makers to evaluate climate change policies and greenhouse gas emission reduction projects by means of cost–benefit analyses (CBAs). Such analyses are complicated by the wide range of SCC values that have been reported in the literature, and the large uncertainties involved in estimating the potential economic impacts and related costs of climate change. This study presents a critical review of the reported SCC estimates by exam-

ining some neglected consequences of climate change, uncertain and extreme scenarios of climate change, the discounting of future climate change effects, the treatment of individual risk aversion, and assumptions about social welfare. In view of the many uncertainties and omissions in conventional cost–benefit analyses of climate impacts and the SCC, alternative approaches to decision-making should be considered for climate policy.

Economic tradeoffs in mitigation, due to different atmospheric lifetimes of CO2 and black carbon

- Ecological Economics---2015---Ashwin K. Seshadri

Tradeoffs are examined between mitigating black carbon (BC) and carbon dioxide (CO2) for limiting peak global mean warming, using the following set of methods. A two-box climate model is used to simulate temperatures of the atmosphere and ocean for different rates of mitigation. Mitigation rates for BC and CO2 are characterized by respective timescales for e-folding reduction in emissions intensity of gross global product. There are respective emissions models that force the box model. Lastly there is a simple economics model, with cost of mitigation varying inversely with emission intensity.

Protest response and willingness to pay for culturally significant urban trees: Implications for Contingent Valuation Method

- Ecological Economics---2015---Alex Y. Lo, C.Y. Jim

The Contingent Valuation Method (CVM) could assist green-space planning, management and appreciation by assigning a monetary value to urban trees. However, the use of CVM is limited by its inherent methodological weaknesses. A critical concern is the existence of a large proportion of survey respondents providing zero willingness-to-pay (WTP) and that these responses are not amenable to economic theory — known as ‘protest’ responses. Censoring protest responses from further treatment is a common practice, which warrants reconsideration in light of our CVM survey results. The

survey involved 800 residents requested to state their WTP for preserving the culturally significant stonewall trees in urban Hong Kong. About 28% of respondents returned a zero WTP. For all respondents the strength of protest beliefs was assessed, and the relationship between protest beliefs and WTP were examined. Our analysis produced contradictory results: some protest items varied negatively with WTP as expected, but other items increased with it. Respondents' stated positive WTP harbored latent protest beliefs which are related to non-economic preference. The findings stand at odds with the assumptions underlying the censoring treatment and raise questions about the validity of WTP estimates. These methodological implications should be taken into account in using CVM.

Integrating socio-cultural perspectives into ecosystem service valuation: A review of concepts and methods

- Ecological Economics---2015---Samantha S.K. Scholte,Astrid J.A. van Teeffelen,Peter H. Verburg

Ecosystem service research has long been dominated by a monetary interpretation of value, neglecting other social perspectives on the importance of ecosystems for human well-being. Emphasis has been put on individual utility and rational choice, which does not adequately capture the full spectrum of social values of ecosystem services. A socio-cultural approach to value ecosystem services is increasingly advocated and is gaining more attention in the ecosystem service research agenda. The current documentation of socio-cultural perspectives on ecosystem services is, however, characterized by a conflation of the concepts of “cultural ecosystem services” and “socio-cultural values” of ecosystem services. This paper reviews (i) the concept of socio-cultural values within the ecosystem service framework, (ii) the social and ecological factors that determine socio-cultural values, and (iii) the methods by which socio-cultural values can be assessed. The clarifications of the concept of socio-cultural valuation and the structured listing of the available methods facilitate a better integration of socio-cultural values into

ecosystem service assessments and help researchers to choose methods from the available portfolio.

Contingent valuation of community forestry programs in Ethiopia: Controlling for preference anomalies in double-bounded CVM

- Ecological Economics---2015---Dambala Gelo,Steven Koch

This study examines the welfare effects of community plantations in Ethiopia via contingent valuation. Both single-bounded and double-bounded survey methods were considered, and, with respect to double-bounded methods, the potential for anomalous response behaviour was also taken into account. The results generally confirm that there are statistically significant welfare benefits to be derived from community forestry; however, the range of the estimated benefits is large. After controlling for anomalous response behaviour, the range of estimated benefits narrows, and our preferred estimates place the welfare gain between Ethiopian Birr (ETB) 20.14 and 30.41 per household, which is much lower than the estimated benefits without controlling for anomalous preference responses.

How do incentive-based environmental policies affect environment protection initiatives of farmers? An experimental economic analysis using the example of species richness

- Ecological Economics---2015---T. Dörschner,Oliver Musshoff

To address ongoing biodiversity losses, the use of incentive-based nature protection policies is increasingly recommended. In the present paper, we examine how action and result-oriented agricultural policy measures affect the species protection initiatives of real agricultural managers. To do so, we use a computer-based economic experiment involving a multi-period individual business simulation game. Our results indicate that action-oriented measures do not have any impacts on farmers' initiatives to protect species. In contrast to action-oriented policy measures, result-oriented measures with identical profit effect significantly increase

these initiatives. Although risk-averse farmers are less willing to participate in result-oriented measures than non-risk-averse farmers, in general, risk aversion does not influence farmers' species protection initiatives. Furthermore, the species protection initiatives are influenced by the opportunity costs of species protection.

Cultural bequest values for ecosystem service flows among indigenous fishers: A discrete choice experiment validated with mixed methods

- Ecological Economics---2015---Kirsten L.L. Oleson, Michele Barnes, Luke M. Brander, Thomas A. Oliver, Ingrid van Beek, Bienvenue Zafindrasilivonona, Pieter van Beukering

Perhaps the most understudied ecosystem services are related to socio-cultural values tied to non-material benefits arising from human-ecosystem relationships. Bequest values linked to natural ecosystems can be particularly significant for indigenous communities whose livelihoods and cultures are tied to ecosystems. Here we apply a discrete choice experiment (DCE) to determine indigenous fishers' preferences and willingness-to-pay for bequest gains from management actions in a locally managed marine area in Madagascar, and use our results to estimate an implicit discount rate. We validate our results using a unique rating and ranking game and other mixed methods. We find that bequest is highly valued and important; respondents were willing to pay a substantial portion of their income to protect ecosystems for future generations. Through all of our inquiries, bequest emerged as the highest priority, even when respondents were forced to make trade-offs among other livelihood-supporting ecosystem services. This study is among a relative few to quantify bequest values and apply a DCE to model trade-offs, value ecosystem service flows, and estimate discount rates in a developing country. Our results directly inform coastal management in Madagascar and elsewhere by providing information on the socio-cultural value of bequest in comparison to other ecosystem service benefits.

Applications of aggregation theory to sustainability assessment

- Ecological Economics---2015---N. Pollesch, V.H. Dale

In order to aid operations that promote sustainability goals, researchers and stakeholders use sustainability assessments. Although assessments take various forms, many utilize diverse sets of indicators numbering anywhere from two to over 2000. Indices, composite indicators, or aggregate values are used to simplify high dimensional and complex data sets and to clarify assessment results. Although the choice of aggregation function is a key component in the development of the assessment, there are few literature examples to guide appropriate aggregation function selection. This paper applies the mathematical study of aggregation functions to sustainability assessment in order to aid in providing criteria for aggregation function selection. Relevant mathematical properties of aggregation functions are presented and interpreted. Cases of these properties and their relation to previous sustainability assessment research are provided. Examples show that mathematical aggregation properties can be used to address the topics of compensatory behavior and weak versus strong sustainability, aggregation of data under varying units of measurements, multiple site multiple indicator aggregation, and the determination of error bounds in aggregate output for normalized and non-normalized indicator measures.

The scope for collective action in a large groundwater basin: An institutional analysis of aquifer governance in Western Australia

- Ecological Economics---2015---James H. Skurray

The Gnangara groundwater system in Western Australia supports multiple ecological systems and human uses, and is under unprecedented stress. This paper examines some of Ostrom's 'situational variables' for the analysis of institutional choice in common-pool resources, as they relate to the Gnangara case. The institutional analysis identifies elements of the current

governance institutions that could be altered to facilitate collective action. We use data from a set of water licensing documents obtained from the state's Department of Water. A number of factors are identified as inhibiting the potential for collective action. Current arrangements are top-down in nature, with all rules, monitoring, and any enforcement supplied by the state-level management agency. Norms and expectations among appropriators appear to be competitive rather than co-operative, and discount rates appear to be high. Monitoring and enforcement are under-supplied, and opportunistic behaviour affects compliance. The interactions between user and regulator influence the appropriation of flows, and have resulting impacts on the resource stock. We conclude that several factors in this case prejudice the development of collective action institutions by appropriator efforts alone. The study highlights important aspects of the institutional arrangements in place, and their likely effects upon the attitudes and behaviours of appropriators who, along with wildlife and ecosystems, depend on the common-pool resource.

Using an intervention framework to value salient ecosystem services in a stated preference experiment

- Ecological Economics---2015---David Lewis,Bill Provencher,Ben Beardmore

To estimate the value of an improvement in the provision of an ecosystem service, analysts often use an intervention framework in a stated preference experiment. An intervention framework is defined by (i) an intervention, such as a publicly-funded program, and (ii) the intervention effect — the difference in the provision of the ecosystem service with and without the intervention. The contention of this paper is that if the purpose of an experiment is to estimate the value of the intervention effect, rather than the intervention itself, consideration needs to be given to the saliency of the service to the respondent population, because for salient services respondents often have prior beliefs about the intervention effect, and if these prior beliefs are different on average than implicitly assumed or

explicitly presented in the choice experiment, the estimate of the value of the improvement will be biased. We emphasize that in some cases a structural model can be used to identify the value of the intervention effect, whereas for others, only the value of the intervention can be identified. We illustrate the issue using two case studies concerning ecosystem service provision on freshwater lakes, prevention of aquatic species invasions, and fish habitat enhancement.

Aligning ‘public good’ environmental stewardship with the landscape-scale: Adapting MBIs for private land conservation policy

- Ecological Economics---2015---Benjamin Cooke,Katie Moon

Market-based instruments (MBIs) are rapidly becoming a dominant characteristic of the policy landscape for private land conservation in Australia and elsewhere. Price-based MBIs are considered attractive to landholders, who are provided with financial payments for the delivery of defined ecological outcomes on their land, and for policy-making, where ecological return on investment can be measured quantitatively. Consequently, MBIs are commonly used to promote competitive, individualized approaches to improve ecological values, framed around the property-scale. We are concerned that there is a tension between the property-centric focus of price-based MBI programs and the need for environmental management policy and practice to reflect landscape-scale social-ecological processes. Targeting MBI programs at individual properties could risk generating insufficient public good conservation benefits, if those programs fail to reflect the relationship between landscape-scale processes and property-scale conservation efforts. To remedy the neglect of the landscape scale in private land conservation MBI policy, we develop a definition of stewardship that directly connects landscape-scale ecological function to the ‘public good’ dimension of stewardship. We apply this over-arching definition to demonstrate how MBI programs can deliver on the goal of landscape-scale conservation, and to suggest when MBIs might

not be well suited to achieving private land conservation objectives.

Using tradeable permits to improve efficiency, equity and animal protection in the commercial kangaroo harvest

- Ecological Economics---2015---Louise Boronyak-Vasco,Neil Perry

The utilisation of wildlife creates conflicts between commercial operators, landholders, traditional owners of the land, conservationists and animal protection advocates. Such conflicts are evident in Australia's utilisation of the iconic kangaroo (*Macropus*) species for their meat and hides. Like many wild animal industries, kangaroos are an open access resource, although restrictions built into the management regime ensure that rents are, approximately, maximised. However, resource allocation decisions and the distribution of rents reflect the values and objectives of the economically powerful stakeholders and particularly commercial processors. Thus, rents are not distributed equitably and the management regime excludes animal protection advocates from adequate participation. Thus, an external cost occurs when kangaroos are harvested that must be internalised for economic efficiency to be achieved. We propose a tradeable permit system where landholders, shooters and processors compete with ordinary citizens for the right to harvest kangaroos. This increases the private cost of harvest and internalises the external cost. It also improves the equity of rent distribution with landholders able to earn a return from kangaroos on their land. As similar issues arise in the utilisation of other wild animals, the research provides an important contribution to the literature on the economics of animal welfare.

Transaction costs, power, and multi-level forest governance in Indonesia

- Ecological Economics---2015---Caleb Gallemore,Monica Di Gregorio,Moirra Moeliono,Maria Brockhaus,Rut Dini Prasti H.

Since 2005, there has been considerable international

interest in Reducing Emissions from Deforestation and Forest Degradation (REDD+), a program intended to finance protection of tropical forests through the sale of carbon offsets or from donor funding. Requiring the collaboration of local and international civil society stakeholders, firms, and donor and host governments, REDD+ is inherently a multi-level governance project, but to date participation in REDD+ and coordination across governmental levels have been weak. Combining literature on multi-level and polycentric governance of socioecological systems with transaction-cost economics, we argue that transaction costs structure cross-level information-sharing and collaboration relationships among organizations engaged in REDD+ policy development at the national and provincial levels in Indonesia. Using an exponential random graph modelling approach with data collected from interviews with over 80 organizations between 2010 and 2012, we find that powerful organizations tend to dominate cross-level connections, though this effect is somewhat mediated by organizational similarity, which reduces transaction costs. We suggest that explicit efforts to help local organizations overcome the transaction costs of building cross-level relationships will be a central component of building an effective and equitable multi-level governance system for REDD+ in Indonesia.

Thinking past, thinking future: An empirical test of the effects of retrospective assessment on future preferences

- Ecological Economics---2015---Caroline L. Noblet,Mark W. Anderson,Mario F. Teisl

In recent work, we asserted that the largest group of stakeholders for sustainability science is future generations; yet intergenerational tradeoffs are often understudied. We proposed retrospective assessment as one potential means of clarifying what future preferences might be. Using a split-sample design we test the potential for retrospective assessment to influence citizens' preferences for future policy decision. We test the potential for retrospective assessment to yield increased or decreased support for policy. Our findings reveal context dependent public policy preferences

where the presence of retrospective assessment significantly impacts citizens' preferences and outcomes appear strongly influenced by the attributes of the historical (or retrospective) scenario provided.

How do rainfall variability, food security and remittances interact? The case of rural Mali

- Ecological Economics---2015---Rémi Generoso

In this paper, we rely on the CFSVA survey of 2005 to assess the impact of rainfall variability and remittances on the food security of rural households in Mali. To this end, we first design a composite food security index which enables us to distinguish households depending on their level of food security (low, intermediate, high). Then, we estimate a partial proportional odds logistic model in order to evaluate the main determinants leading to a switch from one level of food security to the other. We show that inter-annual and seasonal rainfall variability have a negative impact on food security. This is especially true in southern Mali, although agro-ecological conditions in this region are usually more favorable. As for remittances, their impact is positive, though it needs to be qualified: they enable households to solve temporary food security situations, but they have no effect on structural food security issues.

Resource scarcity and democratic elections in commons dilemmas: An experiment on forest use in Ethiopia

- Ecological Economics---2015---Tsegaye T. Gatiso,Björn Vollen,Ernst-August Nuppenau

We study the effect of resource scarcity on human behavior using dynamic lab-in-the-field experiments which are framed around the extraction of trees from a communally managed forest in Ethiopia. Subjects who faced resource scarcity were less cooperative than those who faced more abundant commons condition. When initial condition of the commons was relatively abundant it seemed more likely that resource users established a norm of reciprocity. We further found that especially men overharvested under resource scarcity which is in line with studies that had found men to

be more competitive. We also tested different policies. We found that gaining legitimacy through election increases cooperation independent of whether the resource is scarce or abundant. When sanctions were imposed we observed a crowding-out effect of intrinsic motivation to cooperate under resource abundance. With resource scarcity imposed sanctions did not lead to a crowding-out effect but democratic elections were by far more effective.

Coupled social and ecological dynamics of herders in Mongolian rangelands

- Ecological Economics---2015---Joung Hun Lee,Kaoru Kakinuma,Toshiya Okuro,Yoh Iwasa

Motivated by a field study in a southern Mongolian rangeland, we developed a simple model that couples the social and ecological dynamics of herders who choose foraging sites for their animals in the dry season. If grazing pressure is very strong, the grass biomass becomes depleted and more herders choose to move their animals to an alternative rangeland. These herders may return to the focal rangeland when the quantity and quality of the grass improve. Our model assumes that herders tend to choose the foraging site that gives the higher payoff in a manner described by stochastic best response dynamics. In the model, this social dynamics is coupled with the dynamics of the grass biomass. The resulting system generates typical non-linear behaviors. For example, it may exhibit bistability, with two distinct locally stable equilibria suggesting a strong dependence on the initial condition, or perpetual large-amplitude fluctuation. Implications for rangeland management are discussed.

Understanding the complementary linkages between environmental footprints and planetary boundaries in a footprint-boundary environmental sustainability assessment framework

- Ecological Economics---2015---Kai Fang,Reinout Heijungs,Geert R. De Snoo

While in recent years both environmental footprints

and planetary boundaries have gained tremendous popularity throughout the ecological and environmental sciences, their relationship remains largely unexplored. By investigating the roots and developments of environmental footprints and planetary boundaries, this paper challenges the isolation of the two research fields and provides novel insights into the complementary use of them. Our analysis demonstrates that knowledge of planetary boundaries improves the policy relevance of environmental footprints by providing a set of consensus-based estimates of the regenerative and absorptive capacity at the global scale and, in reverse, that the planetary boundaries framework benefits from well-grounded footprint models which allow for more accurate and reliable estimates of human pressure on the planet's environment. A framework for integration of environmental footprints and planetary boundaries is thus proposed. The so-called footprint–boundary environmental sustainability assessment framework lays the foundation for evolving environmental impact assessment to environmental sustainability assessment aimed at measuring the sustainability gap between current magnitudes of human activities and associated capacity thresholds. As a first attempt to take advantage of environmental footprints and planetary boundaries in a complementary way, there remain many gaps in our knowledge. We have therefore formulated a research agenda for further scientific discussions, mainly including the development of measurable boundaries in relation to footprints at multiple scales and their trade-offs, and the harmonization of the footprint and boundary metrics in terms of environmental coverage and methodological choices. All these points raised, in our view, will play an important role in setting practical and tangible policy targets for adaptation and mitigation of worldwide environmental unsustainability.

Climate policy in hard times: Are the pessimists right?

- Ecological Economics---2015---Aya Kachi,Thomas Bernauer,Robert Gampfer

Conventional wisdom holds that the state of the econ-

omy has a strong impact on citizens' appetite for environmental policies, including climate policy. Assuming median voter preferences prevail, periods of economic prosperity are likely to be conducive, and economic downturns are likely to be detrimental to ambitious climate policy. Using original surveys in the United States and Germany, we engage in a critical re-assessment of this claim. The results show that, for the most part, individuals' perceptions of their own economic situations have no significant effect on their policy support. Negative perceptions of the national economic outlook reduce support for climate policy in the US, but not in Germany. However, the magnitude of this national economy effect in the US is small. On the other hand, individuals' climate risk perceptions consistently have a statistically significant and large effect across various model specifications, and interestingly, this pattern holds for the US, whose government is among the less ambitious in global climate policy, as well as Germany, which is among the frontrunners. Our study indicates that the state of the economy may not trump climate risk considerations as conventional wisdom claims.

Capturing the complexity of biodiversity: A critical review of economic valuation studies of biological diversity

- Ecological Economics---2015---Bartosz Bartkowski,Nele Lienhoop,Bernd Hansjürgens

Biodiversity is a highly complex and abstract ecological concept. Even though it is not one physical entity, it influences human well-being in multiple ways, mostly indirectly. While considerable research effort has been spent on the economic valuation of biodiversity, it remains to be a particularly challenging 'valuation object'. Valuation practitioners therefore have to use proxies for biodiversity, many of which are very simple (single species, habitats). This paper presents a comprehensive and critical review of biodiversity valuation studies with special emphasis on biodiversity valuation in order to depict the state-of-the-art in this research field. It develops evaluation criteria so as to identify best-practice applications and shows that the field of biodiversity valuation studies is rather

heterogeneous regarding both valuation objects and valuation methods. On the basis of our evaluation criteria and best-practice studies we suggest that to account for the complexity and abstractness of biodiversity, multi-attribute approaches with encompassing information provision should be used that emphasise the roles biodiversity plays for human well-being.

Forest owners' willingness to accept contracts for ecosystem service provision is sensitive to additionality

- Ecological Economics---2015---Suzanne Elizabeth Vedel, Jette Bredahl Jacobsen, Bo Thorsen

A key prerequisite to ensure that payment for ecosystem services is effective is that the management measures landowners are paid to undertake are in fact additional to the status quo and hence bring about a change in provision.

A non-simplistic approach to composite indicators and rankings: an illustration by comparing the sustainability of the EU Countries

- Ecological Economics---2015---Tommaso Luzati, Gianluca Gucciardi

Composite indicators are very popular, despite being affected by several problems that often result in lack of robustness of the rankings involved. The aim of this paper is to show that composite indicators can be safely used, provided that rankings are built via uncertainty analysis rather than using a single composite. For this purpose, the approach we follow first combines different normalisation, aggregation rules, and weighting systems to calculate many different composites, and then derives the rankings from the frequency distribution of the rankings of each “competitor” according to each composite. Such an approach appears to be a good compromise between the need for a more concise overview when looking at many variables and the loss of relevant information occurring when indicators are aggregated into a single composite indicator. To illustrate the approach, we rank EU Countries in terms of their sustainability.

Reexamine SO2 emissions embodied in China's exports using multiregional input-output analysis

- Ecological Economics---2015---Qiaoling Liu, Qi Wang

Previous studies on embodied emission in China's exports focus on the national aggregate analysis while pay little attention to the interregional emission transfer driven by exports. We used multiregional input-output model of 30 provinces to reexamine the embodied emissions and to capture the interregional linkage in it. Results in 2002–2007 show that SO2 embodied in exports contributes 15.17–22.08% of the total domestic SO2 emissions, and 74.40–78.14% of the embodiment is in exports from the eastern provinces, where over 90% of China's exports occur. However, only about 70% of the embodied emission in eastern China's exports is discharged in the east; an increasing portion (24% to 34%) is released in the central and western provinces as a result of interregional production linkage. Moreover, the interregional connection becomes closer during the 2002–2007 period, which increases the scale and intensity of embodied emission in China's export given large gaps in emission intensity among regions. Further analysis on Guangdong, China's largest export province, shows that the SO2 emissions per unit of output induced by Guangdong's exports are larger than that induced by the province's own exports for most provinces, especially the central and western provinces which are restricted in exports and indirectly export by supporting Guangdong's exports via interregional economic linkage. The results yield important implications for China's export and pollution emission control policy.

Energy intensive lifestyles: Time use, the activity patterns of consumers, and related energy demands in Finland

- Ecological Economics---2015---Mikko Jalas, Jouni K. Juntunen

Time use survey data has been used to model household activities beyond market transactions. Accordingly,

measures such as the ‘goods intensity of household activities’ and the ‘energy and carbon intensity of household activities’ have been derived. In this paper, we build on this approach by using time use data to model the direct and indirect energy use of households. From this, we present a decomposition analysis of the changes in the embedded and direct energy consumption of Finnish households from 1987 to 2009. Relevant questions that arise include that of whether increases in total energy consumption are due to changes in activity patterns, changes in the energy intensity of activities, or due to demographic changes. Beyond the empirical work, we suggest that time use approaches require a more explicit theorization of time.

Combining discourse analyses to enrich theory: The case of local land-use policies in South Eastern France

- Ecological Economics---2015---Laurence Delattre,Olivier Chanel,Cecile Livenais,Claude Napoléone

Local land-use policies are determined by a wide range of considerations that do not always favor open-space preservation. To identify them, a field study was undertaken in South Eastern France via semi-directive interviews with people responsible for municipal land-use policies. We use it to compare a qualitative (i.e. manual) discourse analysis with two quantitative (i.e. computer-assisted) analyses and combine them to identify the drivers of land-use policies, especially with regard to urban sprawl. Performing all three analyses allows us to switch back and forth between a local empirical approach and large-scale modeling and methods. This should enrich micro-economic models by clarifying more complex local features, like unbalanced relationships with neighboring municipalities or why “agriculture” should be considered as an independent interest group.

The socio-economic drivers of material stock accumulation in Japan's prefectures

- Ecological Economics---2015---Tomer Fishman,Heinz Schandl,Hiroki Tanikawa

Physical economy research has, thus far, focused on the throughput of materials that underpin economic development. The role of stocks of buildings and infrastructure has remained underexplored, yet it is the physical stock that provides service to society. To fill this gap, this research investigates stock dynamics in Japan in relation to population and economic drivers using panel regression and IPAT analyses for the past five decades. We recognize characteristic changes in the strength and relative influence of the drivers throughout time, in different subnational regions, and on the dynamics of buildings compared to transportation infrastructure. We find that material stock accumulation mainly occurred due to growth in economic activity, specifically by tertiary sector demand. Apart from a period of government-driven stock accumulation in the 1990s to stimulate economic growth, as economic and population growth slowed stock accumulation dynamics also changed signaling a new stock saturation trend. Migration from rural to urban areas has recently become an influential driver, leaving behind underused buildings and roads. This analysis provides a case study on how socio-economic drivers and stock accumulation interacted and changed while the country matured, which may have implications for understanding stock dynamics in rapidly industrializing economies.

Compensation and Rewards for Environmental Services (CRES) and efficient design of contracts in developing countries. Behavioral insights from a natural field experiment

- Ecological Economics---2015---Sophie Clot,Fano Andriamahefazafy,Gilles Grolleau,Lisette Ibanez,Philippe Méral

The use of economic incentives for biodiversity (mostly Compensation and Reward for Environmental Services including Payment for ES) has been widely supported in the past decades and became the main innovative policy tools for biodiversity conservation worldwide. These policy tools are often based on the insight that rational actors perfectly weigh the costs and benefits of adopting certain behaviors and well-crafted economic incentives and disincentives will lead to socially desir-

able development scenarios. This rationalist mode of thought has provided interesting insights and results, but it also misestimates the context by which ‘real individuals’ come to decisions, and the multitude of factors influencing development sequences. In this study, our goal is to examine how these policies can take advantage of some unintended behavioral reactions that might in return impact, either positively or negatively, general policy performances. We test the effect of income’s origin (‘Low effort’ based money vs. ‘High effort’ based money) on spending decisions (Necessity vs. Superior goods) and subsequent pro-social preferences (Future pro-environmental behavior) within Madagascar rural areas, using a natural field experiment. Our results show that money obtained under low effort leads to different consumption patterns than money obtained under high efforts: superior goods are more salient in the case of low effort money. In parallel, money obtained under low effort leads to subsequent higher pro social behavior. Compensation and rewards policies for ecosystem services may mobilize knowledge on behavioral biases to improve their design and foster positive spillovers on their development goals.

Harvesting benefits from habitat restoration: Influence of landscape position on economic benefits to pheasant hunters

- Ecological Economics---2015---Scott Knoche, Frank Lupi, Ashley Suiter

The provision of ecosystem services via ecological restoration can be affected by the spatially explicit relationships between existing landscape characteristics and the proposed restoration. In such situations, effective economic targeting of restoration is aided by an accounting of the spatially explicit linkages between initial restoration actions, the resulting changes in ecosystem services, and the changes in economic benefits to individuals resulting from changes in the provision of ecosystem services. To this end, we examine the impact of landscape heterogeneity on economic benefits of USDA Conservation Reserve Program (CRP) restoration for ring-necked pheasant (*Phasianus colchicus*) hunters in Michigan by linking a previously developed

ecological production function of ring-necked pheasant sightings to a recreation demand model of hunter site choice. Using proposed pheasant habitat restoration in Michigan as a framework for our analysis, we find that economic benefits generated by restoration depend critically upon the landscape selected for CRP restoration. Poorly targeted restoration sites yield near-zero economic benefits, while well-targeted investments yield about 2.4 times the economic benefits of the median parcel. The results show how managers can use both ecological and hunter behavior information to enhance the return on conservation investments.

Transport transitions in Copenhagen: Comparing the cost of cars and bicycles

- Ecological Economics---2015---Stefan Gössling, Andy Choi

In many cities of the world, bicycle infrastructure projects are implemented to foster more sustainable transportation systems. However, such projects have often raised questions regarding their public funding, as they entail considerable costs. This paper reviews cost-benefit analysis (CBA) frameworks as these are presently used to assess bicycle infrastructure projects. Specific focus is on the CBA framework developed in Copenhagen, Denmark, a self-declared “city of cyclists” . In this framework, costs and benefits of car and bicycle, the two major urban transport modes, have been assessed and are compared across accidents, climate change, health, and travel time. The analysis reveals that each km travelled by car or bike incurs a cost to society, though the cost of car driving is more than six times higher (Euro 0.50/km) than cycling (Euro 0.08/km). Moreover, while the cost of car driving is likely to increase in the future, the cost of cycling appears to be declining. The paper concludes with a discussion of the applicability of the Copenhagen CBA framework to advance sustainable transport planning and to motivate and justify urban restructuring.

Exploring sprawl: Results from an economic agent-based model of land and housing markets

- Ecological Economics---2015---Nicholas Magliocca, Virginia McConnell, Margaret Walls

This paper uses an economic agent-based model of land use in a growing community on the urban fringe to explore the importance of key economic variables on the spatial patterns of development over time. Understanding dispersed patterns of urban development is important for designing policies for mitigating the environmental and other adverse effects of urban “sprawl”. The model includes as agents heterogeneous farmer/landowners and housing consumers, and a representative developer who buys land and builds houses. Underlying economic behavior of consumer utility maximization and developer and farmer profit maximization is assumed. A unique feature of the model is that housing is characterized by variation in both lot size and house size, allowing for exploration of the effects of changes in key parameters on both land and housing markets and the interaction between them. The paper explores the relative importance of consumer preferences, spatial distribution of agricultural productivity, and travel costs in creating sprawling development patterns. Consumer preferences for large lots do result in more land in development and lower density, but leap frog development in the model appears to be driven by other economic influences as well. And, in general, more stable housing prices mute the effect of more variable land prices and tend to dampen the effects of economic shocks to the urbanizing area.

Towards sustainability in agro-forest systems? Grazing intensity, soil degradation and the socioeconomic profile of rural communities in Italy

- Ecological Economics---2015---Luca Salvati, Margherita Carlucci

Overgrazing is a common form of land degradation at the global scale with negative impact on ecosystem functioning, natural capital stocks, socio-ecological systems and economic development. Although most of the

regions in Mediterranean Europe are affected by soil degradation driven by unsustainable grazing, information on the spatial relationship among overgrazing, the economic structure and socio-spatial attributes of rural communities is limited. The present study explores the relationship between an index of grazing pressure and a set of indicators assessing six thematic domains (Population dynamics and human settlement, Labour market and human capital, Economic specialization and competitiveness, Quality of life, Agriculture and rural development, Territory and environment) at the municipal scale in Italy. An exploratory data analysis based on non-parametric inference, multiple regression models, Principal Component Analysis and Hierarchical Clustering was developed with the aim to profile municipalities exposed to high or low degree of grazing pressure. An index of overgrazing-driven soil degradation risk which integrates grazing intensity and soil erosion risk was finally proposed. The analysis contributes to identify socioeconomic factors influencing soil degradation in areas with unsustainable grazing possibly leading to desertification risk. Results indicate that the socioeconomic profile of municipalities with high grazing pressure is characterized by specific socio-spatial and economic attributes, traditional cropping systems and a typical land-use structure. Our results may support the development of sustainable land management strategies in areas sensitive to land degradation in the Mediterranean region.

Strict versus mixed-use protected areas: Guatemala's Maya Biosphere Reserve

- Ecological Economics---2015---Allen Blackman

Although protected areas, or “parks”, are among the leading policy tools used to stem tropical deforestation, rigorous evaluations of their effectiveness—that is, evaluations that control for their tendency to be sited in remote areas with relatively little deforestation—have only recently begun to appear. Important open questions concern the link between the stringency of protection and park effectiveness. How do mixed-use parks that allow sustainable extractive activities perform relative to strictly protected parks? And what

types of mixed-use management perform best? In addressing these questions, it is particularly important to control for nonrandom siting, since different management regimes tend to be sited in areas with different preexisting characteristics. To date, most rigorous studies of this issue have focused on scores of parks in one or multiple countries, a strategy that in principle could be undermined by unobserved park heterogeneity. This paper uses high-resolution 2001–2006 land cover data derived from satellite images along with statistical techniques that control for nonrandom siting to examine the relative effectiveness of strict and various mixed-use protection strategies in a single large park: the two-million-hectare Maya Biosphere Reserve in Guatemala. Our results comport with the emerging consensus that on the whole, mixed-use protection in this park has been more effective in stemming deforestation than strict protection because of the performance of forest concessions within the multiple-use zone. However, we also find that mixed-use protection has had smaller, more heterogeneous effects than indicated by simple methods that do not control for nonrandom siting.

Towards more accurate and policy relevant footprint analyses: Tracing fine-scale socio-environmental impacts of production to consumption

- Ecological Economics---2015---Javier Godar,U. Martin Persson,E. Jorge Tizado,Patrick Meyfroidt

The consumption of internationally traded goods causes multiple socio-environmental impacts. Current methods linking production impacts to final consumption typically trace the origin of products back to the country level, lacking fine-scale spatial resolution. This hampers accurate calculation of trade and consumption footprints, masking and distorting the causal links between consumers' choices and their environmental impacts, especially in countries with large spatial variability in socio-environmental conditions and production impacts. Here we present the SEI-PCS model (Spatially Explicit Information on Production to Consumption Systems), which allows for fine-scale sub-national assessments of the origin of,

and socio-environmental impacts embedded in, traded commodities. The method connects detailed production data at sub-national scales (e.g., municipalities or provinces), information on domestic flows of goods and in international trade. The model permits the down-scaling of country-to-country trade analyses based on either physical allocation from bilateral trade matrices or MRIO models. The importance of producing more spatially-explicit trade analyses is illustrated by identifying the municipalities of Brazil from which different countries source the Brazilian soy they consume. Applications for improving consumption accounting and policy assessment are discussed, including quantification of externalities of consumption, consumer labeling, trade leakages, sustainable resource supply and traceability.

Strong sustainability, critical natural capital and the capability approach

- Ecological Economics---2015---Jérôme Pe-lenc,Jerome Ballet

This article is an attempt to conceptually improve the notion of strong sustainability by creating a rapprochement between its core concept, critical natural capital, and the capability approach. We first demonstrate that the capability approach constitutes a relevant framework for analysing the multiple links between human well-being and critical natural capital. Second, we demonstrate that the rapprochement between critical natural capital and the capability approach can form both the normative basis and the informational basis for a deliberative approach to human development which embraces a strong sustainability perspective. This conceptual rapprochement, as illustrated in our case study, opens up avenues of research towards the practical implementation of human development projects from a strong sustainability perspective.

Carbon, climate, and economic breakeven times for biofuel from woody biomass from managed forests

- Ecological Economics---2015---Mitch R. Withers,Robert Malina,Steven R.H. Barrett

Woody biomass harvested from old-growth forests results in a significant “carbon debt” when used as a feedstock for transportation fuel. This is because previously stored forest carbon is released to the atmosphere as CO₂. The debt is eventually repaid provided that the life cycle CO₂ emissions of the biofuel are lower than the conventional fuel that is displaced. Managed forests are an alternative to old-growth forests with the potential to reduce the carbon debt associated with woody biomass-derived fuels. This work is the first to quantify the carbon debt incurred by transportation biofuels derived from woody biomass from managed forests. The breakeven time of this carbon debt is computed along with breakeven times for radiative forcing, temperature change, and economic damages. In the case of biofuel production for 30 years, we find that breakeven times for carbon, radiative forcing, and temperature change are 59, 42, and 48 years, respectively. If cumulative economic damages are computed for discount rates of 1–2%, the breakeven time is greater than 100 years, while damages never break even at discount rates above 2%. Breakeven times decrease if the prevailing harvest cycle is left unchanged, but increase if biofuel production is sustained indefinitely.

Willingness to pay for unfamiliar public goods: Preserving cold-water coral in Norway

- Ecological Economics---2015---Margrethe Aanesen, Claire Armstrong, Mikolaj Czajkowski, Jannike Falk-Petersen, Nick Hanley, Ståle Navrud

The world’s largest concentration of cold-water coral (CWC) is found off the Norwegian coast. Most CWC discoveries are recent, posing new challenges for Norwegian coastal and fishery authorities regarding the management of deep-sea resources. Scientific knowledge of CWC is limited, and many citizens have not even heard about them. This creates problems for the application of the stated preference methods to capture their economic value, and very few such studies have been conducted. To fill this gap, we designed a discrete choice experiment, which was implemented in a valuation workshop setting in order to derive estimates of participants’ willingness to pay (WTP) for

increasing the protection of CWC. Despite the fact that marine industries such as oil/gas and fisheries could be adversely affected by CWC protection, this did not reduce the respondents’ willingness to pay for further protection. The possibility that CWCs play an important role as habitat for fish was the single most important variable to explain respondents’ WTP for CWC protection. The survey revealed a high degree of preference heterogeneity, while we found an average WTP for CWC protection in the range of EUR 274–287.

Alien invasions and livelihoods: Economic benefits of invasive Australian Red Claw crayfish in Jamaica

- Ecological Economics---2015---Thomas Pienkowski, Sophie Williams, Kurt McLaren, Byron Wilson, Neal Hockley

Invasive species have caused widespread economic and environmental disruption, which have been widely studied. However, their potential benefits have received much less attention. If invasive species contribute to livelihoods, their eradication may negatively impact wellbeing. Failing to value these benefits may lead to an undervaluation of invaded ecosystems. We assess the potential economic benefits of an invasive species within an artisanal fishery in Jamaica. We monitored catches over 259 fisherman-days, and conducted 45 semi-structured interviews, with 76 fishermen. We show that the invasive Australian Red Claw crayfish (*Cherax quadricarinatus*) is an important source of income for fishermen within the Black River Lower Morass of Jamaica and supplement incomes during periods when native shrimp (*Macrobrachium* spp.) catches decline. We also show that full-time fishermen and those who have no alternative occupations expend the greatest fishing effort. We use the intra-annual variation of fishermen’s harvest effort between seasons (when catch per unit effort changes) as a proxy for dependence. Using this measure, we found that the least wealthy appear to be the most dependent on fishing, and consequently benefit the most from the invasive crayfish. Our results demonstrate the impor-

tance of considering the potential benefits of invasive species within integrated landscape management.

Watering the farm: Comparing organic and conventional irrigation water use in the Murray–Darling Basin, Australia

- Ecological Economics---2015---Sarah Wheeler,Alec Zuo,Adam Loch

This study investigates the role that certified-organic farming systems play in irrigation water-use in the Murray–Darling Basin, where large-scale government policy has focussed on returning water from irrigation to key ecological sites. Information from Australia’s agricultural census in 2011, as well as a specialized irrigation farm survey sample of 1499 observations, compared certified-organic and conventional irrigation water-use. Census and survey results found some evidence for some industries that organic irrigation farms are less water-use efficient (i.e. water use divided by tonne of output), but little significant difference in water-used per irrigated hectare was found overall (although for some industry sectors—notably horticulture—organic farms use less water on a per-hectare basis). After controlling for self-selection, regression model results also indicated that organic irrigation farms use less absolute water than conventional farms; use a smaller percentage of water received; and are more water-use productive (i.e. water use divided by net farm income). A lack of significance for the importance of irrigation infrastructure adoption, plus the importance of water-use charges in reducing water demand, suggests a need for governments to reorientate irrigation policy towards more multi-layered and inclusive practices that promote better soil conditions and water management, rather than focussing on providing subsidies for technology adoption.

Mindful capability

- Ecological Economics---2015---Ramzi Mabsout

The capability approach stands among the major development paradigms in the first decades of the 21st century. But the century’s challenge is shifting from

development as capability expansion to sustainable development. What conception of capability befits sustainable development? The paper sketches contours for a conception of sustainable capability development adequate for the challenges of our time. This integrative framework combines the Buddhist philosophy of non-self and an emerging primal episteme that decentres humanity’s place in the ecosphere to form mindful capabilities. These capabilities limit the space of functioning on Buddhist principles of wisdom, virtues, and meditation as well as a non-anthropocentric conception of humanity’s place in the ecosphere.

A behavioral model of collective action in artisanal and small-scale gold mining

- Ecological Economics---2015---Adrián Saldarriaga-Isaza,Santiago Arango,Clara Villegas-Palacio,Adrián Saldarriaga Isaza

There is a rising global concern about mercury use in small-scale gold mining because of its harmful effects on ecosystems and human health. Associative entrepreneurship has been promoted as a way of accessing alternative techniques to address this concern. By associative entrepreneurship, in this paper we mean the creation of local associations between small-scale gold miners in order to acquire more environmentally-friendly technologies. We built a behavioral simulation model to assess the feasibility of associative entrepreneurship in the context of the public-good dilemma that gold mining communities face. The model construction is based on results from field economic experiments, and properly replicates the observed behavioral patterns; thus, it reveals that sustained collective action is possible when miners completely understand the social dilemma they face, but that self-organization is not possible. Features such as reciprocity and temptation to free ride partially explain why self-organization fails. In such a case, external intervention has a key role in promoting programs that improve the understanding of the social dilemma faced by artisanal and small-scale gold miners.

Microeconomic degrowth: The case of Community Supported Agriculture

- Ecological Economics---2015---Marjolijn Bloemen,Roxana Bobulescu,Nhu Tuyen Le,Claudio Vitarì

In this paper, we attempt to build a new microeconomic approach that could be considered as a basis of the degrowth macroeconomic view. As degrowth is a critique of the dominant macroeconomic model of the endless search for economic growth, its microeconomic foundations can be built by searching a relevant grass-root economic initiative to theorise. Our approach is based upon the case study research of a self-harvesting Community Supported Agriculture in Belgium. The mainstream microeconomic model is based on the well-known Homo economicus assumption of individual self-interest and competitive behaviour. By contrast, our model is based on a holistic approach of producers and consumers, based upon trust, cooperation and ecologically responsible behaviours. This contribution participates to the flourishing literature on degrowth in Ecological Economics. We begin by reviewing the debate on degrowth and economic behaviour. We discuss the case study and its accounting expression that departs from the capitalist profit-seeking model. We conclude by explaining the limits and challenges of our model that implements degrowth on a small scale and in a capitalist environment.

Monetary accounting of ecosystem services: A test case for Limburg province, the Netherlands

- Ecological Economics---2015---Roy P. Remme,Bram Edens,Matthias Schröter,Lars Hein

Ecosystem accounting aims to provide a better understanding of ecosystem contributions to the economy in a spatially explicit way. Ecosystem accounting monitors ecosystem services and measures their monetary value using exchange values consistent with the System of National Accounts (SNA). We pilot monetary ecosystem accounting in a case study in Limburg province, the Netherlands. Seven ecosystem services are modelled and valued: crop production, fodder production,

drinking water production, air quality regulation, carbon sequestration, nature tourism and hunting. We develop monetary ecosystem accounts that specify values generated by ecosystem services per hectare, per municipality and per land cover type. We analyse the relative importance of public and private ecosystem services. We found that the SNA-aligned monetary value of modelled ecosystem services for Limburg was around €112 million in 2010, with an average value of €508 per hectare. Ecosystem services with the highest values were crop production, nature tourism and fodder production. Due to the exclusion of consumer surplus in SNA valuation, calculated values are considerably lower than those typically found in welfare-based valuation approaches. We demonstrate the feasibility of valuing ecosystem services in a national accounting framework.

Effects of environmental regulation on actual and expected profitability

- Ecological Economics---2015---Dylan G. Rassier,Dietrich Earnhart

The Porter hypothesis asserts that properly designed environmental regulation motivates firms to innovate, which ultimately improves profitability. In this study, we test empirically the Porter hypothesis and the competing hypothesis that regulation undermines profitability (“costly regulation hypothesis”). In particular, we estimate the effect of clean water regulation, as reflected in the stringency of firm-specific effluent limits for two regulated pollutants, on the profitability of chemical manufacturing firms. As our primary contribution, we contrast the effect of clean water regulation on actual profitability outcomes and its effects on investors’ expectations of profitability. Our results for actual profitability are consistent with the Porter hypothesis, while our results for expected profitability are consistent with the costly regulation hypothesis. Thus, our empirical results demonstrate that investors do not appear to value the positive effect of tighter clean water regulation on actual profitability.

Nutrient prices and concentrations in Midwestern agricultural watersheds

- Ecological Economics---2015---Brent Sohngen, Kevin W. King, Gregory Howard, John Newton, D. Lynn Forster

This paper assesses the impact of nutrient prices on nutrient concentrations in agricultural watersheds. Specifically, we find that the price elasticity of nutrient emissions from agricultural watersheds is 0.17 to 0.34, suggesting that a 10% increase in nitrogen or phosphorus prices faced by farmers would lead to up to a 3.4% reduction in nitrogen or phosphorus emissions from a watershed. While this sounds modest, it is about the same size as estimates of the price elasticity of nutrient demand by farmers, a relationship which also is very inelastic. Our results suggest that when prices for nutrients rise, there is a direct effect on nutrient emissions from watersheds. Given recent concerns about phosphorus in Lake Erie, we assess the potential implications of applying a phosphorus usage fee to reduce phosphorus emissions there. We find that a 25% increase in phosphorus prices would reduce nutrient outputs from the three Lake Erie watersheds we modelled by 6.5%, or 210t phosphorus per year, and cost about \$6ha⁻¹yr⁻¹. These costs are similar to estimates of the costs of reducing phosphorus through waste water treatment plants, and less than the costs of other widely used agricultural best management practices like cover crops.

Pollution havens and the trade in toxic chemicals: Evidence from U.S. trade flows

- Ecological Economics---2015---John Tang

National registries of toxic chemical emissions and facilities are increasingly used to raise public awareness of potential health hazards in local areas, but an unintended consequence may be the offshoring of production to less regulated countries. Using disaggregated U.S. trade data, this study examines the impact of registry listing on subsequent bilateral trade flows. Estimates from a difference-in-differences model indicate a significant shift toward imports from poorer countries

following registry listing. Assuming that environmental protection is a normal good, this result suggests the emergence of pollution havens due to more stringent U.S. environmental regulation.

Towards a fair, constructive and consistent criticism of all valuation languages: Comment on Kallis et al. (2013)

- Ecological Economics---2015---Elisabeth Gsottbauer, Ivana Logar, Jeroen van den Bergh

We provide critical notes to the paper by Kallis et al. (2013) on monetary valuation. We evaluate the four criteria they propose for assessing valuation studies. We argue that no clear distinction is made between monetary valuation and pricing instruments. The selected criteria are more relevant to assessing policy than monetary valuation. The examples provided are not representative of the diversity of valuation studies encountered in the literature. Moreover, no clear examples are provided of where valuation and associated cost-benefit analysis of environmental policy go wrong. We plea for a more fair, constructive and consistent criticism of all “valuation languages” and offer relevant issues for consideration.

The value of environmental status signaling

- Ecological Economics---2015---Michael S. Delgado, Jessica L. Harriger, Neha Khanna

How much are consumers willing to pay to signal their environmental consciousness? We identify the signaling value of an environmental public good by focusing on hybrid cars and exploiting the physical uniqueness of the Toyota Prius relative to hybrids that look identical to their non-hybrid counterparts. We deploy a quasi-experimental hedonic model to estimate this willingness to pay. We find that, controlling for observable and unobservable factors, the Prius commands an environmental signaling value of \$587 or 4.5% of its value. Our research provides lessons for economists and policy-makers, and contributes to the literature on identifying signaling values.

What influences the probability of wind farm planning approval: Evidence from Ireland

- Ecological Economics---2015---Thomas M. van Rensburg,Hugh Kelley,Nadine Jeserich

The purpose of this work is to explore the extent to which wind farm planning approvals in the Republic of Ireland are influenced by project technology, institutional processes, and site endowments. We use principal components data reduction, z-score data normalization, and Probit regression analyses on a unique revealed preference dataset covering 354 wind farm applications and planning authority decisions between 1990 and 2011. Notably, a unique measure of variable importance is employed that mitigates statistical problems and allows for the ranking of predictors according to their relative influences. Findings reveal that the duration of the local appeal process, decisions of local authorities and inspectors, identities of the appellants, and, projects that conflict with strategic development plans or generate visual externalities emerge as key influences affecting planning approval. Project technology features such as area, rated output capacity, and hub height, as well as site wind endowments, appear to be of less but significant importance. Alternatively, we find that proximity to dwellings, towns, or protected habitats does not influence planning outcomes.

Valuing map validation: The need for rigorous land cover map accuracy assessment in economic valuations of ecosystem services

- Ecological Economics---2015---G.M. Foody

Valuations of ecosystem services often use data on land cover class areal extent. Area estimates from land cover maps may be biased by misclassification error resulting in flawed assessments and inaccurate valuations. Adjustment for misclassification error is possible for maps subjected to a rigorous validation programme including an accuracy assessment. Unfortunately, validation is rare and/or poorly undertaken as often not regarded as a high priority. The benefit of map validation and hence its value is indicated with two maps. The International Geosphere Biosphere Programme's

DISCover map was used to estimate wetland value globally. The latter changed from US\$ 1.92trillionyr⁻¹ to US\$ 2.79trillionyr⁻¹ when adjusted for misclassification bias. For the conterminous USA, ecosystem services value based on six land cover classes from the National Land Cover Database (2006) changed from US\$ 1118billionyr⁻¹ to US\$ 600billionyr⁻¹ after adjustment for misclassification bias. The effect of error-adjustment on the valuations indicates the value of map validation to rigorous evidence-based science and policy work in relation to aspects of natural capital. The benefit arising from validation was orders of magnitude larger than mapping costs and it is argued that validation should be a high priority in mapping programmes and inform valuations.

Dynamics of energy transitions under changing socioeconomic, technological and climate conditions in Northwest Germany

- Ecological Economics---2015---Matthias Ruth,Onur Özgün,Jakob Wachsmuth,Stefan Gößling-Reisemann

This paper analyzes regional interdependencies and trajectories of the energy and agriculture sectors in Germany's Northwest Metropolitan Region in order to assess the performance of regional low-cost and low-carbon strategies to alter energy sector profiles in the light of changing socioeconomic, technological and climate conditions. Our assessment is based on a dynamic, interactive simulation model for the years 2010 to 2050, which was developed and played out in close collaboration with diverse stakeholder groups in the region. Results from the model and modeling exercises demonstrate the need to increase energy efficiency because the reduction in demand it generates extends the policy space for decreasing emissions and reduces vulnerability to climate change. The results also show the feasibility of expanding renewable energy without heavy reliance on biomass, which currently is an important and contested source of energy in the region.

Recreational diver preferences for reef fish attributes: Economic implications of future change

- Ecological Economics---2015---David A. Gill,Peter W. Schuhmann,Hazel A. Oxenford

This study sought to quantify the potential effects of changes in Caribbean reef fish populations on recreational divers' consumer surplus. Over five hundred tourist SCUBA divers were interviewed at seven sites across three Caribbean countries representing a diversity of individuals within the Caribbean dive market. A choice experiment was used to assess willingness to pay as a function of the abundance and size of reef fishes, the presence of fishing activity/gear, and dive price. Despite some preference heterogeneity both between and within sites, the results indicate that future declines in the abundance of reef fishes, and particularly in the number of large fishes observed on recreational dives, will result in significant reductions in diver consumer surplus. On the other hand, improvements in fish populations and reduced fishing gear encounters are likely to result in significant economic gains. These results can be used to justify investment in pre-emptive management strategies targeted at improving reef fish stocks (namely reducing unsustainable fishing activities and land-based reef impacts), managing conflicting uses, as well as to indicate a possible source of financing for such conservation activities.

Evaluation of the environmental impact of weekly food consumption in different socio-economic households in Australia using environmentally extended input-output analysis

- Ecological Economics---2015---Christian Reynolds,Julia Piantadosi,Jonathan David Buckley,Philip Weinstein,John Boland

This paper uses input-output analysis to model the environmental impacts of the weekly food consumption of Australia's households sorted by income quintile in 2003. We found that weekly food consumption of the relatively better off households caused greater

environmental burden than that of the less well-off household.

The potential of Industrial Ecology in agri-food clusters (AFCs): A case study based on valorisation of auxiliary materials

- Ecological Economics---2015---Alberto Simboli,Raffaella Taddeo,Anna Morgante

The location of agricultural activities in favourable geographic areas has led to the development of local agglomerations of companies, recognised as agri-food clusters (AFCs). AFCs are characterised by typical environmental problems such as changes in land use, CO₂ emissions, energy and water consumption, and chemical pollution. Recent technological changes in the agri-food industry have influenced the economic and social development of AFCs towards progressive industrialization. Such changes have also been the source of new environmental problems, such as those related to the large-scale use and disposal of auxiliary materials. Industrial Ecology (IE) proposes approaches and applied solutions to reduce the environmental impacts and improve the competitiveness of production activities. Major applications of IE in AFCs currently involve the valorisation of animal and vegetable by-products and scraps. Further improvements can be achieved by adopting IE-based solutions focused on auxiliary material wastes. This article analyses the potential development of IE-based approaches in a representative Italian AFC. Empirical evidence shows that efficient solutions can be implemented through material substitution, repair, and recycling, and by exploiting collaborative strategies among the agri-food and industrial companies established in the area.

A stated preference valuation of the non-market benefits of pollination services in the UK

- Ecological Economics---2015---T.D. Breeze,Alison Bailey,S.G. Potts,Kelvin Balcombe

Using a choice experiment survey this study examines the UK public's willingness to pay to conserve

insect pollinators in relation to the levels of two pollination service benefits: maintaining local produce supplies and the aesthetic benefits of diverse wildflower assemblages. Willingness to pay was estimated using a Bayesian mixed logit with two contrasting controls for attribute non-attendance, exclusion and shrinkage. The results suggest that the UK public have an extremely strong preference to avoid a status quo scenario where pollinator populations and pollination services decline. Total willingness to pay was high and did not significantly vary between the two pollination service outputs, producing a conservative total of £379M over a sample of the tax-paying population of the UK, equivalent to £13.4 per UK taxpayer. Using a basic production function approach, the marginal value of pollination services to these attributes is also extrapolated. The study discusses the implications of these findings and directions for related future research into the non-market value of pollination and other ecosystem services.

What are shared and social values of ecosystems?

- Ecological Economics---2015---Jasper Kenter, O'Brien, Liz, Neal Hockley, Neil Ravenscroft, Ioan Fazey, Katherine N. Irvine, Mark S. Reed, Michael Christie, Emily Brady, Rosalind Bryce, Andrew Church, Nigel Cooper, Althea Davies, Anna Evely, Mark Everard, Robert Fish, Janet A. Fisher, Niels Jobstvogt, Claire Molloy, Johanne Orchard-Webb, Susan Ranger, Mandy Ryan, Verity Watson, Susan Williams

Social valuation of ecosystem services and public policy alternatives is one of the greatest challenges facing ecological economists today. Frameworks for valuing nature increasingly include shared/social values as a distinct category of values. However, the nature of shared/social values, as well as their relationship to other values, has not yet been clearly established and empirical evidence about the importance of shared/social values for valuation of ecosystem services is lacking. To help address these theoretical and empirical limitations, this paper outlines a framework of

shared/social values across five dimensions: value concept, provider, intention, scale, and elicitation process. Along these dimensions we identify seven main, non-mutually exclusive types of shared values: transcendental, cultural/societal, communal, group, deliberated and other-regarding values, and value to society. Using a case study of a recent controversial policy on forest ownership in England, we conceptualise the dynamic interplay between shared/social and individual values. The way in which social value is assessed in neoclassical economics is discussed and critiqued, followed by consideration of the relation between shared/social values and Total Economic Value, and a review of deliberative and non-monetary methods for assessing shared/social values. We conclude with a discussion of the importance of shared/social values for decision-making.

Taking the sting out of Little Fire Ant in Hawaii

- Ecological Economics---2015---Donna J. Lee, Michael Motoki, Casper Vanderwoude, Stuart T. Nakamoto, Ping Sun Leung

In the 1990's, Little Fire Ants (LFAs) found its way to the island of Hawaii, most likely traveling with a shipment of potted plants from Florida. These plants were subsequently sold to consumers along the east coast of the Island, along with Little Fire Ant colonies living in the potting medium. LFA is now thriving and continues to spread. Fifteen years after the initial detection in 1999, LFA has spread to over 4000 locations on the island of Hawaii and has been found in isolated locations on Kauai, Maui, and Oahu Islands. Current efforts are expected to contain the infestations on the other islands but significant additional investment is needed to halt the rapid spread of LFA on the island of Hawaii.

Governing complex commons — The role of communication for experimental learning and coordinated management

- Ecological Economics---2015---Therese Lindahl, Örjan Bodin, Maria Tengö

In this paper, we build on common-pool research and

adaptive management to increase our understanding on if and how communication between resource users affects their joint ability to learn about and manage complex ecological resources. More specifically we study the role of user communication in relation to learning through continual experimentation when managing a complex resource system involving resource interdependencies. For this purpose we designed a laboratory experiment where we tested the effect of user communication over time in a setup with two interdependent resources, and where resource access is asymmetrical: one resource is shared and the other is private. Our results indicate that communication, through its interaction with experimental learning is more multifaceted than what previous experimental studies on commons dilemmas suggest. We show for example that in communicating groups the likelihood of successful resource management increases, but this effect is mostly dominant in earlier periods, when resource dynamics are unknown. We hypothesize however, that communication stimulates continual improvements by fine-tuning of management through experimental learning and coordinated resource extraction. Furthermore, we hypothesize that in communicating groups, the need to quickly gain a basic understanding of the dynamics overshadows not only the devotion to improve management of the private resource but also the potential tensions brought by the asymmetry in resource access.

The materiality of the immaterial

- Ecological Economics---2015---Matías Piaggio,Vicent Alcantara,Emilio Padilla

This paper analyzes the carbon dioxide emissions of the service sector subsystem of Uruguay in 2004. Services, with the exception of transport, are often considered intangible because of their low level of direct emissions. However, the provision of services requires inputs produced by other sectors, including several highly material-intensive sectors.

Product as process — Commodities in mechanic and organic ontology

- Ecological Economics---2015---Knut J. Ims,Ove D. Jakobsen,Laszlo Zsolnai

Operationalizing an ecosystem services-based approach using Bayesian Belief Networks: An application to riparian buffer strips

- Ecological Economics---2015---Alistair McVittie,Lisa Norton,Julia Martin-Ortega,Ioanna Siameti,Klaus Glenk,Inge Aalders

The interface between terrestrial and aquatic ecosystems contributes to the provision of key ecosystem services including improved water quality and reduced flood risk. We develop an ecological-economic model using a Bayesian Belief Network (BBN) to assess and value the delivery of ecosystem services from riparian buffer strips. By capturing the interactions underlying ecosystem processes and the delivery of services we aim to further the operationalization of ecosystem services approaches. The model is developed through outlining the underlying ecological processes which deliver ecosystem services. Alternative management options and regional locations are used for sensitivity analysis.

‘Constant’ rebound effects in domestic heating: Developing a cross-sectional method

- Ecological Economics---2015---Ray Galvin

Policymakers are increasingly concerned about rebound effects, which lead to lower savings than expected when energy-efficiency increases. There are difficulties in making coherent comparisons between magnitudes of rebound effects in different sectors, such as home heating, industry and transport. A barrier to this in domestic heating is the conceptual difficulty of estimating rebound effects as energy-efficiency elasticities, since the large, stepwise increases in energy-efficiency through thermal retrofits fit uneasily with differential calculus. This paper offers a solution. Firstly, it develops a ‘cross-sectional’ method in which elasticity-based rebound formulae are used to estimate implied average

rebound effects in large datasets of energy consumption and energy efficiency. It then shows how a simple power curve can model these datasets, simplifying the mathematics, giving ‘constant’ rebound effect results that are immediately meaningful, and extending compatibility to rebound effect modelling in other sectors. The method is then extended to case studies of thermal retrofits of individual dwellings. Here the inherent inaccuracy of using linear approximations in rebound effect formulas is also illustrated. The cross-sectional, ‘constant’ rebound effect methodology is offered for wider use in estimating rebound effects in case studies and in domestic heating as more datasets of energy consumption and efficiency become available.

The determinants of private flood mitigation measures in Germany — Evidence from a nationwide survey

- Ecological Economics---2015---Daniel Osberghaus

Public flood protection cannot eliminate totally the risk of flooding. Hence, private mitigation measures which proactively protect homes from being flooded or reduce flood damage are an essential part of modern flood risk management. This study analyses private flood mitigation measures among German households. The final data set covers more than 4200 households from all parts of the country, including flood plains as well as areas which are typically not at a high risk of riverine flooding. The results suggest that the propensity to mitigate flood damage increases i.a. with past damage experience and damage expectations for the future. The latter effect can be interpreted as a ‘climate adaptation signal’ in the flood mitigation behaviour. All other factors remaining equal, a strong belief in a climate-change-induced increase of personal flood damage in the next decades correlates with an increase of the probability of flood mitigation by more than 10 percentage points. Moreover, empirical evidence for moral hazard in the flood mitigation behaviour cannot be observed. Households expecting insurance coverage do not reduce their mitigation efforts. Likewise, the expectation of government relief payments hinders mitigation only for some groups of households.

An empirical analysis of joint residential electricity efficiency gains within and across end uses: implications for demand-side management

- Ecological Economics---2015---Nour-El Imane Bouhou,Michael F. Blackhurst,Pamela Torres

To better understand the observed performance of demand-side approaches on residential electricity use, we develop and apply a mixed regression model of electricity consumption that includes marginal, joint technical change for multiple residential electricity end-uses (air conditioning, appliances, devices, and electric vehicles). Results indicate that the relative technical state of a home can significantly influence the performance of demand-side interventions, particularly the presence of a programmable thermostat. Within air conditioning, we generally find that “enough” consistent technical improvement is needed to realize energy savings, which could be due to engineering building performance or a declining marginal rebound effect as householders become thermally comfortable. Results indicate that homeowners do not leverage efficiency gains for appliance services but demonstrate mixed results when considering the expansion of electricity services. Householders may rebound into device loads, albeit such results are not statistically significant. However, results indicate that householders do not leverage efficiency gains for electric vehicles. These results demonstrate that the net effect of technological change in households is relative to a home’s baseline technical efficiency and the degree to which homeowners seek new and existing energy services, challenging empirical assessments that do not control for the technical state of multiple end uses.

‘Growing your own’ : A multi-level modelling approach to understanding personal food growing trends and motivations in Europe

- Ecological Economics---2015---A. Church,R. Mitchell,N. Ravenscroft,L.M. Stapleton

Growing food for personal and family consumption is a significant global activity, but one that has received insufficient academic attention, particularly in developed

countries. This paper uses data from the European Quality of Life Survey (EQLS) to address three areas of particular concern: the prevalence of growing your own food and how this has changed over time; the individual and household context in which growing takes place; and whether those who grow their own food are happier than those who do not. Results showed that there was a marked increase in growing your own food in Europe, in the period 2003–2007. This increase is largely associated with poorer households and thus, possibly, economic hardship. In the UK however the increase in growing your own food is predominantly associated with older middle class households. Across Europe, whether causal or not, those who grew their own were happier than those who did not. The paper therefore concludes that claims about the gentrification of growing your own may be premature. Despite contrary evidence from the UK, the dominant motive across Europe appears to be primarily economic — to reduce household expenditure whilst ensuring a supply of fresh food.

Biodiversity offset markets: What are they really? An empirical approach to wetland mitigation banking

- Ecological Economics---2015---Anne-Charlotte Vaissière, Harold Levrel
- Mitigation banking is a hybrid form halfway between a market and a hierarchy. • Its features are well-adapted to implement public policy dealing with biodiversity. • It is a useful decentralized regulation tool for biodiversity conservation.

An ecological economic assessment of risk-reducing effects of species diversity in managed grasslands

- Ecological Economics---2015---Robert Finger, Nina Buchmann

Over the last decade, it has been shown in the ecology literature that species diversity increases yield stability in managed grasslands. Here, we develop and apply ecological economic and econometric frameworks to

evaluate these potential risk-reducing effects of species diversity in terms of yields and their temporal stability from a farmer's perspective. Our empirical analysis is based on a rich panel dataset obtained from a diversity experiment covering in total 60 species and a period of 6 years. We find empirical evidence for the risk-reducing effect of species diversity and the economic assessment reveals significant insurance values associated with diversity for a risk-averse decision maker. Thus, the economic value of diversity would be underestimated if not accounting for this property, and species diversity may serve as valuable ex-ante risk management strategy.

Valuing the Barmah–Millewa Forest and in stream river flows: A spatial heteroskedasticity and autocorrelation consistent (SHAC) approach

- Ecological Economics---2015---Sorada Tap-
suwan, Maksym Polyakov, Rosalind Bark, Martin
Nolan

This paper uses spatial heteroskedasticity and autocorrelation consistent (SHAC) hedonic property price analysis of house sales during 2000–2011 to estimate the marginal value of in stream flows and proximity to an iconic freshwater ecosystem, the Barmah–Millewa Forest (BMF) in Australia's Murray–Darling Basin. We establish: (1) that proximity to the BMF is a statistically significant and positive determinant of nearby house prices in Victoria and New South Wales, i.e. for an average property worth \$199,000 that is 10km away from the BMF, moving 1km closer will increase sales price by \$2000; and (2) a non-linear relationship between in stream flow and sales price which is suggestive of homebuyer preferences for flow that is neither low (i.e. drought flows) nor high (i.e. flood flows). The results provide estimates of the benefits of in stream flow that could be used to inform freshwater ecosystem restoration policy in the basin and are suggestive of regional benefits that accrue to homeowners living near key freshwater-dependent ecosystems in the basin.

Renewable electricity producing technologies and metal depletion: A sensitivity analysis using the EROI

- Ecological Economics---2015---Florian Fizaine, Victor Court

More and more attention is being paid to renewable technologies because they are seen as a great opportunity to disengage our society from its dependence on fossil fuels. Such flow-based energy resources that rely on solar energy are supposed to lead us toward a sustainable energy future. However, because of their high capital intensity, renewable technologies require large amounts of matter, including both common and rare metals. These metals require energy for their production, and more specifically for their extraction. The energy cost associated with metal extraction is linked to mineral ore grade, meaning that as depletion progresses, energy cost increases. In addition, renewable energy resources deliver less net energy to society compared to fossil fuels, because of their diffuse nature. It is therefore easy to see that a close relationship exists between energy and metal sectors. In this article, we describe more precisely this relationship by investigating how the energy requirement associated with metal extraction could impact the energy-return-on-investment (EROI) of different renewable and nuclear technologies. More precisely, we present a methodology that can be used to calculate the sensitivity of the EROI of a given technology to a specific or to multiple metal ore grade degradation. We found that if considered separately, the qualitative depletion of a given metal has no significant impact on the EROI of renewable and nuclear technologies, unless its concentration approaches very low grade. However, if all metals are considered together, the EROI of these same technologies could be importantly diminished, especially if they tend to very low concentrations.

Relocation or reallocation: Impacts of differentiated energy saving regulation on manufacturing industries in China

- Ecological Economics---2015---Junming Zhu, Matthias Ruth

Unilateral tightening of environmental regulation is often considered to cause regulated industries to locate at places with lower compliance cost. The pollution haven effect may be offset, however, when endogenous technical change and factor reallocation can compensate increased compliance cost. This paper identifies the overall effects on industrial activities from provincially differentiated regulation of energy saving in China. Econometric specifications take into account the workings of different policy instruments, quantity and revenue-based measurement of output, policy-induced price effects, and alternative measurement of productivity and competitiveness. Results indicate that an introduction of energy-saving policies leads to loss of output and productivity in energy-intensive industries initially, which is passed on to other industries via markets of capital and energy-intensive goods. Under higher regulation, energy-intensive industries become more capital-intensive, regain productivity more quickly, and increase export rates; other industries become more labor-intensive, recover more slowly, and decrease export rates. Through capital investment and factor reallocation, China's policy has been effective in improving industrial energy efficiency without causing competitive loss or carbon leakage. An incentive-based instrument of differential electricity prices leads to similar effects on industries, implying the possibility for more efficient policy-making.

Determinants of agricultural land values in Argentina

- Ecological Economics---2015---Johanna Choumert Nkolo, Pascale Phelinas

In the context of the rapid development of the cultivation of genetically modified soybeans in Argentina, we conduct a hedonic analysis of agricultural land values. The main objective is to evaluate the impact of land

tenure systems and agricultural practices on these values. Data on 338 parcels, located in the Pampas region, are analyzed. The tenure appears to be a particularly important variable. We find that plots rented either by physical persons or by companies are negatively valued in relation to plots owned. Results also highlight the importance, though not to a large degree, of a diversified cropping pattern compared to soybean monoculture. Soil quality, location of the plots, distance to markets, as well as to the nearest city, were also found to affect land values.

The job generation impacts of expanding industrial cogeneration

- Ecological Economics---2015---Paul Baer, Marilyn A. Brown, Gyungwon Kim

Sustainable economic development requires the efficient production and use of energy. Combined heat and power (CHP) offers a promising technological approach to achieving both goals. While a recent U.S. executive order set a national goal of 40GW of new industrial CHP by 2020, the deployment of CHP is challenged by financial, regulatory, and workforce barriers. Discrepancies between private and public interests can be minimized by policies promoting energy-based economic development. In this context, a great deal of rhetoric has addressed the ambiguous goal of growing “green jobs.” Our research provides a systematic evaluation of the job impacts of an investment tax credit that would subsidize industrial CHP deployment. We introduce a hybrid analysis approach combining simulations using the National Energy Modeling System with Input-output modeling. NEMS simulates general-equilibrium effects including supply- and demand-side resources. We identify first-order employment impacts by creating “bill of goods” expenditures for the installation and operation of industrial CHP systems. Second-order impacts are then estimated based on the redirection of energy-bill savings accruing to consumers; these include jobs across the economy created by the lower electricity prices that would result from increased reliance on energy-efficient CHP systems. On a jobs-per-GWh basis, we find that the second-order impacts

are approximately twice as large as the first-order impacts.

Motivations for implementing environmental management practices in Indian industries

- Ecological Economics---2015---Neelam Singh, Suresh Jain, Prateek Sharma

The motivations to implement environmental management system (EMS) practices in Indian industries are explored empirically. The study presents a survey of 104 industries from different sectors to identify the main motivational factors and firms’ characteristics that determine the adoption of EMS practices by firms. The empirical evidence suggested that the comprehensiveness of the adopted EMS practices is positively influenced by relational motivations as firms consider their image, compliance and prevention of environmental incidents as significant drivers to implement EMS practices. Firms are also expected to adopt EMS practices to stay competitive if other firms are implementing similar EMS practices. However, the results show that Indian firms do not consider innovation and cost saving as a significant motivation to employ EMS practices. The findings also confirm that larger firms are more likely to adopt comprehensive EMS practices compared to small and medium enterprises (SMEs). The results show that compared to the service sector, firms in manufacturing, chemical and agricultural sectors are more likely to adopt comprehensive EMS practices.

100 percent reserve banking: A critical review of green perspectives

- Ecological Economics---2015---Kristofer Dittmer

100 percent reserve banking (C-PeRB) is an enduring proposal for monetary reform that has been taken up by some ecological economists. This paper identifies three groups of green arguments in favor of C-PeRB, and offers some criticism. First, the proposal could serve to constrain new investments by the availability of savings, thereby checking economic growth. However, this would strongly increase interest rate volatility.

Second, it could potentially elevate environmental considerations in decisions about resource allocation by increasing the role of the democratic state as an economic actor. This line of argument faces problems that require further detailed exploration and historical perspective. Third, a transition to C-PeRB would allow debt levels to be drastically cut. This is technically possible, but politically a tall order. Whether the existing system of ‘debt-based’ bank money generates a significant growth imperative is unclear, and the importance of other driving forces behind perennial economic growth in modern societies – which C-PeRB does not address – remains an issue of contention. In general, the adoption of C-PeRB presupposes a tremendous reconfiguration of power relations between states and finance capital.

Understanding how income influences willingness to pay for joint programs: A more equitable value measure for the less wealthy

- Ecological Economics---2015---William S. Brefle, Mark E. Eiswerth, Daya Muralidharan, Jeffrey Thornton

The preponderance of evidence from many studies is that less wealthy households are subjected to greater exposure per capita and in aggregate to air pollution, water pollution, and toxic wastes. It also is the case that the less wealthy are provided with a disproportionately low amount of other programs to enhance amenities provided by the natural environment, such as recreational resources and high-quality esthetic opportunities (both quality and quantity). However, to date, no study has quantified the scale of this effect on the less wealthy as compared to their more wealthy counterparts when it comes to policy choices made on the basis of benefits analysis. This study provides a new equity adjustment method to measure quantitatively the effect of this inequity in the case of public goods.

The power of environmental indifference. A critical discourse analysis of a collaboration of tourism firms

- Ecological Economics---2015---Heidi Rapp Nilsen, May-Britt Ellingsen

International attempts have not succeeded in addressing climate change, leaving an even heavier responsibility on countries, firms and people. As tourism is an expanding branch in the world economy, it is crucial to focus on how climate change issues are addressed in this industry as well. This paper analyses a group of tourism firms in Norway that join together to promote growth and profitability in winter tourism. The span in how these firms deal with environmental issues ranges from ecotourism till not addressing the subject at all. Although the majority of the firms have environmental issues on the agenda, environmental issues are not included in the cooperation. We use critical discourse theory to explore how this stance on environmental issues within a cooperation has come about, and categorize the firms into three discourses: neoclassical economics, environmental economics and ecological economics. Our data indicate that the hegemonic power of neoclassical economics hampers an environmental focus in the network. This power is exerted through the position of being environmentally indifferent. The paper adds knowledge to economic discourses on firm level.

Metaphor as a mechanism of global climate change governance: A study of international policies, 1992–2012

- Ecological Economics---2015---Christopher Shaw, Brigitte Nerlich

This paper explores the emergence of a global climate change mitigation regime through an analysis of the language employed in international science-policy reports. We assume that a global climate regime can only operate effectively on the basis of a shared understanding of climate change which is itself based on a shared language of governance. We therefore carried out an in-depth thematic and metaphor analysis of 63 policy

documents published between 1992 and 2012. Results show that global climate science-policy discourses universalise the myriad impacts of a changing climate into a single dichotomous impacted/not-impacted scenario and aim to govern this world according to economic principles of cost–benefit analysis. These discourses use metaphors that draw on narrative structures prevalent in the wider culture to produce and legitimate a reductionist representation of climate change. This representation undermines public understanding of and engagement with climate change by marginalising subordinate policy framings which do not align with the prevailing dichotomous framing. The types of documents we analyse in this paper represent important sources for journalists reporting on climate change. We therefore suggest that any attempt to improve public communication of climate change should include revisions to these organisational discourses.

The fragility of the Environmental Kuznets Curve: Revisiting the hypothesis with Chinese data via an “Extreme Bound Analysis”

- Ecological Economics---2015---Haisheng Yang, Jie He, Shaoling Chen

This article revisits the validity of the Environmental Kuznets Curve hypothesis. Based on data for seven pollutants in 29 Chinese provinces from 1995 to 2010, we conducted statistical tests on the coefficients of the critical variables (polynomial income-related terms) by following the logic of a “General Sensitivity Test,” more often known under the name of “Extreme Bound Analysis (EBA),” which was initially proposed by Leamer (1978). We tested a set of models (6144) and estimation methods (23) using a bootstrap approach in which each model is estimated 1001 times (1000 bootstrapped database+one original database). Based on the 6144 × 23 × 1001 regression results, we construct distributions for the coefficients of the income-related terms and calculate the cumulative probabilities for the single coefficients with the expected signs and the regressions that obtain the “accepted” forms of the EKC (inverted-U or N forms). Our test reveals that the EKC hypothesis cannot be considered valid for any

of the seven emission indicators because the probability of obtaining a negative coefficient for the quadratic income terms and the probability of finding an inverted-U-form relationship between income and pollution are all lower than the 95% critical level. Without reaching the 95% statistical significance level for emissions such as CO₂ and industrial gas, our results seem to more often reveal a positive linear relationship with income.

Where is the value in valuing pollination ecosystem services to agriculture?

- Ecological Economics---2015---Andony P. Melathopoulos, G. Christopher Cutler, Peter Tyedmers

Current national and global scale monetary valuation of pollination services do not accurately estimate the contribution of wild pollinators to agricultural production. First, ecosystem (wild) pollination services remain largely bundled with those of managed pollinators. This problem is compounded by the fact that the dependency of crops on pollination, a key parameter used in current valuations, does not reflect variation in pollinator density, crop cultivars and growing conditions that exist in practice. Over half of the €153 billion of estimated global pollination service value in 2005 is based on estimates of pollinator dependency from crops with fewer than three field studies that measure actual levels of pollinator activity and corresponding fruit set. The resulting uncertainty may be most distorting when applied to widely-planted intensive oilseed crops. Furthermore, current valuations are underpinned by simplistic assumptions regarding the likelihood of pollinator decline and the impact on agricultural prices. Although efforts to motivate wild pollinator protection through their ecosystem service value remain highly circumscribed by conceptual and empirical limitations, we identify the need to go beyond technical solutions and develop a critical framework that could account for why pollinator conservation has come to be predominantly justified in these terms to begin with.

The Vermont Common Assets Trust: An institution for sustainable, just and efficient resource allocation

- Ecological Economics---2015---Joshua Farley,Robert Costanza,Gary Flomenhoft,Daniel Kirk

Both private and public sectors have failed to adequately provide critical ecosystem goods and services or an equitable distribution of wealth and income. To address this problem, the Vermont legislature is considering the creation of a Vermont Common Assets Trust (VCAT) that would make the state's atmosphere, aquifers and other resources created by nature or by society as a whole the common property of all Vermonters, present and future. Under the Trust, a board of trustees would have the legal obligation to manage these assets for the benefit of all Vermonters, including future generations. This paper first explains why certain resources are likely to be managed more sustainably, fairly and efficiently as common property than as private property. It then discusses mechanisms for integrating assets into the trust. Estimates of potential revenue from a VCAT suggest that it could eliminate the state budget deficit, contribute to a better distribution of wealth and resources, and help address critical ecological problems. Survey results suggest that a VCAT is politically feasible. The VCAT promises to be an important pilot project that could later be scaled up to a national or global level.

Publisher's Note

- Ecological Economics---2015---Julian Rode,Erik Gómez-Baggethun,Torsten Krause

2015

The Kenneth E. Boulding Memorial Award 2014

- Ecological Economics---2015---Peter A. Victor

This speech was delivered at the meeting of the International Society for Ecological Economics at Reykjavik, Iceland on the 13th of August 2014 at the presentation of the 2014 Kenneth E. Boulding Memorial Award.

In the speech Peter Victor pays tribute to Kenneth Boulding, one of the pioneers of ecological economics, and then describes his own principal contributions to ecological economics over a period of 45 years. These contributions include environmental applications of input-output analysis, the problematic extension of the concept of capital to nature, the definition and analysis of green growth, and his research on ecological macroeconomics and the challenge to economic growth.

The unfinished journey of ecological economics

- Ecological Economics---2015---Robert L. Nadeau

The goal of the economists and ecologists who laid the conceptual foundations for ecological economics in the 1960s and 1970s was to create a scientifically informed discipline that could serve as the basis for coordinating economic activities in environmentally responsible ways. The aim of this article is to make a convincing case that the history of neoclassical economic theory provides a coherent basis for understanding why ecological economists must finish the journey begun by these economists and ecologists.

Bigger cakes with fewer ingredients? A comparison of material use of the world economy

- Ecological Economics---2015---Frank Pothén,Michael Schymura

The amount of materials used worldwide in production and consumption increased by 56% from 1995 to 2008. Using an index decomposition analysis based on the logarithmic mean Divisia index, we investigate the drivers of material use, both on a global and a country scale. We exploit a panel dataset of 40 countries, accounting for 75% of worldwide material extraction and 88% of GDP, from 1995 to 2008. The results show that economic growth and structural change towards material-intensive countries explain most of the growth in global material use. Slight gains in material efficiency and falling importance of material-intensive sectors have decelerating effects. The country-level analysis reveals substantial heterogeneity. Some nations exhibit

stable or falling material use, while it increases notably in most countries. Improving material efficiency is able to dampen growth of material use in important industrializing nations like China or India.

Actions and intentions to pay for climate change mitigation: Environmental concern and the role of economic factors

- Ecological Economics---2015---Christian Dienes

This study empirically investigates the relationship between an individual's concern about climate change and one's actions reducing the effects of climate change and intentions to pay for mitigating such effects. Particular emphasis is placed on the role of economic factors that may serve as a contextual factor influencing these relationships. Based on data from the Life in Transition Survey covering individuals from 35 countries in 2010, this study uses information regarding the financial crisis of 2008 to inform about economic factors. The results suggest that respondents exhibiting higher climate change concerns are not only more likely to intend to pay for mitigating the effects of climate change, but they are also more likely to take actions in order to minimize such effects. The results also indicate that economic factors only have a moderating effect on the relationship between higher climate change concerns and actions. Furthermore, the results also point to the relevance of a country's state of economic development.

'Yes-in-my-backyard' : Spatial differences in the valuation of forest services and local co-benefits for carbon markets in México

- Ecological Economics---2015---Arturo Balderas Torres,Douglas C. MacMillan,Margaret Skutsch,Jon C. Lovett

Forests provide many and large benefits, including cost-efficient climate change mitigation. However international carbon markets have not stimulated the demand for forestry offsets. Domestic market-mechanisms are emerging in many countries and forests could be highly valued through these policies as most of the benefits produced by forests are enjoyed locally. Here, a choice

experiment explores drivers of valuation and willingness to pay for forest carbon services in voluntary markets in Mexico by comparing the valuation of citizens from four regions to test geographical preference for projects (n=645). Findings from multinomial-logit models show valuation of forest carbon services is transferable and citizens would pay more for offsets from projects closer to their homes. Proximate forests provide a range of co-benefits to local users, including environmental services and opportunities for recreation. Factors related to valuation include sense of responsibility, previous knowledge of carbon emissions, previous visits to the sites, regional identification and the valuation of local environmental services (e.g. improvements in local air quality). Knowledge of spatial heterogeneity in valuation of the use of forest services can help to design market-based instruments by identifying highly valued areas for environmental services programs and carbon markets.

Connecting net energy with the price of energy and other goods and services

- Ecological Economics---2015---Robert A. Herendeen

Net energy is intuitively compelling and useful in calculating total impacts (e.g., primary energy, greenhouse gases, land use, and water requirements.) of delivering useful energy to the larger economy. However, it has little policy impact unless connected quantitatively to the price of energy and other goods and services. I present an input-output (IO)-based method to do this. The method is illustrated by a two-sector model fitted to U.S. IO economic data. In an IO-characterized system, the energy returned on energy invested (EROI) and the energy intensity of energy are directly related. However, EROI and prices are not uniquely related because they depend differently on four independent IO coefficients representing internal structure of, and the relationship between, the energy sector and the rest of the economy. If only one of these coefficients varies, then EROI does uniquely determine prices. Uncertainties in the IO coefficients, as well as persistent issues of choosing system boundary and aggregating diverse

energy types, further complicate the EROI-price connection. In this context I review two recent empirical comparisons of U.S. oil and gas prices and EROI for 1954–2007.

Unraveling the effects of environmental outcomes and processes on financial performance: A non-linear approach

- Ecological Economics---2015---Nicola Misani,Stefano Pogutz

We examine the roles of the outcome and process dimensions of environmental performance in determining financial performance as measured by Tobin's q. Outcomes refer to the impacts of the firm on the natural environment, while processes are the firm's actions to reduce these outcomes. We focus on a specific outcome – carbon emissions – and suggest that it affects Tobin's q non-linearly. We find that firms achieve the highest financial performance when their carbon performance is neither low nor high, but intermediate. We also find that environmental processes moderate this relationship as they reinforce firms' financial performance through improved stakeholder management. This mixed picture suggests that firms do not generally internalize the costs of poor carbon performance, but those that stand out in both environmental outcomes and processes achieve net financial benefits. These findings are based on a sample of carbon-intensive firms that disclosed their greenhouse gas (GHG) emissions through the Carbon Disclosure Project from 2007 through 2013.

Ecosystem services and economic development in Austrian agricultural landscapes — The impact of policy and climate change scenarios on trade-offs and synergies

- Ecological Economics---2015---Mathias Kirchner,Johannes Schmidt,Georg Kindermann,Veronika Kulmer,Hermine Mitter,Franz Prettenhaler,Johannes Rüdissler,Thomas Schauppenlehner,Martin Schönhart,Franziska Strauss,Ulrike Tappeiner,Erich Tasser,Erwin Schmid

We have developed an integrated modeling framework (IMF) to quantify indicators for ecosystem services (ES) and economic development (ED) in agricultural landscapes. Austria serves as a case study in which impacts, trade-offs, and synergies of ES and ED are assessed for different agricultural policy pathways and regional climate change scenarios. Agricultural intensification and incentivized use of provisioning ES (e.g. biomass production) lead to higher macro-economic output (e.g. GDP) but usually reduce ES related to regulation and maintenance (e.g. ecological integrity, climate regulation), as well as cultural services (landscape diversity). We revealed both synergies for certain ES (e.g. biomass production and soil organic carbon stocks) as well as large spatial deviations from the national mean across the heterogeneous agricultural landscapes in Austria. Climate change scenarios (i) lead to substantial variation in ES and ED indicators and (ii) usually amplify trade-offs by stimulating land use intensification. Our findings depict the complex relationship between different ES and ED indicators as well as the importance of considering spatial heterogeneity and regional climate change. This assessment can help to improve targeting of agri-environmental schemes in order to provide a more balanced and efficient supply of ES and to foster rural development.

Leaving oil underground in Ecuador: The Yasuní-ITT initiative from a multi-criteria perspective

- Ecological Economics---2015---María Cristina Vallejo,Rafael Burbano,Fander Falconi,Carlos Larrea

The Ecuadorian proposal to keep 846 million barrels of crude oil in the Yasuní National Park underground—for the purposes of avoiding CO₂ emissions and to protect both the biological diversity and the indigenous peoples in isolation who inhabit this area of the Amazon—is evaluated from a “multi-criteria” analysis. The main purpose of the paper is to compare this policy option with other alternatives across different values. An analytical framework is used that recognises the inherent complexity of a problem of this nature,

in which the financial values are indeed relevant for policy, but other values are also relevant: the economic (in a broad sense), social, environmental, cultural and political. The results confirm that from a financial standpoint, extracting the oil is preferable, but by incorporating the non-monetary values into the multi-criteria decision process, one can plausibly defend the Yasuní-ITT Initiative as the most desirable policy option. Indeed, the social and environmental benefits (or “criteria”) signalling an economic transition towards a model based on renewable sources of energy, along with the protection of critical environmental and social capital, make up for the financial gap.

Explaining the economic ‘irrationality’ of farmers’ land use behaviour: The role of productivist attitudes and non-pecuniary benefits

- Ecological Economics---2015---Peter Howley, Cathal Buckley, Cathal O Donoghue, Mary Ryan, Cathal O’donoghue

Although the physical conditions of a farm and farming system will to some extent predispose a farmer towards converting land to alternative agricultural uses such as forestry, results presented in this paper suggest that differences in underlying farming motivations can also play an important role in explaining farmers’ decision-making. Our findings suggest that even in the face of higher economic returns, some farmers may be reluctant to convert land to forestry as to do so would not be in keeping with their productivist attitudes. Other farmers may fear losing the non-pecuniary benefits derived from ‘working the land’. We conclude that economic incentives alone are unlikely to encourage certain cohorts of farmers to consider alternative land uses such as farm forestry and that policy ought to be guided by a better understanding of the differing farming motivations of farm operators.

Unraveling the veil of fuzziness: A thick description of sustainability economics

- Ecological Economics---2015---Moritz C. Remig

This article provides a thick description (Geertz, 1973) of sustainability economics. Baumgärtner and Quaas (2010a, b) have proposed as an alternative to ecological economics the new field of sustainability economics, which has triggered various replies. The purpose here is to order and to review these contributions. Building upon a literature review of sustainability economics, the paper argues that the concept currently has more of a fuzzy and declamatory character. The rhetoric (McCloskey, 1998) of sustainability economics contains general issues of sustainability economics, externalities and the capability approach. The article argues that it is currently not clear how the solutions for science and policy proposed by sustainability economics differ from those of ecological economics. Efforts should be directed towards further development of the theory and the operationalization of sustainability principles. The systemic view of co-evolutionary development, social learning and sustainability economics’ normative underpinning merits more consideration in the debate about sustainability economics.

Identifying the role of final consumption in structural path analysis: An application to water uses

- Ecological Economics---2015---Maria Llop, Xavier Ponce-Alifonso

The complexity of the connections within an economic system can only be reliably reflected in academic research if powerful methods are used. Researchers have used structural path analysis (SPA) to capture not only the linkages within the production system but also the propagation of the effects into different channels of impacts. However, the SPA literature has restricted itself to showing the relations among sectors of production, while the connections between these sectors and final consumption have attracted little attention. In order to consider the complete set of channels involved, in this paper we propose a structural path method that endogenously incorporates not only sectors of production but also the final consumption of the economy. The empirical application comprises water usages, and analyses the dissemination of exogenous impacts into

various channels of water consumption. The results show that the responsibility for water stress is imputed to different sectors and depends on the hypothesis used for the role played by final consumption in the model. This highlights the importance of consumers' decisions in the determination of ecological impacts.

Towards a thick understanding of sustainability transitions — Linking transition management, capabilities and social practices

- Ecological Economics---2015---Felix Rauschmayer, Tom Bauler, Niko Schöpke

Scientific activities which are targeted to engage and enact on societal problems – and governance of sustainability transition itself is one such activity – are necessarily prescriptive endeavours, have to recognize the fundamental normativity of sustainable development, need to be based on a thick description of the issues to change, and should embrace the multi-dimensional importance that individuals take in societal change. Societally relevant research on and for sustainability transitions therefore has to produce systems, target, as well as transformative knowledge. The challenges of sustainability transitions require furthermore that the individual and the societal levels have to be linked as to relate individual agency and structural change within the different knowledge types.

A framework for guiding the management of urban stream health

- Ecological Economics---2015---H.K. Millington, J.E. Lovell, C. Lovell

Urban stream ecosystems are vulnerable to urbanisation of surrounding land cover and land use. We study 30 sites along two highly urbanised streams in Brisbane, Australia. Fieldwork generated a suite of primary stream health indicators. Geographic information system techniques generated spatially-explicit metrics of land cover and a lumped metric of nearby population that put stress on stream health. Stream health indicators were aggregated into a stream health index, and land-use stress indicators were aggregated

into a land-use stress index, using data envelopment analysis (DEA). DEA was then applied to these indices to create an ecological performance index. Dominator analysis generated a set of practical role models for each ecologically underperforming site. A subsequent round of DEA was applied to the stream health index and multiple stress indicators to calculate response elasticities of stream health with respect to specific stress indicators. Empirical findings show widespread deviations beneath best practice, enlightening dominator relationships, and informative variation in response elasticities. Each of these findings can provide guidance to those responsible for allocating scarce resources in an effort to improve the health of Brisbane's urban streams.

Economic incentives and natural resource management among small-scale farmers: Addressing the missing link

- Ecological Economics---2014---Kindie Getnet, Catherine Pfeifer, Charlotte MacAlister

Small-scale farmers face numerous challenges to invest in natural resource management practices. The problems are interlinked, with such perverse economic problems as high transaction costs and risk rooted in the lack of comprehensive institutional and organizational services to farmers for risk reduction and incentive creation. Failure to address such a missing link undermines success in natural resource management. This paper ponders the importance of such a missing link and proposes analytic framework that explicitly integrates the economics of natural resource management into institutional and organizational analysis. The framework features the instrumentality of integrated institutional and organizational innovation to create opportunities and incentives to small-scale farmers to encourage investment in natural resource management practices.

Wasteland energy-scapes: A comparative energy flow analysis of India's biofuel and biomass economies

- Ecological Economics---2014---Jennifer Baka,Robert Bailis

Through a comparative energy flow analysis, this paper examines the energy security impacts of growing biofuels on wastelands in South India. India's National Policy on Biofuels claims that wastelands are well suited for biofuel production because they are empty and unused. However, in rural Tamil Nadu, a *Prosopis juliflora* fuelwood energy economy already exists on these lands and services a mix of rural and urban consumers at household and industrial levels. This *Prosopis* economy currently provides 2.5–10.3 times more useful energy than would the government's proposed *Jatropha curcas* biodiesel economy, depending on *Jatropha* by-product usage. Contrary to the government's claims, growing biofuels on wastelands can weaken, rather than improve, the country's energy security. Further, replacing *Prosopis* with *Jatropha* could engender changes in economic and property relations that could further weaken energy security. These findings are not specific to rural Tamil Nadu as *Prosopis* is widely used as a fuelwood throughout Asia and Africa. Calls to 'develop' degraded lands through biofuel promotion similarly exist in these regions. This study underscores the importance of analyzing wasteland-centered biofuel policies at local levels in order to better understand the changes in human–environment relationships resulting from this policy push.

The complex role of attitudes toward science in pro-environmental consumption in the Nordic countries

- Ecological Economics---2014---Annukka Vainio,Riikka Paloniemi

Applying system justification theory, we studied the role of attitudes toward science in pro-environmental consumption among the adult population of the Nordic countries (Denmark, Finland, Iceland, Norway, and

Sweden). We analyzed International Social Survey Programme (ISSP) data from 2010 using structural equation modeling (SEM). Attitudes toward science were found to play a complex role in pro-environmental consumption. First, a positive general attitude toward science was indirectly associated with pro-environmental consumption through increased environmental concern and knowledge. Second, the belief that science makes pro-environmental behavior unnecessary was indirectly associated with the avoidance of pro-environmental consumption through reduced environmental concern and knowledge. When these indirect associations were taken into account, a positive general attitude toward science was directly associated with the avoidance of pro-environmental behavior, and the belief that science makes pro-environmental behavior unnecessary was directly associated with increased pro-environmental consumption. The associations between the main variables were similar in all Nordic countries. These results increase our understanding about the ways in which attitudes toward science are related to pro-environmental consumption.

The culturality of ecosystem services. Emphasizing process and transformation

- Ecological Economics---2014---Michael Präpper,Felix Haupts

The concept of ecosystem services was formulated to create a market- and value-based foundation for sustainable natural resource use — by land users as well as by planners. The concise definition, measurement and especially valuation of nature's services is challenging, as values are notoriously fluid and there are dimensions of value other than the biophysically or economically measurable. However, the so-called "cultural ecosystem services", which are intended as a way to integrate these immaterial aspects of valuation, pose challenges. It is not clear what they are, to what degree they impact on valuations, or to whom these valuations are most relevant; nor how to integrate them into existing value classifications. Focusing on services as fixed outcomes, rather than processes, prevents the concept from remaining open to local actors' dynamic changes

in valuation. Additionally, they are often classified as a Eurocentric residual category for e.g. esthetic and recreational experiences nature provides. Building on anthropological theories and own cases from Angola, Namibia and Botswana, we suggest a definition of culture as a processual activity of meaning-making. By illustratively outlining the locality and culturality of land users' valuation we argue in favor of subjecting universalizing perspectives of ecosystem service valuation to new scrutiny.

Socio-cultural valuation of ecosystem services: uncovering the links between values, drivers of change, and human well-being

- Ecological Economics---2014---Irene Iniesta-Arandia, Marina García-Llorente, Pedro A. Aguilera, Carlos Montes, Berta Martín-López

Ecosystem services studies currently lack information regarding stakeholders' socio-cultural values. This information is highly relevant to human well-being, which is the motivation of ecosystem services assessments. We present results from an analysis of stakeholders' perceptions of ecosystem services, well-being and drivers of change in two semi-arid watersheds in south-eastern Spain. Based on the information compiled through a literature review, participant observation and semi-structured interviews, we designed a questionnaire and conducted 381 interviews. Our results show that semi-arid watersheds deliver a large variety of ecosystem services; however, these services are perceived in different ways. We identified five stakeholder groups, including: locals dependent on provisioning ecosystem services, locals not directly dependent on provisioning ecosystem services, environmental and local development professionals and rural and nature tourists. Overall, provisioning services related to traditional practices were perceived as highly important and highly vulnerable by every stakeholder group. However, we found contrasting perceptions of some ecosystem services among stakeholders and of the relevant drivers of change and well-being. We suggest that socio-cultural valuation is a useful tool to prioritize ecosystem services but more attention should be directed to emerging trade-offs.

Linking values to other stakeholder perceptions might be a useful way to move forward in ecosystem services valuation.

Adoption of greenhouse gas mitigation in agriculture: An analysis of dairy farmers' perceptions and adoption behaviour

- Ecological Economics---2014---Klaus Glenk, Vera Eory, Sergio Colombo, Andrew Barnes

The agenda towards greenhouse gas mitigation within agriculture implies changes in farm management practices. Based on a survey of Scottish dairy farmers, this study investigates farmers' perceptions of how different GHG mitigation practices affect the economic and environmental performance of their farms, and the degree to which those farmers have adopted those practices. The results of the farm survey data are used to identify promising mitigation practices for immediate policy support based on their potential for additional adoption by farmers, their perceived contribution to the farm's financial and environmental performance and information on their cost-effectiveness. The study demonstrates the usefulness of including adoption behaviour and farmers' perception of mitigation practices to inform early stages of policy development. This would ultimately contribute to the robustness and effectiveness of climate change mitigation policies in the agricultural sector.

Dependence on environmental resources and implications for household welfare: Evidence from the Kalahari drylands, South Africa

- Ecological Economics---2014---Gladman Thondhlana, Edwin Muchapondwa

This paper examines dependence on environmental resources and impacts on household welfare among the indigenous San and Mier rural communities neighbouring Kgalagadi Transfrontier Park in South Africa. Data on the various household income types, including environmental income, were collected through a structured survey of 200 households. Environmental income

constituted 20% of the total income. The poorest income quintile showed the highest relative dependence on environmental income (31%), though absolute environmental income increased with total income.

Estimating stocks and flows of nitrogen: Application of dynamic nutrient balance to European agriculture

- Ecological Economics---2014---Natalia Kuosmanen

This study elaborates the dynamic nutrient balance model and applies it to analyze nitrogen use and nitrogen efficiency in agriculture. We use publicly available agricultural production data to estimate the net inflows, stocks and outflows of nitrogen for 14 European countries in years 1961–2009. The dynamic model allows us to analyze the trends in the nitrogen stocks and flows over time, and break down the total outflow of nitrogen into flows to water, air and soil. We argue that the nitrogen outflow, modeled as the decay of nitrogen stock, provides a more reliable and robust agri-environmental indicator than the conventional nutrient balance. Mathematically, the nutrient balance is an interval scale measure, whereas the nitrogen stock and the outflow from stock are ratio scale measures. Nitrogen efficiencies, calculated based on the nitrogen stocks, provide useful and insightful information beyond the conventional eco-efficiency measures defined from the nitrogen balances. The results of this paper can be used as input data for more comprehensive eco-efficiency or productivity analysis and for the evaluation and design of agri-environmental policies in Europe.

Using Choice Modeling to estimate the effects of environmental improvements on local development: When the purpose modifies the tool

- Ecological Economics---2014---M^a. Helena Guimarães,Lívia Madureira,Luis Nunes,José Lima Santos,Carlos Sousa,Tomasz Boski,Tomaz Dentinho

A Choice Modeling (CM) study was chosen to assess specific management actions related to bird-watching on the Portuguese island of Terceira in the Azores. The usual willingness-to-pay measure was replaced by the willingness-to-stay (WTS) longer on the island for bird-watching, given changes in the site attributes. Results of the valuation study were presented to stakeholders and policy-makers using an innovative method. In particular, CM results were incorporated into a modeling tool which simulated the impact of alternative policy packages. For each selected scenario, users were able to understand birders' WTS and its impact on the local economy. The tool provided a fast and clear way of communicating relevant information, resulting in a more informed and inclusive deliberative process. Furthermore, we were able to see how results were used by the final users and came to the conclusion that local managers had preconceived ideas which did not match birders' preferences. This work led to a shift regarding prior beliefs about the relevance of bird-watching activities on the local economy as well as management actions likely to promote it. The underlying participatory approach was found to be an essential feature for the success of this science and policy interaction.

Investigating fishers' preferences for the design of marine Payments for Environmental Services schemes

- Ecological Economics---2014---Rhona F. Barr,Susana Mourato

We determine the effects of various management restrictions on adoption rates of marine Payments for Environmental Services (PES) schemes. Choice experiments are used in order to determine how fisher participation rates change under different marine PES programme designs. Various designs, with differing restriction rates, show different rates of adoption. However, fishers show a high utility loss associated with any move away from the current management situation, irrespective of restriction levels. This indicates that PES scheme costs may be high and creating an enabling environment could be important to reducing perceived losses, as could investment into conditional

in-kind compensation mechanisms. The paper also shows choice experiments to be a useful tool in marine PES design.

Aldo Leopold's unrealized proposals to rethink economics

- Ecological Economics---2014---Qi Feng Lin

The writings of Aldo Leopold (1887–1948), in particular his essay “The Land Ethic” in *A Sand County Almanac*, constitute a milestone in the discourse on human–environment relationships. During his career, Leopold witnessed several cases of land degradation that were caused by unbridled economic activity. The objective of this article is to examine two sets of draft proposals prepared by Leopold for the purpose of rethinking economics along conservation and ecological principles. The first is a set of four draft prospectuses written during the 1930s to pursue research on “conservation economics.” The focus here was on developing economic tools to promote conservation. The second is a draft memo written in late 1947 to propose creating a position in “ecological economics” at the University of Wisconsin, with the conservationist William Vogt (1902–1968) as candidate. Leopold was inspired by the work of Vogt in analyzing human–land interaction according to ecological principles. Unfortunately, Leopold passed away in April 1948. This article concludes with a discussion of Vogt's thinking on conservation up to that time, including his 1948 book *Road to Survival*, to provide a sense of the foundational work that would have gone into the development of Leopold and Vogt's “ecological economics.”

Perceptions of the services provided by pond fish farming in Lorraine (France)

- Ecological Economics---2014---Thierry Blayac, Syndhia Mathé, Hélène Rey-Valette, Pascal Fontaine

This article discusses a study of the perceptions of ecosystem services in pond fish farming in the Lorraine region, one of the principal pond fish farming regions in France. In total, 668 people were surveyed

from four types of population: fish farmers, economic and institutional stakeholders, pond users and inhabitants of villages located close to the ponds. A typology of perceptions was established using a principal component analysis associated with an ascending hierarchical ranking. It shows differentiated perceptions of the categories of ecosystem services by population type. Age and education affect these perceptions. In addition, econometric modeling (a multinomial logit model) showed the importance of regulating and supporting systems for fish farmers, stakeholders and pond users. The preferences of local residents are more evenly spread across service categories, although it may be noted that educational level tends to increase the choice of supporting and regulating services.

Measuring the environmental cost of hypocrisy

- Ecological Economics---2014---Arthur Caplan, Charles Sims, Elliot Jordan Anderson

This paper provides an example of how to estimate the marginal environmental cost of hypocrisy using revealed-behavior and self-identification survey responses from coffee drinkers regarding their use of cardboard and plastic (i.e., non-reusable) cups. Coffee shops provide a convenient microcosm for assessing the impact of hypocritical behavior because of (1) readily available, cheap substitutes (i.e., reusable coffee cups), (2) a relatively accurate estimate of the environmental (in particular, carbon) cost associated with using non-reusable cups, and (3) the ability to delineate hypocritical behavior by observing a choice with relatively few potential confounding factors. Hypocritical behavior is measured as a geometric mean of how often an individual takes coffee in a non-reusable cup and the degree to which the individual self-identifies as being concerned about his environmental footprint. All else equal, the more often a person takes his coffee in a non-reusable cup and the greater the degree to which he self-identifies as being concerned about his footprint, the greater the individual's “hypocrisy score.” Controlling for other attitudinal and demographic characteristics (including self-identified awareness of environmental issues and willingness to pay for

the convenience of using a non-reusable cup), we are able to determine the marginal effect of an individual's hypocrisy score on the environmental cost associated with the use of non-reusable coffee cups.

Extending the concept of the resource curse: Natural resources and public spending on health

- Ecological Economics---2014---Lara Cockx,Nathalie Francken

This paper extends the concept of the resource curse by studying whether and through which transmission channels natural resource wealth affects social spending. Even though the availability of vast natural capital reserves has commonly been linked to the neglect of human development, most of the literature has continued to focus on economic performance. This paper is the first to empirically investigate the link between natural resource wealth and public health expenditures in light of the hypothesis that resource wealth as a source of unearned state income enhances state autonomy and increases volatility, which leads to policies that fail to prioritize human development. Using a large panel dataset of world countries covering the period from 1995 to 2009, we find a robust, significant inverse relationship between natural resource dependence, and even abundance, and public health spending over time. The effect remains significant after controlling for state autonomy, volatility, and other factors. These findings have implications for national authorities as well as the extractive industry. Governments should be made accountable for natural resource wealth and correct taxation could provide additional resources, earmarked for health. The extractive industry could increase their investments in sustainable Corporate Social Responsibility operations, specifically in the health sector.

Green tangible investment strategies and export performance: A firm-level investigation

- Ecological Economics---2014---Roberto Antoni-etti,Alberto Marzucchi

In this paper we empirically investigate the relationship between investments in environmentally oriented

equipment and firms' export performance. We adopt a two-stage model where we first estimate the impact of green tangible investment strategies (GTIS) on the level of productive efficiency (TFP), and then assess whether induced productivity influences the propensity and the intensity of exports. We rely on a rich firm-level dataset on Italian manufacturing. Our results show that firms with higher productivity, induced among other factors by green investments combining environmental and increased revenue objectives, achieve a higher export performance. In particular, GTIS-enhanced TFP affects the probability of exporting in foreign markets characterized by more stringent environmental regulation. Our evidence supports a 'green-based' firm heterogeneity argument.

Present bias predicts participation in payments for environmental services: Evidence from a behavioral experiment in Uganda

- Ecological Economics---2014---Sophie Clot,Charlotte Y. Stanton

Farmers are necessary agents in global efforts to conserve the environment now that croplands and pastures together constitute the largest terrestrial system on Earth – covering some 48% of ice-free land surface. Whereas standard economic models predict that farmers will participate in conservation programs so long as they are profitable, empirical findings from behavioral economics point to a number of normally unobservable preferences that may influence the decision-making process. This study tests, for the first time, whether heterogeneity in behavioral preferences correlates with decisions to participate in Payments for Environmental Services (PES) programs. We elicit individual trust and time preferences using economic experiments and link resulting measures to household survey data and participation decisions in a Ugandan PES program. We find that farmers who exhibit a preference for proximate gains – present-biased preferences – are 47.7% more likely to participate in the program than those who show time-consistent or future-biased preferences. This result has implications for ongoing and planned PES programs involving farmers, particularly in Africa,

by highlighting a potential relationship between payment timing and participation, and further validates the use of behavioral experiments in explaining real-world decisions.

Fukushima and the preference for nuclear power in Europe: Evidence from subjective well-being data

- Ecological Economics---2014---Heinz Welsch,Philipp Biermann

The sustainable supply of energy is high on the agenda of many European countries. One of the pertinent issues, the future role of nuclear power, has gained increasing attention after the nuclear disaster at Fukushima, Japan. As a contribution to preference elicitation, we test whether the relationship between subjective well-being (SWB) of European citizens and the supply of nuclear power has changed after the Fukushima nuclear accident of March 11, 2011. Survey data for about 124,000 individuals in 23 European countries reveal that while European citizens' SWB was statistically unrelated to the share of nuclear power before the Fukushima disaster, it was negatively related to the nuclear share after the disaster. Taking the relationship between SWB and the nuclear share as an indicator of preference, this suggests the existence of an induced preference change.

Food labeling and eco-friendly consumption: Experimental evidence from a Belgian supermarket

- Ecological Economics---2014---Pieter Vlaeminck,Ting Jiang,Liesbet Vranken

Using an incentive-compatible framed field experiment, we investigate whether consumers' food consumption is more eco-friendly when the information about a product's environmental impact is more easily accessible. Through an online survey, we identify a food label that is perceived to be the most easily accessible for assessing a product's eco-friendliness among six alternatives. These alternatives vary on multiple dimensions, including whether a standardized score of the overall

environmental impact is added. This new food label is subsequently tested in an experimental food market embedded in a Belgian supermarket. We find that the presence of the new label that was preselected in the online survey leads to more eco-friendly food consumption relative to either the label currently used in the supermarket, or the label that contains the raw information of the environmental impact. In our experimental food market, the use of an easy-to-interpret but comprehensive environmental information label increases the overall eco-friendliness of our subjects' food consumption by about 5.3% relative to the default label used in current markets.

Potentials for prosperity without growth: Ecological sustainability, social inclusion and the quality of life in 38 countries

- Ecological Economics---2014---Martin Fritz,Max Koch

Recent contributions to ecological economics and related social sciences indicate that issues such as climate change, resource depletion and environmental degradation cannot be effectively addressed under conditions of continued economic growth. This paper aims at empirically identifying structural potentials and policy challenges for prosperity at scales where economic development remains within ecological carrying capacities. Building on the growing literature that interprets prosperity 'beyond' economic growth, the paper presents a three-dimensional concept to operationalise prosperity in terms of ecological sustainability, social inclusion, and the quality of life. These dimensions are measured using data from sources such as The World Bank, the Global Footprint Network and the OECD. The results of cluster and correspondence analyses indicate the existence of five 'prosperity regimes' and demonstrate that all aspects of prosperity – including (unsatisfactory) ecological performance – are linked to economic development. However, our findings also indicate that in order to achieve a decent minimum of prosperity moderate levels of the material living standard are sufficient. Further increases in the material living standard do not lead to significant additional

prosperity; instead they cause greater environmental harms. The paper concludes by highlighting potentials for prosperity for each of the ‘prosperity regimes’ and corresponding policy challenges.

The water footprint of the Spanish agricultural sector: 1860–2010

- Ecological Economics---2014---Rosa Duarte,Vicente Pinilla,Ana Serrano

Since 1860, the Spanish agricultural sector has undergone an intensive process of development resulting in important structural changes, not only in the sector itself, but also in the relationship of the agrarian system to natural resources. This paper studies the evolution of domestic water consumption as a consequence of increasing agricultural production, as well as the impact that the growing need for water had on the construction of infrastructure for irrigation. To that end, we examine the water consumed in the production of vegetable and animal goods for five different years: 1860, 1900, 1930, 1962 and 2010. From these results, a detailed analysis of the trends in water consumption and changes in compositional patterns is carried out. We determine to what extent the development of the agricultural sector conditioned the construction of new irrigation infrastructure. Finally, a Decomposition Analysis (DA) is applied to analytically identify and quantify the main explanatory factors behind that evolution, and to understand the increase in agricultural water consumption over the long term. Our findings show the large pressures on water resources exerted as a result of the expansion of the Spanish agricultural sector during the last 150years.

The strange case of cultural services: Limits of the ecosystem services paradigm

- Ecological Economics---2014---Robert H. Winthrop

As interest in the concept of ecosystem services (ES) has grown, so has its scope. This paper considers some limitations of the ES paradigm by examining one category of ES: cultural services, including the

environmental basis for esthetic, spiritual, and recreational experiences, cultural heritage, sense of place, and ways of life. It examines whether cultural ES can be assessed in terms of purely individual benefits or if social/collective considerations must be included; and whether the concept of ‘services’ even provides an appropriate framework for understanding such values. To pursue these questions I consider the recent literature on the assessment and valuation of ‘cultural services’ and assess the adequacy of this perspective against several examples from American Indian communities of the Pacific Northwest. Three characteristics of these situations from Indian Country are problematic for an ES framework: the social construction of environmental experience, the symbolic character of environmental knowledge, and the multidimensionality of environmental value. On the basis of this analysis, I propose a model of culturally reflexive stewardship as potentially a more productive and theoretically consistent framework for characterizing such socially constructed environmental values and practices.

A gravity model of virtual water trade

- Ecological Economics---2014---Andrea Fracasso

This work investigates the determinants of bilateral ‘virtual water trade (VWT) flows’ by means of an estimated gravity model of trade applied to the services of the water embodied in the agricultural goods exchanged across countries. In line with the recent literature on the gravity model of trade, the paper presents a battery of estimation methods. The analysis shows that bilateral VWT flows are affected by the classical determinants of trade, by national water endowments, and by the level of pressure on water resources. These general findings are robust, even though some variation can be observed across the estimation methods and, in particular, when smaller sub-samples of countries (such as continents and regional groups) are considered. This contributes to account for the mixed evidence in the literature on the importance of water endowments for the VWT flows.

Valuing conservation benefits of an offshore marine protected area

- Ecological Economics---2014---Tobias Börger, Caroline Hattam, Daryl Burdon, Jonathan P. Atkins, Melanie C. Austen

Increasing anthropogenic pressure in the offshore marine environment highlights the need for improved management and conservation of offshore ecosystems. This study scrutinises the applicability of a discrete choice experiment to value the expected benefits arising from the conservation of an offshore sandbank in UK waters. The valuation scenario refers to the UK part of the Dogger Bank, in the southern North Sea, and is based on real-world management options for fisheries, wind farms and marine protection currently under discussion for the site. It is assessed to what extent the general public perceive and value conservation benefits arising from an offshore marine protected area. The survey reveals support for marine conservation measures despite the general public's limited prior knowledge of current marine planning. Results further show significant values for an increase in species diversity, the protection of certain charismatic species and a restriction in the spread of invasive species across the site. Implications for policy and management with respect to commercial fishing, wind farm construction and nature conservation are discussed.

Happy for how long? How social capital and economic growth relate to happiness over time

- Ecological Economics---2014---Stefano Bartolini, Francesco Sarracino

What predicts the evolution over time of subjective well-being? We correlate the trends of subjective well-being with the trends of social capital and/or GDP. We find that in the long and the medium run social capital largely predicts the trends of subjective well-being. In the short-term this relationship weakens. Indeed, in the short run, changes in social capital predict a much smaller portion of the changes in subjective well-being than over longer periods. GDP follows a reverse path, thus confirming the Easterlin paradox: in the short

run GDP is more positively correlated to well-being than in the medium-term, while in the long run this correlation vanishes.

Ecosystem services concepts and approaches in conservation: Just a rhetorical tool?

- Ecological Economics---2014---Janet A. Fisher, Katrina Brown

Many commentators have raised questions about the recent focus on ecosystem services (ES) concepts in conservation, but little empirical analysis exists. We present a novel empirical analysis using interviews and Q Methodology to examine how conservation practitioners and organisations are interpreting and using ES concepts and associated approaches. We find that these concepts are being adopted for instrumental imperatives to broaden constituencies and with an expectation of extending funding sources. We uncover concerns within conservation that the utilitarian emphases of ES concepts may compromise the ability to make non-utilitarian arguments for nature in the future. In relation to changing practice, we examine shifts in partnerships and funding, where ES ideas provide a shared language about flows of value, apparently accelerating the integration of conservation and the private sector. Whilst many respondents noted the significance of shifts related to ES ideas, some attempted to play these down, presenting their organisation's adoption of these ideas as 'just a rhetorical tool'. However, we argue that the adoption of ES concepts cannot be presented as solely rhetorical, given that these increasingly underpin and inform planning tools and policy instruments.

Does environmental concern change the tragedy of the commons? Factors affecting energy saving behaviors and electricity usage

- Ecological Economics---2014---Adrienne M. Ohler, Sherrilyn M. Billger

Electricity consumption produces private goods, such as heat for homes, but fossil fuel consumption impacts the public goods of clean air and water. While self

interests can increase usage, social interests, such as global climate change, can impact an individual's attitude toward energy consumption. This paper examines the tragedy of the commons using household data, and compares the impact of self and social interests in predicting electricity consumption. Using both stated and observed behavioral data, the results show that self interests have a greater impact on energy saving behaviors and electricity use. We extend the analysis to control for an individual's environmental concern and perceived behavioral impact, finding similar results, and supporting the notion that the tragedy of the commons occurs regardless of a person's perception or environmental concern. These findings may explain why pro-environmental attitudes do not necessarily lead to pro-environmental behaviors, and it contributes to our understanding of the motivating factors for energy savings and electricity use by examining both stated and observed behaviors. Policies aimed at electricity reduction may have a greater impact if they focus on private interests, such as pricing, rebates, subsidies, and taxes, rather than social interests alone.

Integrating the planetary boundaries and global catastrophic risk paradigms

- Ecological Economics---2014---Seth D. Baum, Itsuki C. Handoh

Planetary boundaries (PBs) and global catastrophic risk (GCR) have emerged in recent years as important paradigms for understanding and addressing global threats to humanity and the environment. This article compares the PBs and GCR paradigms and integrates them into a unified PBs-GCR conceptual framework, which we call Boundary Risk for Humanity and Nature (BRIHN). PBs emphasizes global environmental threats, whereas GCR emphasizes threats to human civilization. Both paradigms rate their global threats as top priorities for humanity but lack precision on key aspects of the impacts of the threats. Our integrated BRIHN framework combines elements from both paradigms' treatments of uncertainty and impacts. The BRIHN framework offers PBs a means of handling human impacts and offers GCR a theoretically precise

definition of global catastrophe. The BRIHN framework also offers a concise stage for telling a stylized version of the story of humanity and nature co-evolving from the distant past to the present to multiple possible futures. The BRIHN framework is illustrated using the case of disruptions to the global phosphorus biogeochemical cycle.

Blue carbon: Knowledge gaps, critical issues, and novel approaches

- Ecological Economics---2014---Sebastian Thomas

Blue carbon – the carbon stored and sequestered in mangrove forests, seagrass meadows, and tidal salt marshes – is considered a cost-effective means to achieve positive climate change mitigation and adaptation outcomes. Blue carbon is therefore of considerable interest to the scientific and policy communities, and is frequently discussed in relation to carbon markets and climate finance opportunities. This paper identifies peer-reviewed and ‘gray literature’ documents that discuss blue carbon in the context of finance and market mechanisms. The document set is analyzed both quantitatively and qualitatively, and the principal scientific, economic, regulatory, social, and management issues that emerge are discussed. The study reveals that (1) the blue carbon literature is dominated by technical and policy commentary, with a dearth of research into practical social considerations and a stark absence of private sector perspectives; (2) there is confusion over the nature and role of important concepts including private and public sector finance and instruments; and (3) understanding of the important issues of investment priorities and risk considerations is also limited. This paper therefore identifies gaps in the blue carbon literature, clarifies critical concepts and issues, and proposes novel pathways for blue carbon research and project development.

Environmental policy when pollutive consumption is sensitive to advertising: Norms versus status

- Ecological Economics---2014---Elisabeth Gsottbauer, Jeroen van den Bergh

A theoretical model is developed to analyse optimal environmental policy when consumer preferences are endogenous. It captures that pollutive consumption is sensitive to consumption by others and commercial advertising. This is conceptualized through a consumption norm. An increase in this norm means that consumers will become dissatisfied with a given consumption level and try to raise it, which will cause an increase in pollution. The model is particularly relevant for the study of conspicuous consumption which generally is subject to concentrated advertising efforts while it generates considerable pollution. The model can accommodate the cases of an externality created by advertising being positive or negative. We also show that using different functional specifications for the norm function one can address either conformity or status seeking. We derive optimal rules for a pollution tax, a subsidy or tax on advertising, and information provision by the government. The results not only contribute to more realism in environmental policy theory but also extend public policy with new instruments.

Negative income effect on perception of long-term environmental risk

- Ecological Economics---2014---Alex Y. Lo

The notion that people with higher income are more concerned about environmental problems is deeply entrenched in economics and some other disciplines. Studies have shown a positive income effect on the intention to pay for environmental improvement. Perception of environmental risk, however, follows a different pattern of variation. This paper demonstrates a negative income effect, using data extracted from a cross-national social survey involving 36 countries. An inverse relationship is observed between people's reported income and their perception of long-term environmental risks associated with climate change, genetic modification of crops and the use of nuclear power. Lower-income individuals see the potential environmental consequences of these human interventions as extremely dangerous—more so than the higher-income ones. Richer people are relatively less concerned about the long-term environmental risks. A possible explanation is that

material insecurity reinforces the feeling of risk and danger. People living under more difficult economic situation are more vulnerable and see greater danger. A key implication of these findings is that concern does not follow the ability to pay. People facing higher environmental risks are potentially less able to afford risk reduction support despite that they are likely to be in greater need for it.

Group certification supports an increase in the diversity of sustainable agriculture network–rainforest alliance certified coffee producers in Brazil

- Ecological Economics---2014---Luís Fernando Guedes Pinto,Toby Gardner,Constance L. McDermott,Karim Omar Lara Ayub

Socioenvironmental certification is a market-based mechanism aimed to foster sustainability of production systems. However, mainstream certification schemes in the agricultural sector have been adopted primarily by larger and more established producers, indicating an unequal distribution of social benefits. Group certification is often promoted as one alternative to increase accessibility for smaller producers, but there has been a lack of studies assessing this hypothesis. We assessed all coffee producers certified under the Sustainable Agriculture Network–Rainforest Alliance Certified system in Brazil in 2011, comprising 55 individual farms and 11 groups of individual producers. We found that group certification has increased access to small and medium size producers compared to certification for individually certified producers. There is diversity in the way producers are organized and in the profile of producers among and inside groups. However, the small producers participating in group certification are those with high productivity, suggesting that the most marginalized producers are still unable to access the certification system. Thus additional policy interventions will be necessary to promote more sustainable practices among the large numbers of marginalized coffee farmers in Brazil.

Linking ecosystem services with the constituents of human well-being for poverty alleviation in eastern Himalayas

- Ecological Economics---2014---Harpinder Sandhu,Sukhbir Sandhu

Dependence of rural poor on local ecosystems for livelihood has potential to accelerate loss of ecosystem services. In this study, we use ecosystem services concept to investigate poverty and ecosystem interactions in the Darjeeling district, West Bengal, India which is a part of the eastern Himalayan biodiversity hotspot. First, we assessed multidimensional poverty in six villages (57 households) in the region using household surveys. Chronic poverty existed in all the six villages in the study area and the cash income per capita per day was US\$ 0.16–0.34 which is far below the international standards of defining poverty on income basis. Second, we identified five direct and three indirect drivers of ecosystem change through semi-structured interviews with the head of the households. Then we identified linkages between ecosystem services and basic human needs. These linkages were used to identify measures to improve livelihood of rural poor. The major outcome of this study is in highlighting the ecosystem-based approach to improve livelihood of rural poor.

Green hypocrisy?: Environmental attitudes and residential space heating expenditure

- Ecological Economics---2014---Ian Lange,Mirko Moro,Laura Traynor

Popular media make claims of a green hypocrisy: groups, which have the strongest attitude towards the environment, also have the highest emissions. This study examines whether environmental behaviours, beliefs and attitudes are associated with space heating energy use in the UK in order to test for evidence of a green hypocrisy. In the UK, the largest proportion of household energy use is for space heating. We find that environmental behaviours are negatively correlated with heating expenditures, while environmentally friendly attitudes and perceptions are not associated with lower heating expenditure. Further, the effect

of these attitudes and behaviours does not change as income increase. There seems to be little evidence of a green hypocrisy amongst the UK public with respect to space heating.

Simulating the impact of new industries on the economy: The case of biorefining in Australia

- Ecological Economics---2014---Arunima Malik,Manfred Lenzen,Rômulo Neves Ely,Erik Dietzenbacher

We investigate the economic and employment consequences of introducing a new sugarcane-based biofuel industry into Australia. We model the new biofuel industry on the production recipe of the existing large-scale gasoalcohol and alcohol sectors in the Brazilian economy. To this end we utilise a hybrid IO-LCA (input–output life cycle assessment) approach, which involves inserting data on new processes and/or sectors into an existing IO table. In particular, we develop and test an analytical and a numerical approach for re-balancing an IO table augmented with rows and columns representing large new biofuel industries. We quantify changes in economic output and employment in the Australian economy. We conclude that a future biofuel industry will be employment-positive for Australia.

Identifying the drivers of environmental risk through a model integrating substance flow and input–output analysis

- Ecological Economics---2014---Pi-Cheng Chen,Douglas Crawford-Brown,Chi-Hui Chang,Hwong-wen Ma

In addition to risk assessment, effective environmental risk management requires information indicating sources and driving forces of risks. Systematic substance flow analysis can indicate critical emissions and potential strategies of risk reduction by mapping the flows of toxic substances throughout the economic system. This research developed an integrated modeling framework for examining the connections between driving forces and environmental risk. Three methodolo-

gies, including substance flow modeling, input–output model, and environmental risk assessment, were integrated into the framework. We built a model of lead flow system integrating four risk chain modules, which are corresponding to the Driver, Presser, State, and Impact component of DPSIR environmental management framework. Thus, risk can be backtraced to its exposure pathways, emission sources, and driving forces. In the results, Sankey diagrams are presented to highlight the sources and driving forces of the lead flow system. Among the driving forces, unit change in the demand on computer products is associated with the most significant change in risk of lead. Backtracing the contributions of the causes along the risk chain, the sectors of electronic product and computer product had driven the electronic supply chain which contributes the greatest to risk of lead by discharging into water body.

When ignorance is not bliss: Pest control decisions involving beneficial insects

- Ecological Economics---2014---Kelly A. Grogan

Recent survey data revealed that many California citrus growers did not know whether or not important beneficial insects were found on their fields while other growers were relying heavily or even entirely on these insects for pest control. Some pesticides are toxic both to the targeted pest and the predaceous or parasitic insect that could provide pest control. Alternative pesticides with fewer or no negative effects on the beneficial insect often exist but can be more expensive. Additionally, some beneficial insects are commercially available and can be purchased and released in the field. This paper models the pest control decisions of a grower who utilizes a pesticide and a predaceous insect to control the crop pest and compares these decisions to that of a grower who does not know that the predaceous insect exists. The results show that the latter grower will drive the predator population to zero and will overutilize chemical control. When the predator is known and utilized, the optimal decisions involve entirely mitigating the negative effects of the pesticide as well as releasing additional predators.

What value São Pedro's procession? Ecosystem services from local people's perceptions

- Ecological Economics---2014---Luiz Eduardo Chimello de Oliveira, Fikret Berkes

Although several frameworks have been developed to identify and value ecosystem services, few studies have focused on the perceptions of individuals about how they relate to their surroundings and how they value ecosystem services. We investigated the extent to which the concepts and categories of ecosystem services are able to accommodate peoples' perceptions about their individual–surroundings relationships. We used a qualitative approach to identify local people's perceptions in Tarituba, a coastal village on the southeastern Brazil. We found that the categories of ecosystem services accommodated only partially the range of perceptions of individuals about their relationships with the environment. Individuals perceive that they actively search and pursue their provisioning and other services, and are not passive recipients of “benefits” or “products” from nature. As well, we documented how the relations with the environment change over time. Some cultural values can be identified using ecosystem services frameworks, but they do not fit the monetary valuation models from economics. Regulating and supporting services could rarely accommodate people's perceptions. More realistic models for understanding individual–surroundings relationships must include people's perceptions, and account for the dynamic nature of these relationships.

Protected area acquisition costs show economies of scale with area

- Ecological Economics---2014---Taeyoung Kim, Seong-Hoon Cho, Eric R. Larson, Paul R. Armsworth

Protected areas are a center-piece of strategies for conserving biodiversity and providing ecosystem service benefits to enhance human well-being. One of the most striking characteristics of protected areas is how much they vary in size. We examine the consequences of this size variation for the cost of acquiring protected

areas. We use recent land acquisitions (2000–2009) in central and southern Appalachian forest ecosystems of the United States. Acquisition costs for these protected areas show pronounced economies of scale; specifically ten times the area can be purchased for seven times the cost of a smaller site. We examine how these economies of scale differ by contract type and motivations. For example, we find that easements do not show economies of scale despite costing less than fee simple acquisitions overall. Also, we find that economies of scale are stronger for protected areas that were specifically created to protect occurrences of rare or imperiled species but where development pressure was not identified as an explicit threat to the site. Conservation organizations may better account for acquisition costs in protected area creation by recognizing such economies of scale and their context dependency with respect to land acquisition contract type and conservation motivations.

Optimal investment in ecological rehabilitation under climate change

- Ecological Economics---2014---Anke Leroux, Stuart Whitten

Ecological rehabilitation is subject to a variety of risks affecting the likely return on investment. We propose an options approach to allocating scarce conservation funds that explicitly allows for the irreversibility of investment and risks to investment payoffs. The approach captures ecosystem dynamics from extinction debt, as well as ecological and climatic risks at the project scale. Climatic risks are introduced through three channels: the effects of climate change on species loss, future rehabilitation benefits and frequency of catastrophic events. Our results suggest that allocating voluntary rehabilitation contracts on the basis of real options criteria increases cost-efficiency and delivers greater value for money for the Government when compared with the conventional cost-effectiveness criterion as it is illustrated for the case of Box Gum Grassy Woodland rehabilitation in Australia.

Comparing instrumental and deliberative paradigms underpinning the assessment of social values for cultural ecosystem services

- Ecological Economics---2014---Christopher M. Raymond, Jasper Kenter, Tobias Plieninger, Nancy J. Turner, Karen A. Alexander

Despite rapid advancements in the development of non-monetary techniques for the assessment of social values for ecosystem services, little research attention has been devoted to the evaluation of their underpinning paradigms. This study evaluates two contrasting paradigms for the assessment of social values in non-monetary terms: an instrumental paradigm involving an objective assessment of the distribution, type and/or intensity of values that individuals assign to the current state of ecosystems and a deliberative paradigm involving the exploration of desired end states through group discussion. We present and then justify through case examples two approaches for assessing social values for ecosystem services using the instrumental paradigm and two approaches using the deliberative paradigm. Each approach makes different assumptions about: the underlying rationale for values assessment; the process through which values are elicited; the type of representativeness sought, and; the degree of involvement of decision-makers. However, case examples demonstrate that the boundaries between instrumental and deliberative paradigms are often not concrete. To accommodate this fluidity, we offer a third, pragmatic paradigm that integrates some of the qualities of both. This paradigm has implications for engaging multiple community groups and decision-makers in the articulation and mapping of social values for cultural ecosystem services.

Managing apparent competition between the feral pigs and native foxes of Santa Cruz Island

- Ecological Economics---2014---Richard Melstrom

This paper presents a model of pest impacts in a multispecies framework. Strong detrimental relationships often form between pest populations and other biota,

damaging ecosystem services and reducing social welfare. Under these circumstances, optimal pest management must account for the interactions between pests and other species. The bioeconomic model of competition developed in this manuscript is illustrated using the case of feral pigs (*Sus scrofa*) on Santa Cruz Island, California. The presence of the pigs, an introduced species, resulted in the near extirpation of the native island fox (*Urocyon littoralis*) before managers intervened and removed the pigs from the island. The application compares a policy of pig eradication with one of perpetual control, which is found to involve initially over-culling the pigs relative to the equilibrium level. To protect the foxes of Santa Cruz Island, the results suggest that pig eradication rather than pig control is the optimal strategy.

Waste prevention and social preferences: the role of intrinsic and extrinsic motivations

- Ecological Economics---2014---Grazia Cere,Susanna Mancinelli,Massimiliano Mazzanti

It is only recently that EU policies have started defining targets for waste reduction despite waste prevention being at the top of the ‘waste hierarchy’. Against this backdrop, we examine whether individual behaviour towards waste reduction is more strongly driven by extrinsic motivations such as social norms, or intrinsic motivations, such as altruistic preferences. We exploit a new survey covering 22,759 individuals from EU27 countries. Our results suggest that individual preferences matter to move beyond an orientation based on recycling, to achieve a reduction of the sources of waste. Behaviour patterns which lead to waste reduction are seldom socially oriented, seldom exposed to peer pressure, and very reliant on purely ‘altruistic’ attitudes.

Buen Vivir (living well) in Ecuador: Community and environmental satisfaction without household material prosperity?

- Ecological Economics---2014---Jorge Guardiola,Fernando García-Quero

This paper provides a quantitative approach to assessing whether the subjective wellbeing (SWB) of Ecuadorian people is dependent on income and employment or on more distinctive features relating to Buen Vivir ethos. The latter are reflected in the indigenous Buen Vivir ideology, based mainly on relations with the community, the environment and food sovereignty. The empirical analysis shows that both Buen Vivir features and factors such as income and unemployment status are significant in the models explaining SWB. Accordingly, economic policies should take into account the Buen Vivir ethos, that seems to be important for the SWB of the Ecuadorian people. This supports the conservationist political position, which focuses on protecting the environment and people’s traditional livelihoods, rather than the extractive view, which regards people’s welfare as merely dependent on income.

Cross Compliance as payment for public goods? Understanding EU and US agricultural policies

- Ecological Economics---2014---Claas Meyer,Bettina Matzdorf,Klaus Müller,Christian Schleyer

Cross Compliance (CC) is a mechanism for encouraging farmers to fulfill certain environmental conditions in return for governmental support payments. Introduced to United States (US) and European Union (EU) agricultural policy from the 80s onwards, upcoming new US (Farm Bill 2012) and EU (Common Agricultural Policy after 2013) policies will include CC. Cross Compliance is seen (i) as a policy for enforcing environmental objectives or (ii) as a way to organize and reward agricultural public good production. In recent years, the instrument’s effectiveness and efficiency have been criticized. To validate the deviating understandings, we drew back on an economic institutionalist perspective. We found that regarding EU CC as payment for public goods does not generally align with the existing German property rights distribution. In both the EU and US, CC standards above those contained regulatory law have characteristics of a payment for public goods but create severe problems. We conclude

that CC, even if useful for triggering and broadening environmental protection efforts, may cause several long-term problems. Therefore, the rights structure should be clearly communicated, law enforcement function should be temporary, the instrument should be included in an overall concept, and payments should be better linked to the environmental output.

Determinants of trip choice, satisfaction and loyalty in an eco-tourism destination: a modelling study on the Shiretoko Peninsula, Japan

- Ecological Economics---2014---João Romão,Bart Neuts,Peter Nijkamp,Asami Shikida

Eco-tourism has recently gained an important position in the choice mechanism of tourists. Sustainable tourism development implies a combination of ecological protection, economic prosperity and social benefits for local communities. This requires an effective marketing policy to identify and attract visitors interested in – and motivated by – the particular local attractions of the place. This study addresses the development of tourism services on the Shiretoko Peninsula, a World Heritage Site since 2005, located in the northeast part of the Japanese island of Hokkaido. The novelty of our study is found in a systemic approach, combining tourists' characteristics and expectations/motivations regarding a certain destination with the resulting dissatisfaction and loyalty behaviour regarding the tourist site concerned. A multinomial logistic regression is applied to the tourists' characteristics and motivations, while next a structural path analysis is applied to the elements determining their satisfaction with the visit concerned. This structural model allows us to depict the relations between trip choice (in this case, the specific kind of boat tour) and the effects of this choice on tourists' satisfaction and loyalty. The implications of this analysis for the marketing and management of the site (e.g. in terms of loyalty behaviour) are also presented.

What makes people seal the green power deal? — Customer segmentation based on choice experiment in Germany

- Ecological Economics---2014---Andrea Tabi,Stefanie Lena Hille,Rolf Wüstenhagen

Consumers have the power to contribute to creating a more sustainable future by subscribing to green electricity tariffs. In order to reach consumers 'beyond the eco-niche', identifying the drivers that positively influence the adoption of green electricity is of fundamental importance. This paper examines various factors that help to explain the extent to which green electricity subscribers differ from those that display strong preferences towards green electricity but have not yet 'walked the talk'. By making use of a latent class segmentation analysis based on choice-based conjoint data, this paper identifies three groups of potential green electricity adopters with varying degrees of preference for renewable energy. Findings indicate that socio-demographic factors play a marginal role in explaining the differences between green electricity subscribers and potential adopters, with the exception that actual adopters tend to be better educated. Analysis of psychographic and behavioral features reveals that adopters tend to perceive consumer effectiveness to be higher, place more trust in science, tend to estimate lower prices for green electricity tariffs, are willing to pay significantly more for other eco-friendly products and are more likely to have recently changed their electricity contract than non-adopters. Policy recommendations associated with these findings are provided.

Risk preferences and purchase of energy-efficient technologies in the residential sector

- Ecological Economics---2014---Yueming Qiu,Gregory Colson,Carola Grebitus

Perceived risk in future energy cost savings of energy efficient technologies has been well identified as a major barrier to the adoption of such technologies. However, direct empirical evidence of the impact of consumer risk

aversion on the adoption of energy efficient technologies has been limited. In this paper, we elicit consumer risk preferences using a multiple price list experiment tailored to household energy decisions. We then use the elicited risk preferences to explain consumers' self-reported historical purchase of energy efficient appliances and installation of energy efficiency retrofitting technologies. Using data from 432 homeowners from Arizona and California, USA, results show that more risk averse consumers are less likely to adopt energy efficient technologies (except for the case of energy efficient air-conditioners). In addition, the findings provide evidence that households' perceived mobility as measured by the probability of moving within five years, can amplify the negative impact of risk aversion on the adoption of energy efficiency retrofitting technologies. Overall, the results provide implications for policy makers and companies involved in promoting energy efficient technologies.

The inverted pyramid: A neo-Ricardian view on the economy–environment relationship

- Ecological Economics---2014---Eric Kemp-Benedict

In ecological economics, natural resources – which may contribute only a small amount to GDP – are viewed as fundamental to the functioning of the economy. They are sometimes pictured as sitting at the base of an inverted pyramid, with the rest of the economy balanced on top of them. In this paper we show that when prices are set by markup, a standard heterodox assumption, then the “inverted pyramid” picture of the economy emerges naturally in a neo-Ricardian model. We demonstrate the use of the model with brief applications to biophysical economics. The paper is one of a growing number that use heterodox macroeconomics to address questions in ecological economics.

Insiders, outsiders, and the role of local enforcement in forest management: An example from Tanzania

- Ecological Economics---2014---Elizabeth Robinson, Heidi Albers, Guylain Ngeleza, Razack B. Lok-

ina

In low-income countries, both nearby local villagers, “insiders”, and non-locals, “outsiders”, extract products from protected forests even though their actions are illegal. Forest managers typically combine enforcement and livelihood projects offered to nearby communities to reduce this illegal activity, but with limited budgets cannot deter all extraction. We develop a game theoretic model of a forest manager's decision interacting with the extraction decisions of insiders and outsiders. Our analysis suggests that, depending on the relative ecological damage caused by each group, budget-constrained forest managers may reduce total forest degradation by legalizing “insider” extraction in return for local villagers' involvement in enforcement activities against outsiders.

Protected areas, local governments, and strategic interactions: The case of the ICMS-Ecológico in the Brazilian state of Paraná

- Ecological Economics---2014---Alexandre Sauquet, Sébastien Marchand, José Fères

Various conservation initiatives have been implemented in developing countries with increasing involvement on the part of local governments. A concern in entrusting decisions to local governments is that the effectiveness of the conservation instrument can be threatened by interactions among these local governments. We examine this concern with respect to an ecological fiscal transfer mechanism, the ICMS-Ecológico, implemented in Brazil in the early 1990's in order to reduce biodiversity loss. The mechanism enables states to reward municipalities for the creation and management of protected areas. We describe this mechanism, present a conceptual framework aimed at understanding the potential sources and consequences of interactions among local governments on the effectiveness of a decentralized mechanism aimed at promoting the creation of protected areas, and propose an empirical application using a Bayesian spatial Tobit model. Our empirical investigation on the creation of protected areas in the state of Paraná between 2000 and 2010 reveals

strategic substitutability in municipalities' conservation decisions. This finding also leads us to discuss the issue of identification of a negative spatial lag coefficient when there is a positive spatial error correlation.

The raw and the carved: Shipping costs and ivory smuggling

- Ecological Economics---2014---Brendan Moyle

The recent and rapid increase in elephant poaching has caused international alarm. A fixed-effects panel-data regression model was employed to identify possible causes of this upsurge. Ivory seizures were categorised as worked or raw. These categories were also divided into four weight classes ranging from under 10kg to over 1000kg. With Africa being the source of ivory and much of the poached ivory destined for Asia it was hypothesised that smugglers would respond to shipping costs. The results showed that shipping costs, especially for large shipments, were correlated to smuggling levels. Other factors include global interest rates, which motivate stockpiling by criminal organisations. Stability in Africa as measured by refugee numbers correlates to raw ivory seizures. The data describes a scenario where three forces converged to escalate poaching in the late 2000s. Raw ivory was being made increasingly available at a time from Central African range states, when criminal organisations desired larger stockpiles of tusks. The sharp decline in shopping costs gave them the means to take advantage of this.

Transaction network analysis for studying Local Exchange Trading Systems (LETS): Research potentials and limitations

- Ecological Economics---2014---Eva Fraňková, Jan Fousek, Lukáš Kala, Jan Labohý

The numerous studies of Local Exchange Trading Systems (LETS) have so far been based mostly on qualitative approaches. The aim of this paper is to introduce the method of transaction network analysis as an important complement to these studies, enabling one to quantitatively describe functioning of LETS in terms of the actual flows of currency, materialized

transactions and topology of the exchange network, the types of information markedly missing in most of the existing LETS studies. We demonstrate the potentials of the method on the case of the LETS initiative “RozLEŤSe” based in Brno, Czech Republic. Looking at the transaction flows using the network analysis approach, we identify the key members of the group, network characteristics of the exchange system and its development over time. This allows us not only to provide a complex description of the system, but also to simulate certain scenarios (e.g. removal of a key person from the network). Within the discussion of potentials and limitations of applying transaction network analysis for studying LETS and other community currency initiatives (e.g. time banks) on a larger scale, we also provide a free accessible software tool for doing so and invite other researchers to cooperate on the task.

Green goals and full employment: Are they compatible?

- Ecological Economics---2014---Miklós Antal

Two empirical correlations are studied: one between economic growth and environmental impacts, and the other between the lack of economic growth and unemployment. It is demonstrated that, at a global level, economic growth is strongly correlated with environmental impacts, and barriers to fast decoupling are large and numerous. On the other hand, low or negative growth is highly correlated with increasing unemployment in most market economies, and strategies to change this lead to difficult questions and trade-offs. The coexistence of these two correlations – which have rarely been studied together in the literature on “green growth”, “degrowth” and “a-growth” – justifies ambivalence about growth. To make key environmental goals compatible with full employment, the decoupling of environmental impacts from economic output has to be accompanied by a reduction of dependence on growth. In particular, strategies to tackle unemployment without the need for growth, several of which are studied in this article, need much more attention in research and policy.

Modeling economic and carbon consequences of a shift to wood-based energy in a rural ‘cluster’ ; a network analysis in southeast Alaska

- Ecological Economics---2014---David Saah,Trista Patterson,Thomas Buchholz,David Ganz,David Albert,Keith Rush

Integrated ecological and economic solutions are increasingly sought after by communities to provide basic energy needs such as home heating, transport, and electricity, while reducing drivers of and vulnerability to climate change. Small rural communities may require a coordinated approach to overcome the limitations of economies of scale. Low-carbon development strategies present potential for large payoffs at a household and community scale. Southeast Alaskan forests previously harvested for timber are currently re-growing and require thinning to maintain ecosystem service benefits such as wildlife habitat and hunting. Thinned material presents a potential biofuel source. However, without verification among decision alternatives, communities may not have the momentum, vision, or conviction to stimulate a shift to a new energy source. We present a network approach to evaluating multiple energy delivery pathways, and a calculation of carbon, energy, and dollar savings presented by each pathway. We quantify chain of production impacts; from the point of energy extraction and transport (upstream), through consumption and emission accounting (downstream). Our findings suggest substantial greenhouse gas emission savings of over 70% as well as heating cost savings for all bioenergy scenarios compared to fossil fuel scenarios. Outputs can facilitate dialog between land managers, planners, community members and decision-makers.

The Political Transaction Costs and Uncertainties of Establishing Environmental Rights

- Ecological Economics---2014---Kerry Krutilla,Alexander Alexeev

The significance of transaction costs for the analysis of environmental policy is increasingly recognized. This article focuses on one aspect of the topic: the political

uncertainty and transaction costs of establishing environmental rights. Our contribution is to model the political process around the rights establishment, and to monetize the associated welfare costs. The model includes both policy-related and political-institutional parameters, including the extent to which environmental rights are shared with polluters; the environmental benefits of the policy; the policy's abatement costs, and the relative political power of polluters and environmentalists. The model is solved to give unique Nash equilibria for the transaction costs of lobbying, and for the probability of the policy's political success. These results are then used to show the degree to which political actions can dissipate the expected economic surplus from environmental policymaking.

What matters and why? Ecosystem services and their bundled qualities

- Ecological Economics---2014---Sarah C. Klain,Terre A. Satterfield,Kai M.A. Chan

Much ecosystem service (ES) research is structured around four often implicit assumptions about ES, benefits, and stakeholders' conceptions of these: 1) ES assessors can identify and characterize priority ES across stakeholders without local participation; 2) Stakeholders derive one kind of benefit from each ES in a one-to-one, production function manner; 3) Most ESs are amenable to market or non-market economic valuation; and 4) Stakeholders primarily conceive of the importance of nature in terms of ecosystems' production of benefits. We empirically evaluated these assumptions with a map-based interview protocol to characterize what can be managed (ES and related activities), what matters (benefits) and why (values). Based on interviews with residents of coastal communities in British Columbia, 87% of responses to cultural ES interview prompts conveyed bundles of linked services, benefits and values. Many ES-related values (e.g., transformative and identity) matter in ways that are not adequately expressed using market or non-market valuation. Respondents used diverse metaphors about why the ocean is important, not only the ES production metaphor, which assumes that values are a function of

ecosystem processes. Our research demonstrates the utility of our interview protocol for providing a fuller representation of ecosystem-related values and benefits, potentially informing environmental decision-making processes.

Benefits and costs of deforestation by smallholders: Implications for forest conservation and climate policy

- Ecological Economics---2014---Oscar J. Ca-cho,Sarah Milne,Ricardo Gonzalez,Luca Tacconi

Deforestation is a leading cause of biodiversity loss and an important source of global carbon emissions. This means that there are important synergies between climate policy and conservation policy. The highest rates of deforestation occur in tropical countries, where much of the land at the forest frontier is managed informally by smallholders and where governance systems tend to be weak. These features must be considered when designing policies to reduce emissions from deforestation such as REDD+. Deforestation is often accompanied by fires that release large amounts of carbon dioxide. These emissions are especially high in the case of peatlands which contain thick layers of carbon-rich matter. In this paper we derive marginal abatement cost (MAC) curves using data from a farmer survey in Sumatra, where rates of peatland deforestation are high. Comparing these results with farmers' stated willingness to accept payment not to clear forest to establish oil palm suggests that REDD+ policies may be more expensive than MAC estimates suggest. The extent to which this is true depends on the types of soils being deforested.

Natural disasters' impact, factors of resilience and development: A meta-analysis of the macroeconomic literature

- Ecological Economics---2014---Sara Lazza-roni,Peter Bergeijk

We systematize 64 primary studies published in 2000–2013 on the macroeconomic impact of natural disasters by providing OLS and generalized ordered

probit meta-analyses for 1858 and 1991 regressions, respectively. We investigate how the reported results in the primary studies are influenced by the empirical design, the estimation technique, and/or publication bias. We analyze primary studies on disaster direct costs and indirect costs separately. According to our meta-analysis, disasters on average have a negative impact in terms of direct costs and an insignificant impact in terms of indirect costs.

Policy design and technological substitution: Investigating the REACH regulation in an agent-based model

- Ecological Economics---2014---Nabila Arfaoui,Eric Brouillat,Maïder Saint Jean,Maïder Saint-Jean

This article proposes an agent-based model to study the impact of the European regulation REACH on industrial dynamics. This new regulation was adopted in 2006 and establishes a new philosophy of how to design environmental protection and health, especially through the authorization process and the extended producer responsibility. The main contribution of this article is to investigate how different combinations of flexible and stringent mechanisms create the incentives and constraints to shape market selection and innovation. The model outcomes stress that (1) stringency is the most determining feature of policy design (timing is also decisive but it appears to be of secondary importance); (2) technology substitution that brings radical technological change and significant pollution reduction is possible only if regulation is stringent enough but after many sacrifices, especially in terms of market concentration and number of failures; and (3) soft regulation does not lead to technology transition because of weak incentive and selection effects.

Assessing the value of the Central Everglades Planning Project (CEPP) in Everglades restoration: An ecosystem service approach

- Ecological Economics---2014---Leslie Richard-son,Kelly Keefe,Christopher Huber,Laila Racevskis,Gregg Reynolds,Scott Thourot,Ian Miller

This study identifies a full range of ecosystem services that could be affected by a restoration project in the central Everglades and monetizes the economic value of a subset of these services using existing data. Findings suggest that the project will potentially increase many ecosystem services that have considerable economic value to society. The ecosystem services monetized within the scope of this study are a subset of the difference between the future-with the Central Everglades Planning Project (CEPP) and the future-without CEPP, and they totaled ~\$1.8 billion USD at a 2.5% discount rate. Findings suggest that the use of ecosystem services in project planning and communications may require acknowledgment of the difficulty of monetizing important services and the limitations associated with using only existing data and models. Results of this study highlight the need for additional valuation efforts in this region, focused on those services that are likely to be impacted by restoration activities but were notably challenging to value in this assessment due to shortages of data.

Developing an analytical framework for reconstructing the scalar reorganization of water governance as institutional change: The case of Southern Spain

- Ecological Economics---2014---Andreas Thiel

Relying on theories of institutional change, a framework is developed to explain formal change in natural resource governance, in this case, formal scalar reorganization (re-scaling) of governance. Modifications of water governance are the outcome of inter-related changes in the determinants of actor-specific perceptions of costs and benefits of governance. To become effective, actors need to be able to bring their preferences to bear on constitutionally defined action situations where collective bargaining processes over governance take shape. Rescaling is conceptualized as being about whose economic interests are able to control the processes by which rescaling is advocated and carried out and whose technically, economically, or politically oriented vision of water management prevails. The framework developed goes beyond the alternatives

of either functionalist problem-solving approaches or approaches focussing on political bargaining. Its application is illustrated through an in-depth qualitative case study of decentralization of governance in Spain's Guadalquivir river basin. Here, rescaling resulted from some politically dominant regional actors favoring better coordination of water management with regional environmental management and greater control of water and coincided with a political two-level majority at the national and regional levels. The case highlights the role of relations between institutional arrangements and biophysical settings, such as the specific geographical setting and changes in the relative importance of characteristics of the nature-related transactions, implicit, for example, in the changing relative importance groundwater management at the expense of surface water management.

A ZEN approach to post-2015 development goals for Asia and the Pacific

- Ecological Economics---2014---Douglas H. Brooks, Kaushal Joshi, John McArthur, Changyong Rhee, Guanghua Wan

The Asia-Pacific region includes a majority of the world's population and many of its most rapidly growing economies. It is also home to the world's largest number of extremely poor people, many fragile states, and unsustainable environmental practices. The region has increased its influence in the world economy but is still grappling to overcome complex interrelated challenges of poverty, inequality and sustainable development. Its priorities must be addressed as a central element of any post-2015 global development goal framework. Drawing from lessons of the Millennium Development Goals, this paper suggests a conceptual framework to guide a new generation of goals, along with an intergovernmental approach to implementation. The "ZEN" framework stresses the distinct challenges of achieving zero extreme poverty (Z), setting country-specific "Epsilon" benchmarks for broader development challenges (E), and promoting environmental sustainability both within and across borders (N).

Environmental decentralization and political centralization

- Ecological Economics---2014---Per Fredriksson, Jim Wollscheid

In this paper, we investigate how political institutions affect policy outcomes. In particular, does the level of political centralization affect the outcome of environmental decentralization? We use a cross section of up to 110 countries and a propensity score estimation approach. We find that political centralization, measured by the strength of national level political parties, increases the stringency of environmental policies set under decentralized regimes.

Modelling market diffusion of electric vehicles with real world driving data — Part I: Model structure and validation

- Ecological Economics---2014---Patrick Plötz, Till Gnann, Martin Wietschel

The future market diffusion of electric vehicles (EVs) is of great importance for transport related green house gas emissions and energy demand. But most studies on the market diffusion of EVs focus on average driving patterns and neglect the great variations in daily driving of individuals present in real-world driving data. Yet these variations are important for EVs since range limitations and the electric driving share of plug-in hybrids strongly impact the economic evaluation and consumer acceptance of EVs. Additionally, studies often focus on private cars only and neglect that commercial buyers account for relevant market shares in vehicle sales. Here, we propose a detailed, user specific model for the market diffusion of EVs and evaluation of EV market diffusion policies based on real-world driving data. The data and model proposed include both private and commercial users in Germany and allow the calculation of realistic electric driving shares for all usage patterns. The proposed model explicitly includes user heterogeneity in driving behaviour, different user groups, psychological aspects and the effect of charge-at-home options. Our results show that the proposed model reproduces group specific market shares,

gives confidence bands of market shares and simulates individual electric driving shares.

Material transfer agreements: An economic and econometric analysis

- Ecological Economics---2014---Laura Onofri

This paper uses econometric analysis for understanding the determinants that affect the payment mechanism in material transfer agreements (MTAs). These contracts regulate the exchange of peculiar ecosystem services (genetic and biological materials) between a provider and a recipient of the service. The paper uses a set of “model” contracts from the late 2000s, gathered from the U.N. World Intellectual Property Organization (WIPO) and the Convention of Biological Diversity (CBD). Empirical results show that the probability that a payment scheme is included in the contract negatively depends on the presence of an acknowledgment obligation to the provider of the material. Probably aware of the complexity and uncertainty of the recipient’s research activity, the provider (and the CBD) requires to be compensated through the recognition of his/her important input to the research venture. In economics, this can be interpreted as payment in terms of moral satisfaction.

Sweet dreams (are made of cellulose): Sociotechnical imaginaries of second-generation bioenergy in the global debate

- Ecological Economics---2014---Magdalena Kuchler

This paper critically examines the sociotechnical imaginaries of second-generation bioenergy technology in the global debate, exemplified by the deliberations of international organizations specializing in food and agriculture, energy security, and climate change. The analysis is guided by two objectives: first, to identify and illuminate visions of future advanced biofuels by implementing the concept of sociotechnical imaginaries; second, to scrutinize these imaginaries using a critical and diagnostic utopian method to determine whether the projected visions entail the promise of radical change and hope for socioeconomic transition

to a “green” future, or instead manifest an ideological stranglehold striving to perpetuate the status quo. The article demonstrates that sociotechnical imaginaries of advanced biofuel technology superficially project the illusion of utopian potential. On closer examination, however, visions of future second-generation biofuels are limited by the necessity of cost-effectiveness that underpins market competitiveness. They manifest utopian impotence to imagine the future beyond the ideological closure of the currently dominant socio-economic system.

Towards global voluntary standards: Questioning the effectiveness in attaining conservation goals

- Ecological Economics---2014---Denis Ruysschaert, Denis Salles

Global voluntary agreements, such as the Roundtable on Sustainable Palm Oil (RSPO), have emerged as alternatives to apparent State failure to enforce law. This research questions how effective RSPO is in attaining its claimed conservation goals especially regarding orangutans, as this is central to justifying its existence.

Applying Q-methodology to select and define attributes for non-market valuation: A case study from Northwest Wyoming, United States

- Ecological Economics---2014---Christopher A. Armatas, Tyron J. Venn, Alan E. Watson

The underlying validity of stated preference non-market valuation methods relies on the analyst's ability to identify, select, define, and articulate the goods being valued in a way that is relevant and understandable to the respondent, which requires detailed understanding of the respondents' experiences and points of view. Poor articulation of the good being valued will result in biased to useless information for decision-makers. It should therefore be of concern to economists and policymakers that the question of how best to perform pre-design qualitative work with local stakeholders is a neglected area of inquiry. This paper assesses Q-methodology as an objective, transparent, easily

replicable, and statistically-rigorous approach to qualitative research to support the selection and definition of attributes for non-market valuation.

The second generation of ecological economics: How far has the apple fallen from the tree?

- Ecological Economics---2014---Gaël Plumecocq

This paper examines the discourse produced in the academic journal *Ecological Economics* from its inception in 1989, and compares this discourse with that of the field of environmental economics. I used methods for discourse analysis (Alceste and Iramuteq) on 6308 abstracts of papers published in four journals — namely *Ecological Economics*, the *Journal of Environmental Economics and Management*, *Environmental Values*, and *Environmental and Resource Economics*, published between 1989 and 2013. The results suggest that the discourses of ecological economics and environmental economics have grown closer over time. The semantic classification of co-occurrent terms used in *Ecological Economics* indicates increasing significance of the notions of ecosystem services and of monetary valuation. I argue that this trend is parallel to Costanza's career-path, which suggests the rise of a tacit recognition of the New Environmental Pragmatic scientific approach. I conclude with some of the implications for EE of promoting this kind of discourse to such an extent.

Complementarity of socio-economic and emergy evaluation of agricultural production systems: The case of Slovenian dairy sector

- Ecological Economics---2014---Tina Jaklič, Luka Juvančič, Stane Kavčič, Marko Debeljak

Agriculture is a complex system in which the economic principles of production are directly intertwined with its biological and ecological characteristics. The paper investigates synergetic potentials of multiple-criteria and multiple-perspective evaluation of agricultural activity through a study of the dairy sector in Slovenia. Socio-economic and emergy evaluation was performed on nine farm types, formulated to represent the diversity of the country's dairy sector. The results in-

dicating larger discrepancies in the performance of the farm types when defined by socio-economic or emergy based indicators. Standard socio-economic evaluation favours larger conventional systems that are cost efficient and financially independent. Emergy analysis however, favours less productive organic farms, which show greater ability to exploit free local resources and produce less stress on the local environment. Socio-economic and emergy indicators show that small conventional farm types are the poorest performers overall. Analysis of emergy flows reveals for all farm types a high dependency on the wider socio-economic system, suggesting that within the current economic system agriculture itself has little ability to affect its sustainability. The paper suggests a complementarity in the evaluation approaches. Their joint application can improve the quality of the decision-making process in various stages of planning in agriculture and land use.

Cooperation in common property regimes under extreme drought conditions: Empirical evidence from the use of pooled transferable quotas in Spanish irrigation systems

- Ecological Economics---2014---Sergio Villamayor-Tomas

The success of a common property regime can be partially judged on the basis of its ability to handle extreme events that stress its capacity for cooperation. This paper compares the performance of 38 irrigation associations in a large irrigation area in Spain during a severe drought as a test of hypotheses derived from property right theories. The case is particularly interesting because it contains a transferable quota institution that can potentially strengthen the effectiveness of common property regimes in scarcity conditions. According to the results the use of transferable quotas across associations can contribute to cooperation and drought performance. In this context, performance is higher when the associations enjoy (1) effective monitoring systems, (2) experience and legitimate leaders, and (3) facilitative biophysical conditions like soil water holding capacity. The analysis also suggests that biophysical properties like soil water holding capacity

may compensate for weaker monitoring or leadership, and vice-versa.

Regional variation in environmental inequality: Industrial air toxics exposure in U.S. cities

- Ecological Economics---2014---Klara Zwickl, Michael Ash, James K. Boyce

This paper analyzes how racial and ethnic disparities in exposure to industrial air toxics in U.S. cities vary with neighborhood income, and how these disparities vary regionally across the country. Exposure is estimated at the census block-group level using geographic micro-data from the Risk-Screening Environmental Indicators of the U.S. Environmental Protection Agency (EPA). We find that racial and ethnic disparities in pollution exposure are strongest among neighborhoods with median incomes below \$25,000, while income-based disparities are stronger among neighborhoods with median incomes above that level. We also find considerable differences in the patterns of disparity across the ten EPA regions. In the two regions with the highest median exposure (the Midwest and South Central regions), for example, African-Americans and Hispanics face significantly higher exposures than whites, whereas in the region with the next highest exposure (the Mid-Atlantic), the reverse is true. We show that the latter result is attributable to intercity variations – minorities tend to live in the less polluted cities in the region – rather than to within-city variations.

Sustainable harvest of a native species and control of an invasive species: A bioeconomic model of a commercial fishery invaded by a space competitor

- Ecological Economics---2014---Marjolaine Frésard, Carole Ropars-Collet

Biological invasions are nowadays an important challenge to biodiversity and human welfare. This paper deals with the control of an invasive species, void of market value, and acting as a space competitor for a valuable native harvested species. It presents a theoretical bioeconomic model describing the interacting

dynamics of the two species and accounting for the undesirable consequences of native stock harvesters' behaviour on the spread of invasion. Dynamic optimisation of the model displays the existence of a time-path leading to an optimal stationary steady-state solution where the native species is sustainably harvested and the invasive species is kept under control, provided unit costs of native species harvesting and of invaded areas cleaning are quite low, natural and anthropogenic dispersal coefficients of invasion, and time-discount rate are moderate. Moreover, the problem should be addressed early enough. The model is applied to the Bay of Saint-Brieuc scallop fishery invaded by slipper limpet. We show that it is nearly always optimal to control the invasion in that case study.

Who rebounds most? Estimating direct and indirect rebound effects for different UK socioeconomic groups

- Ecological Economics---2014---Mona Chitnis, Steve Sorrell, Angela Druckman, Steven K. Firth, Tim Jackson

This study estimates the combined direct and indirect rebound effects from various types of energy efficiency improvement and behavioural change by UK households and explores how these effects vary with total expenditure. The methodology is based upon estimates of the expenditure elasticity and GHG intensity of 16 categories of goods and services, and allows for the capital cost and embodied emissions of the energy efficiency measures themselves. The study finds that rebound effects, in GHG terms, are modest (0–32%) for measures affecting domestic energy use, larger (25–65%) for measures affecting vehicle fuel use and very large (66–106%) for measures that reduce food waste. Furthermore, measures undertaken by low income households are associated with the largest rebound effects, with direct emissions forming a larger proportion of the total rebound effect for those households. Measures that are subsidised or affect highly taxed energy commodities may be less effective in reducing aggregate emissions. These findings highlight the importance of allowing for rebound effects within

policy appraisals, as well as reinforcing the case for economy-wide carbon pricing.

Give and take: How the funding of adaptation to climate change can improve the donor's terms-of-trade

- Ecological Economics---2014---Oliver Schenker, Gunter Stephan

This paper discusses the interplay between international trade, regional adaptation to climate change and financial transfers for funding adaptation. It combines insights from a theoretical model of North-to-South transfers with the findings of a calibrated dynamic multi-region multi-sector computable general equilibrium model that takes into account the impacts of climate change and the adaptation to it. Assessing the effects of adaptation funding indicates that funding of adaptation in developing regions can be Pareto-improving. Not only will developing regions, which do not own sufficient resources for adapting optimally, profit from receiving adaptation funding. Terms-of-trade improvements in the high and middle income donor countries can dominate transfer costs and hence lead to a net-welfare gain in almost any developed region except North America. As such our consideration adds a new argument for financially supporting adaptation in the developing world besides the well-known ones such as fairness and incentives for participation in a global climate treaty.

Weather conditions and outdoor recreation: A study of New England ski areas

- Ecological Economics---2014---Laura Beaudin, Ju-Chin Huang

We present a structural model and employ discrete time survival analysis to examine the impact of weather conditions on firms' exit decisions within the New England ski industry. Our results suggest that weather conditions can have significant direct and indirect effects on the closure of ski areas. The results also indicate that larger ski areas are more likely to engage in investment activities to help offset the effects of adverse weather

conditions, which tip the odds of success in favor of these ski areas. Consequently, this study shows that climate change may have played a significant role in altering the market structure of the New England ski industry.

Environmental justice and air pollution: A case study on Italian provinces

- Ecological Economics---2014---Anna Rita Germani,Piergiuseppe Morone,Giuseppina Testa

This paper provides an empirical analysis on the relationship between income, demographic characteristics and concentrations of air industrial pollutants within the Italian provinces. Two general conclusions can be drawn from the empirical results. First, the estimates obtained are consistent with an inverse U-shaped environmental Kuznets curve: air pollution releases increase with income up to a turning point where the relation reverts. Second, there is evidence that air releases tend to be higher in provinces with high concentration of females as households' head and with high concentration of children. Since our findings do not point to environmental discrimination on the basis of ethnicity, this suggests that environmental justice issues in Italy are not likely to manifest themselves along racial and ethnic terms but instead in terms of social categories and gender composition. We also find that the proxy variables employed to measure the efficiency or inefficiency of law enforcement are associated with higher levels of pollution. In terms of policy implications, this result suggests the need to strengthen, all through the country, the local enforcement of environmental laws in order to possibly reduce the negative effects on ambient air pollution.

A flexible ecosystem services proto-typology based on public opinion

- Ecological Economics---2014---L.M. Stapleton,P. Hanna,N. Ravenscroft,A. Church

Interest in the conception and application of ecosystem services has increased significantly in recent years.

However, there remains some doubt about the universality and utility of the terminology used to describe these services. Public preferences for ecosystem service terminology were elicited using an online survey (n=145) of adults in the UK and other countries. A list of different ecosystem phenomena was provided and respondents identified each as a benefit, function, good and/or service. Results were generally robust to subjective differences in familiarity with the subject matter. In the overall sample, benefit was the most preferred descriptor followed by function, service and good. However, by using a combination of non-parametric statistical tests, 10 descriptor sets emerged from the data to describe 22 different ecosystem phenomena. Three of these descriptor sets were individual words (benefit, function and good), covering 9 of the 22 ecosystem phenomena. The other 7 descriptor sets were multiple words (e.g. benefit-good and benefit-function-service) covering the remaining 13 ecosystem phenomena. Scoring the 22 ecosystem phenomena in terms of 4 characteristics (intake, solid, survive and visible) yielded mixed results in terms of being able to distinguish between descriptor sets based on the presence or absence of these characteristics.

Understanding the heterogeneity of social preferences for fire prevention management

- Ecological Economics---2014---Elsa Varela,Jette Bredahl Jacobsen,Mario Soliño

The forest area burnt annually in the European Mediterranean region has more than doubled since the 1970s. In these forests, the main preventive action consists of forest compartmentalization by fuel break networks, which entail high costs and sometimes significant negative impacts. While many studies look at public preferences for fire suppression, this study analyses the heterogeneity of social preferences for fire prevention. The visual characteristics of fire prevention structures are very familiar to respondents, but their management is unfamiliar, which raises specific attention in terms of analysing preference heterogeneity. A random parameter logit model revealed large heterogeneity and preference for traditional heavy ma-

chinery, maintaining linear unshaded fuel breaks at a high density. A latent class model showed that this may be reflected by a third of the population preferring lighter machinery and shaded irregular fuel breaks; a quarter of the population not treating the budget constraint as limiting, another quarter only being worried about the area burnt and the remaining group being against everything. Finally, a discrete mixture model revealed extreme preference patterns for the density of fuel breaks. These results are important for designing fire prevention policies that are efficient and acceptable by the population.

Nested open systems: An important concept for applying ecological footprint analysis to sustainable development assessment

- Ecological Economics---2014---Jiun-Jiun Ferng

The calculation procedures and index interpretation of ecological footprint (EF) analysis, a method for assessing sustainable development (SD), have been continuously improved since the early 1990s. To identify potential for further improvement, this study compared the information revealed by existing EF applications for SD assessment with the core concerns of SD and found that intra-generational equity has not been appropriately addressed in the existing applications of EF analysis for SD assessment because the concept of nested open systems has been ignored. This study then argued that the concept of nested open systems should play a critical role in addressing global SD and conducting national EF analysis for SD assessment. Finally, the potential for improving EF analysis for SD assessment at the global and national scales was discussed.

The impact of environmental policy instruments on innovation: A review of energy and automotive industry studies

- Ecological Economics---2014---Anna Bergek,Christian Berggren

Various types of policy instruments have been implemented to reduce local and global emissions, but the

impact on innovation of different instruments has received less attention. This paper reviews empirical studies of the innovation impact of four main types of policy instruments in two high-emitting sectors. The conclusions are threefold. (1) Policy plays a key role for the development and diffusion of environmental innovation in the studied sectors. (2) Different types of instruments promote different types of innovations: general economic instruments has primarily encouraged incremental innovation, general regulatory instruments has enforced improvements based on modular innovation, and technology-specific instruments appears to have been needed to support the development and deployment of radically new technologies. (3) All types of policy instruments face challenges in design and implementation: understanding the selection impact of the chosen instruments, implementing increasing stringency levels, committing to an appropriate scale, and safeguarding policy stability.

Project evaluation with democratic decision-making: What does cost–benefit analysis really measure?

- Ecological Economics---2014---Karine Nyborg

It is often argued that projects involving public good changes should be chosen on the basis of monetary valuation and cost–benefit analysis (CBA). However, CBA is not value-free. When used to measure welfare, it is based on highly controversial value judgements. When used to measure efficiency, it is based on assumptions of limited relevance to democratic decision-making processes. CBA measures total net willingness to pay, neither more nor less. While interesting in its own right, the normative significance of this indicator is not obvious.

Understanding the shadow impacts of investment and divestment decisions: Adapting economic input–output models to calculate biophysical factors of financial returns

- Ecological Economics---2014---J. Ritchie,H. Dowlatabadi

In recognition of the cumulative effects resulting from financial decisions, a growing number of campaigns are advocating for the removal of investment funds from companies responsible for high levels of carbon emissions. A systematic approach can aid in examining the social, economic and environmental impacts that extend beyond political motivations to divest from fossil fuel companies.

Towards a more inclusive and precautionary indicator of global sustainability

- Ecological Economics---2014---John Pezzey,Paul Burke

We construct a hybrid, economic indicator of the sustainability of global well-being, which is more inclusive than existing indicators and incorporates an environmentally pessimistic, physical constraint on global warming. Our methodology extends the World Bank's Adjusted Net Saving (ANS) indicator to include the cost of population growth, the benefit of technical progress, and a much higher, precautionary cost of current CO₂ emissions. Future warming damage is so highly unknowable that valuing emissions directly is rather arbitrary, so we use a novel, inductive approach: we modify damage and climate parameters in the deterministic DICE climate-economy model so it becomes economically optimal to control emissions in a way likely to limit warming to an agreed target, here 2°C. If future emissions are optimally controlled, our ANS then suggests that current global well-being is sustainable. But if emissions remain uncontrolled, our base-case ANS is negative now and our corresponding, modified DICE model has an unsustainable development path, with well-being peaking in 2065. Current ANS on an uncontrolled path may thus be a useful heuristic indicator of future unsustainability. Our inductive method might allow ANS to include other very hard-to-value, environmental threats to global sustainability, like biodiversity loss and nitrogen pollution.

Bioenergy and rural development: The role of agroforestry in a Tanzanian village economy

- Ecological Economics---2014---Anja Faße,Etti Winter,Ulrike Grote

Recent papers indicate that decentralized bioenergy crop production offers increased market access and income diversification strategies for the rural population. The analyses concentrate on the potential effects of newly discussed crops such as *Jatropha curcas*, cassava, and sugarcane on macro level. Thereby two aspects are neglected, the income effects on micro level, and the integration of traditional firewood production systems for comparison. To fill this gap, an Environmentally Extended Social Accounting Matrix (ESAM) at the village level is developed and applied to a rural village in Tanzania. The objective is first to explore the integration of agroforestry systems in rural smallholder systems and second to analyze income effects of agricultural biomass production for bioenergy purposes in comparison to firewood production. In order to distinguish the use of firewood from public and private tree resources, environmental accounts for changes in tree stocks (public and private) are included. Findings indicate the importance of including common firewood production as a reference point. The highest income effect for the poorest households derives from agroforestry, which households use as a source of firewood and fruits for sale or home consumption, followed by *J. curcas*, sugarcane and finally cassava. Agroforestry in general has been also found to substantially release the pressure on public forest reserves.

Capitalist diversity and de-growth trajectories to steady-state economies

- Ecological Economics---2014---Hubert Buch-Hansen

Growth-critical scholarship has done much to both expose the environmentally unsustainable nature of the capitalist growth-economies of the overdeveloped part of the world and to develop an alternative vision of a de-growth transition leading to a steady-state economy. However, this scholarship fails to adequately take

into consideration that if planned de-growth actually materialised it would do so in societies that differ considerably from one another and that this would have implications both for the transition processes and the nature of their outcomes. In other words, not enough importance is ascribed to capitalist diversity and the nature of institutional change in the growth-critical literature. Against this background, the purpose of the present article is to make the “concrete utopia” of de-growth scholars and steady-state economists more specific by utilising insights from scholarship on capitalist diversity and institutional change. On the basis of a typology of different models of capitalism, the article suggests that if de-growth transitions took place they would take different forms and lead to a variety of types of steady-state economies (SSEs). To illustrate this point, three ideal-typical SSEs are delineated.

A dynamic bio-economic model for community management of goat and oak forests in Zagros, Iran

- Ecological Economics---2014---Arezoo Soltani,Prem L. Sankhayan,Ole Hofstad

A deterministic, non-linear dynamic bio-economic model is developed to analyze interactions between goats and forests under different management regimes at a village level in Zagros, Iran. Data for the study were mainly obtained through participatory rural appraisal, village level survey, forest inventory and secondary sources. The model was run under six alternative management regimes represented by model scenarios: (1) BAU: the business as usual, (2) NSIR: no state intervention with traditional rules, (3) NRFG: no state and traditional rules, (4) NRF: no state and traditional rules without goat husbandry, (5) NFH: no forest harvesting, and (6) NGH: no goat husbandry. The results of BAU, NSIR and NRFG scenarios brought out that state control, traditional rules as well as biological feed-back mechanisms keep the goat population within carrying capacity. Comparing forest density in NSIR and NRFG model scenarios showed that even without state control, villagers managed to preserve forest resources through traditional institutional arrangements.

The population of goats would decline if forest harvesting was banned due to reduction in coppicing and fodder availability. The highest NPV was observed under the NRFG model scenario resulting in lowest sustainability of resource use.

Perverse incentives in fishery management: The case of the defeso in the Brazilian Amazon

- Ecological Economics---2014---Maria Angélica de Almeida Corrêa,James Kahn,Carlos Edwar de Carvalho Freitas

The policy of a closed season with compensation for fishers (called the defeso) was implemented in Amazonia in 2005, with the idea of protecting fishery stocks while maintaining the flow of income of fishers, most of whom are small scale and artisanal fishers. This paper examines the economic theory of this policy, and shows that such a policy could actually hurt fish stocks, even if rigorously enforced. It is then shown that in the absence of enforcement, the policy would definitely lead to an increase in the number of fishers and a decline in fish stocks. In short, the current policy is worse than no policy. This hypothesis is tested using data from the state of Amazonas (both statewide data and data from the county (município) of Coari) and we arrive at the following conclusions. First, the defeso is completely unenforced. Second, the number of fishers has increased dramatically. Finally, catch per unit effort (CPUE) has declined over the period from 2005 to 2010 and additional evidence (presented later in the paper) suggests that stocks have decreased as well. The paper concludes with the recommendation of spatially oriented fishery regulations (zoning and rotating closures) combined with a co-management regime with fishing communities.

Integrating agricultural pest biocontrol into forecasts of energy biomass production

- Ecological Economics---2014---T. Skevas,Scott Swinton,T.D. Meehan,T.N. Kim,C. Gratton,A. Egbendewe-Mondzozo

Biological control of pests is an important ecosystem

service in agricultural landscapes as it protects crops and reduces the need for insecticide use. Establishing a sustainable bioenergy industry requires considering the role of biological control in farm decision making. An important question is how biomass supply changes when farmers take into account agricultural pest biocontrol services. A spatially-explicit bioeconomic model of potential biomass supply that incorporates the effect of biological control on crop choice is employed using data from four Wisconsin counties. The results of the study show that integrating agricultural biocontrol into farmers' production technology generally results in biomass from crop residues being supplied more readily (at a lower relative price).

Climate change and farm-level adaptation decisions and strategies in drought-prone and groundwater-depleted areas of Bangladesh: an empirical investigation

- Ecological Economics---2014---Mohammad Alaudin,Md Abdur Rashid Sarker

Despite recognizing the vulnerability of Bangladesh's agriculture to climate change, the existing literature pays limited attention to a rigorous, quantitative analysis of farm-level data to investigate rice farmers' preferred adaptation strategies, perceived barriers, and policy implications. By employing data from 1800 Bangladeshi farm-households in eight drought-prone and groundwater-depleted districts of three climatic zones and logit models, this study breaks new ground in investigating farm-level adaptation to climate change.

Do government ideology and fragmentation matter for reducing CO2-emissions? Empirical evidence from OECD countries

- Ecological Economics---2014---Sebastian Gar-mann

This paper empirically examines whether government ideology and government fragmentation have influenced the process of CO2-emission reductions in the time period 1992–2008. Using data from 19 OECD countries, I find that (1) right-wing governments are associated

with emission reduction to a smaller extent than center and left-wing governments and (2) emissions are higher the more parties are in government. On the other hand, the distinction between majority and minority governments has no significant influence on emissions.

Ecological economics, Marxism, and technological progress: Some explorations of the conceptual foundations of theories of ecologically unequal exchange

- Ecological Economics---2014---Alf Hornborg

Almost regardless of ideological persuasion, the seemingly self-evident concept of “technological progress” inherited from early industrialism is resorted to as an article of faith serving to dispel the specter of truncated growth. The increasingly acknowledged threats of peak oil and global warming are thus generally countered with visions of a future civilization based on solar power. I discuss this technological scenario as a utopia that raises serious doubts about mainstream understandings of what “technology” really is. Technological utopianism raises difficult but fundamental analytical questions about the relation between thermodynamics and theories of economic value. While Marxism and some ecological economics share the ambition of grounding notions of economic value in physical parameters, notions of economic value and physical processes should be kept analytically distinct.

Linkages between landscapes and human well-being: An empirical exploration with short interviews

- Ecological Economics---2014---Claudia Biel-ing,Tobias Plieninger,Heidemarie Pirker,Christian R. Vogl

Human well-being is tightly linked to the natural environment. Although this notion is well-established, it remains difficult to assess how the biophysical features of a specific area contribute towards the well-being of the people attached to it. We explore this topic using the case of four areas in Germany and Austria by performing open, single-question interviews with

262 respondents. Data reveal an outstanding relevance of nonmaterial values. Linkages between landscapes and human well-being are tied to specific features of the material environment but, likewise, practices and experiences play an important role in the creation and acknowledgment of such values. Our results accord with the conceptual outline of the cultural values model but fit to a lesser degree into the ecosystem services framework. Due to the high relevance of experiential factors, providing manifold opportunities for people to engage with their natural surroundings should be considered a strategy for fostering human well-being.

Willingness to pay of committed citizens: A field experiment

- Ecological Economics---2014---Dominique Ami,Frédéric Aprahamian,Olivier Chanel,Robert-Vincent Joulé,Stéphane Luchini

In this paper, we propose a behavioral approach to determine the extent to which the consumer/citizen distinction affects interpretations of monetary values in stated preferences methods. We perform a field experiment dealing with air pollution, where some (randomly selected) subjects are given the opportunity to behave politically by signing a petition for environmental protection prior to stating their private preferences in a standard contingent valuation exercise. We show that signing has the potential to influence respondents' willingness to pay values. Results indicate that even market-like situations are not immune to citizen behavior.

Zero discounting can compensate future generations for climate damage

- Ecological Economics---2014---Marc D. Davidson

In cost-benefit analysis of climate policy there are two main approaches to discounting, each with implications conflicting with our moral intuitions. Thus, discounted utilitarianism implies that we hardly need to protect future generations against climate change, while classical utilitarianism implies that we should reduce our

consumption across the board to benefit future generations. The insolubility of the debate derives from the fact that both classical and discounted utilitarianism permit only a single discount rate for all consequences occurring in the same future year, while our intuitions clearly do distinguish between consequences, depending on whether we cause adverse effects on other people's interests and violate their rights. Most people share the moral intuition that we ought to refrain from harming others, and ought to compensate them if we were unable to prevent harm. To regain a reflective equilibrium between such deontological intuitions and economic theory there is a need to accept different discount rates for different situations: a zero consumption discount rate in the case of cost-benefit analysis of measures to prevent wrongful harm to future generations, and standard discounting in all other cases. Applying a zero consumption discount rate means that future generations are automatically largely compensated for climate damage that remains unmitigated.

The impact of changing rainfall variability on resource-dependent wealth dynamics

- Ecological Economics---2014---Christopher Barrett,Paulo Santos

Climate change is widely expected to lead to changing rainfall variability and thus to changing frequency of drought. In places where drought is a major driver of agroecosystem dynamics, as in the extensive livestock grazing systems that dominate Africa's sprawling arid and semi-arid lands, changing rainfall variability can fundamentally alter human wealth dynamics. We use subjective livestock herd growth expectations data elicited from Boran pastoralists in southern Ethiopia to generate estimates of herd dynamics conditional on rainfall state. The climate state-conditional estimates permit simulation of herd dynamics under different rainfall patterns. The multiple herd size equilibria observed in multiple pastoralist household data sets from the region appear sensitive to climate regimes. Reduced rainfall variability that significantly reduces drought frequency would eliminate, in expectation, the poverty trap equilibrium that presently exists only for

households with herd sizes beneath a threshold level. Conversely, if the drought frequency more than doubles relative to recent patterns, then the whole system becomes a poverty trap, in expectation.

Energy savings and the rebound effect with multiple energy services and efficiency correlation

- Ecological Economics---2014---Neal K. Ghosh, Michael F. Blackhurst

The rebound effect, or the increased use of energy services following an increase in the efficiency of that service, is widely studied in the literature, but it is usually only considered in a single-service environment. Such a framework ignores the potentially significant indirect rebound effects that occur through increased purchasing power for other services and does not allow for joint efficiency improvements across many services, what we call “efficiency correlation.” We develop a household production model with two energy services and distinct but simultaneous efficiency changes to test the implications of efficiency correlation on net energy elasticities and the rebound effect. Positively correlated efficiency choices across end-uses not only increase technically feasible energy reductions but also drive additional rebound responses that erode these savings. Model simulations suggest that the rebound effects through the efficiency correlation channel are just as large as traditional direct and indirect rebound effects reported in the literature, though they are offset by added technical energy savings. Moreover, we find that negative correlation can significantly reverse any energy savings (e.g. a household installs energy-saving window panes but then trades in their sedan for a SUV), but current Federal efficiency standards make this scenario unlikely. This paper offers new insight into a host of additional behavioral responses to efficiency improvements, particularly the incidence of efficiency correlation across different energy services, and highlights its implication for realized energy savings.

Activism mobilising science

- Ecological Economics---2014---Marta Conde

The article sheds light on a process where unequal power relations are contested through the co-production of scientific and local knowledge. I argue that lay citizens, communities and local grassroots organisations immersed in socio-environmental conflicts are engaging with professional scientists to understand the impacts a polluting project is causing to their environment and themselves. Together with scientists they co-produce new and alternative knowledge that gives the local organisations visibility and legitimacy, information on how to protect themselves from the impacts, and allows them to engage in practical activism, challenging the manufactured uncertainty and other information produced by the state or companies running the projects. This process is what I term Activism Mobilising Science (AMS). It is locally driven by activists who have built related capacities and is generally based on voluntary work. AMS is compared to other participatory processes and gives clues into how grassroots organisations can avoid co-optation. The analysis is based on two uranium mining conflicts in Niger and Namibia where two local organisations are trying to confront the manufactured uncertainty of the nuclear industry through an AMS process.

On the empirical content of carbon leakage criteria in the EU Emissions Trading Scheme

- Ecological Economics---2014---Ralf Martin, Mirabelle Muûls, Laure de Preux, Ulrich Wagner

The EU Emissions Trading Scheme continues to exempt industries deemed at risk of carbon leakage from permit auctions. Carbon leakage risk is established based on the carbon intensity and trade exposure of each 4-digit industry. Using a novel measure of carbon leakage risk obtained in interviews with almost 400 managers at regulated firms in six countries, we show that carbon intensity is strongly correlated with leakage risk whereas overall trade exposure is not. In spite of this, most exemptions from auctioning are granted

to industries with high trade exposure to developed and less developed countries. Our analysis suggests two ways of tightening the exemption criteria without increasing relocation risk among non-exempt industries. The first one is to exempt trade exposed industries only if they are also carbon intensive. The second one is to consider exposure to trade only with less developed countries. By modifying the carbon leakage criteria along these lines, European governments could raise additional revenue from permit auctions of up to €3billion per year, based on a permit price of €30.

Smarter than metering? Coupling smart meters and complementary currencies to reinforce the motivation of households for energy savings

- Ecological Economics---2014---Helene Joachain,Frédéric Klopfert

A crucial argument in the debate around smart meter deployment in the EU is the potential for households to save energy. One strand of research in this field has investigated the effects on household energy consumption of the feed-back provided by smart meters. However, another aspect that deserves attention is the motivation for households to use the feed-back to save energy. This paper explores how the emerging trend of using complementary currencies for sustainability policies could translate into new interventions adapted to the smart meter deployment and capable of promoting more autonomous forms of motivation compared to interventions using official currencies. Three systems designs (rewarding, regulatory and hybrid) are presented and discussed within the framework of self-determination theory. Because the rewarding system S1 can contribute positively people's basic needs for autonomy, competence and relatedness, it could lead to more autonomous forms of motivation. The conclusions regarding the regulatory system S2 are less clear, although the hybrid variant S3 that integrates mechanisms from the rewarding system into the regulatory system could be perceived as more consonant with people's basic need for autonomy.

Markets in environmental governance — From theory to practice

- Ecological Economics---2014---Arild Vatn

2014

Product level embodied carbon flows in bilateral trade

- Ecological Economics---2014---Misato Sato

As increasingly complex modelling approaches to quantifying embodied carbon in trade have become popular, the lack of disaggregation has been identified as a key weakness. This paper quantifies embodied carbon in bilateral trade at the product level. This is done using the material balance approach, by collecting product carbon intensity factors from multiple data sources and combining with bilateral trade data in physical quantities. The dataset covers trades between 195 countries for 1080 products in 2006. The detailed mapping of trade embodied carbon provides detailed insights into the nature of the flows that were previously masked or under-reported. For example, it finds that the lion's share of global trade embodied emissions are concentrated in a relatively small number of product categories of traded goods, suggesting that focusing mitigation efforts and trade-measures on these products would be an effective strategy to address potential carbon leakage, and to decarbonise international supply chains. The results also highlight that embodied carbon is focused in regional trade, thus regional harmonisation of climate mitigation policy will be effective in mitigating leakage.

Do conservation auctions crowd out voluntary environmentally friendly activities?

- Ecological Economics---2014---Gerda J. Kits,Wiktor Adamowicz,Peter Boxall

Research has shown that introducing external incentives to encourage pro-social behavior, such as monetary rewards or regulation, may crowd out voluntary pro-social activity. This has implications for the appropriate design and use of such incentive-based programs.

This study investigates motivational crowding out in the case of conservation auctions, a relatively new tool that provides monetary incentives to encourage landowners to adopt environmentally friendly management practices. Our experimental evidence shows that the introduction and subsequent removal of a conservation auction significantly reduces voluntary provision of environmental quality (via monetary donations to an environmental charity), compared to a control group that does not experience an auction. We also attempt to examine some economic theories of behavior that explain this effect according to either individual motivations or social interactions, and our initial exploration finds that crowding out occurs regardless of whether or not participants have opportunities to interact with one another during the experiment.

Inequality and rules in the governance of water resources

- Ecological Economics---2014---Carmen Marchiori

This paper considers two types of farmer, with unequal land endowments, who voluntarily contribute to a joint project for the maintenance of an irrigation network. The collective output (water) is distributed according to some allocation rule and used by each farmer in combination with land to produce a final good. The analysis shows that the initial degree of inequality affects the allocation rule that maximises the amount of water collectively provided. Specifically, two forces act in opposite directions. The first ‘effort-augmenting’ force pushes the distribution of water towards the agent with the higher return to water in the attempt to maximise the aggregate level of effort. This is the prominent force when efforts are highly substitute. If efforts display some degree of complementarity, the effort mix, alongside with aggregate effort, becomes important. A second ‘effort-mix’ force then emerges, that favours more egalitarian or even progressive water allocation rules.

Is eco-village/urban village the future of a degrowth society? An urban planner’s perspective

- Ecological Economics---2014---Jin Xue

In the degrowth literature, relocalization is widely considered as a strategic approach to transition to a degrowth society, and eco-village/urban village is argued to be the spatial organization suitable for implementing localism. These debates on eco-village/urban village as a vision for long-term sustainability have profound implications for the spatial development of our society. This paper aims to challenge this proposition from an urban planner’s perspective by dwelling on spatial implications and planning process. It is argued that spatial decentralization can lead to various social and environmental consequences contradicting the multi-goals of a degrowth society. Localizing and decentralizing decision making in the planning process does not necessarily lead to a just and sustainable society. Instead, it is of importance to have multi-scalar strategies in the planning context to pursue degrowth. The paper concludes by pointing out the complex relation between paradigmatic societal transformation and spatial development, and the significant role that urban planning can play in the transition to degrowth.

Linking common property resource management to human capital outcomes

- Ecological Economics---2014---Ram Ranjan

In regions where common pool resources provide significant support to their surrounding communities, any climate change related shock could produce multiple livelihood repercussions. In this paper, a model explores how the health of common pool resources could impact upon human capital outcomes for communities that struggle to find alternate livelihood options when traditional means such as agriculture become unsustainable. The management of common pool resources is modeled as a strategic interaction process between two heterogeneous communities that are directly or indirectly dependent upon it. An unconstrained harvesting of common resources such as forestry not only

depletes its stocks, but it also indirectly affects crop output through soil degradation. A number of situations are constructed where communities are able to successfully finance human capital accumulation through proper management of their common pool resources. However, results also warn that communities that are faced with limited opportunities towards accumulating human capital must plan ahead to prevent the depletion of their common resources below critical levels. When non-linear feedbacks to soil degradation emanate from low levels of common pool stocks, human capital outcomes as well as future livelihoods of such communities are threatened.

Economic drivers of biological invasions: A worldwide, bio-geographic analysis

- Ecological Economics---2014---Silvana Dalmazzone,Sergio Giaccaria

The introduction of invasive alien species (IAS) is generally acknowledged to depend both on the propagule pressure imposed by openness to international trade and on the health of the receiving ecosystem. Bio-geographic factors however play a crucial role in determining the level of risk associated with trade. We develop an analytical treatment of bioclimatic similarity between trade partners, within a model that links the incidence of invasive species to resource extraction, pollution and to import volumes disaggregated by country and region of origin. The model, estimated with data on invasive species of all taxa in 123 countries, shows that considering the geographical structure of trade flows and the bioclimatic similarity between sources and destinations substantially improves our understanding of the drivers of biological invasions. The results allow us to identify, in a worldwide perspective, the relative risk of biological invasions (in general, and by habitat type) entailed by different commercial partners.

Why do farmers join Payments for Ecosystem Services (PES) schemes? An Assessment of PES water scheme participation in Brazil

- Ecological Economics---2014---Matheus A. Zanella,Christian Schleyer,Stijn Speelman

Payments for Ecosystem Services (PES) have become a popular instrument in the last decades and this growing trend is also clearly evident in Brazil. However, challenges related to implementation of these schemes are often underestimated. Any guarantee that a payment will secure or provide such a service is subject not only to underlying ecological uncertainties but also to those entailed by the kinds of social interaction that are inherent to policy implementation. It is argued that the objectives proposed with these instruments can only be attained by ensuring a wide participation of land users. This article advances this topic reporting and discussing evidence on farmer's reasons to participate in three PES-water schemes in Brazil using a combination of qualitative and quantitative research approaches. Results indicate that the diverging opinions regarding how ecosystem services are generated or secured, decentralized governance structures and the involvement of representative bodies in scheme design and implementation are important factors to consider. Furthermore, access to information and general environmental concern were found to be important variables to explain the propensity of farmers to participate. This generates serious policy implications for developing consistent communication and consultation strategies with scheme beneficiaries.

Pluralising climate change solutions? Views held and voiced by participants at the international climate change negotiations

- Ecological Economics---2014---Naghmeh Nasir-tousi,Mattias Hjerpe,Katarina Buhr

Intergovernmental organisations have developed into important sites of normative contestation where increasingly non-state actors participate. A common puzzle is however whether engaged non-state actors represent already strong and established interests or if

they also bring forth marginalised voices. This concern raises the pertinent question of what views non-state actors actually represent and if this adds to the perspectives voiced by state actors. This paper examines the views held and voiced by state and a range of non-state participants at the United Nation's climate change conferences. Specifically, questions on what types of climate change solutions are favoured and to what extent these solutions are discussed are addressed. Through statistical analyses of questionnaire data and a content analysis of abstracts of side-events to the conferences, we find that while non-state actors help in broadening the discursive space, some perspectives remain marginalised. We conclude that while non-state actors represent a pluralising force, greater non-state actor participation in intergovernmental organisations is on its own unlikely to lead to democratic global governance.

Negative externalities in cropping decisions: Private versus common land

- Ecological Economics---2014---Juan Benito,R. Ezcurra,N. Osés-Eraso

This paper analyzes to what extent the entitlement of property rights affects cropping decisions when these decisions generate negative externalities. To that end, we implement an experimental study where agents make cropping decisions in two different treatments: private and common land. The results show that there are no statistically significant differences between the two treatments in the contribution to the negative externality, thus revealing that the entitlement of property rights does not affect cropping decision in this context. Furthermore, our findings indicate that the implication of the agents in activities generating negative externalities tends to increase over time, thus amplifying its adverse consequences.

Wind farms — Where and how to place them? A choice experiment approach to measure consumer preferences for characteristics of wind farm establishments in Sweden

- Ecological Economics---2014---Kristina Ek,Lars Persson

This paper explores preferences among the general public in Sweden for attributes related to the establishment of wind power farms. The method applied is a choice experiment where people are asked to choose between two hypothetical wind farms characterized by different attributes. Five attributes are included in the experiment: (i) type of landscape, (ii) type of ownership, (iii) the degree of local participation in the planning process, (iv) the choice to transfer revenue to the society in a pre-specified way, and (v) a monetary cost in terms of an additional electricity certificate fee. The data are analyzed with multinomial logit, random parameter logit, and latent class models. The results indicate that consumers in Sweden are more likely to accept the higher renewable electricity certificate fee if: (a) wind power farms in areas used for recreational purposes are substantially avoided, (b) the establishment is anchored by whole or partial ownership in the local community and, (c) the locals are involved in the planning and implementation process. Our policy simulation exercise shows that respondents are willing to pay a higher electricity fee corresponding to about 0.6 Euro cents per kWh to avoid wind farms located in the mountainous area and private ownership.

Conservation through intensification? The effects of plantations on natural forests

- Ecological Economics---2014---Robert Heilmayr

The rapid growth in plantation forestry over the past two decades attests to the sector's importance in meeting rising global demand for timber, fuel and fiber. However, plantation forests differ dramatically from natural forests in the types of ecosystem services they can provide. As a result, it is important to understand the aggregate effects of plantation expansion on natural forests. Using a simple partial equilibrium model

and a global panel dataset of forest statistics, this paper assesses the impacts of plantation expansion upon the extent of natural forests. The analysis shows that plantation expansion has resulted in a contraction of natural forests dedicated to forest product extraction, but an expansion of un-harvested natural forests and the associated generation of ecosystem services. The model and empirical evidence emphasize, however, that there is significant heterogeneity in this outcome depending upon the own-price elasticity of demand for forest products and, as a result, the trade intensity of the forestry sector. The potential for beneficial effects of plantation expansion on un-harvested natural forests is diminished in countries with trade-oriented forestry sectors.

Patterns of change in material use and material efficiency in the successor states of the former Soviet Union

- Ecological Economics---2014---James West, Heinz Schandl, Fridolin Krausmann, Jan Kovanda, Tomas Hak

The successor states of the former Soviet Union present a unique opportunity to study the changes in the socio-metabolic profile of a cohort of nations which underwent a radical and contemporaneous shift in economic system. That change was from being regions within an economically integrated, centrally planned whole, to being independent nations left to find their own place in the global economic system. The situation of these nations since the dissolution of the Soviet Union provides a rare experiment, in which we might observe the influence of the different starting conditions of each nation on the development path it subsequently followed, and the attendant socio-metabolic profiles which resulted. Here we take the opportunity to examine patterns for the region as a whole, and for three individual countries. We also examine the relative importance of three different drivers of material consumption using a version of the IPAT framework. Finally, an area for follow-on investigation was suggested by a significant positive correlation observed between the economic growth of individual successor states, and the degree to

which they improved their material productivity. This latter is of potential importance in assessing whether dematerialization acts primarily to accelerate or retard economic growth.

Toward a neoclassical theory of sustainable consumption: Eight golden age propositions

- Ecological Economics---2014---Harry D. Saunders

Popular trends in ecological economics increasingly consign neoclassical economics to the sidelines of modern-day relevancy. The neoclassical tradition is often seen as reliant for its authenticity on a presumption of human avarice – both unbridled consumerism and corporate cupidity – and demanding for its real-world applicability an assumption of continuous economic growth in a world of hard limits.

Controlling non-additional credits from nutrient management in water quality trading programs through eligibility baseline stringency

- Ecological Economics---2014---Marc Ribaud, Jeffrey Savage

A concern for programs that offer payment for environmental services is that those services be additional. Non-additional services are those that would have been provided without the payment. One source of non-additionality is farmer misrepresentation of their pre-program management. Farm management practices are often difficult to observe, particularly those that do not involve structural changes, such as nutrient management. If practices are difficult to observe, management oversight lax, and enforcement weak, the farmer has an incentive to provide biased information that increases the likelihood that he will receive a more favorable baseline for calculating services created, and a larger payment. This is a moral hazard problem. The presence of non-additional credits in a water quality trading program can result in the degradation of water quality. Point source discharges above permitted levels are replaced by equivalent reductions from unregulated nonpoint sources. If the abatement that point sources

purchase from nonpoint sources is non-additional, discharges will be higher than if the abatement was truly additional. Preventing non-additional credits from entering a water quality trading market is one of the goals of program design. In this paper we assess how program eligibility baseline choice affects the incentive to misrepresent baseline nutrient management practices.

Beyond environmental and ecological economics: Proposal for an economic sociology of the environment

- Ecological Economics---2014---Corinne Gendron

The vast majority of approaches in environmental economics attribute the current ecological crisis to the fact that, from its inception, the industrial economic system was founded on premises that made no allowance for the limits and regulatory functions of ecosystems. According to these approaches, we must therefore remedy the historical error of dissociating the fields of economics from the natural sciences, notably by restoring the links between these two disciplines. Distinguishing themselves from the two historic approaches, environmental economics and early ecological economics, the emerging institutionalist schools evoke not only the constructed nature of the environmental crisis (generally viewed as an objective fact by both traditional environmental economists and ecological economists), but also the socially constructed nature of the economy and its institutions. An actionalist regulationist approach allows us to formalize this twofold construction and lays the groundwork for a new economic sociology of the environment in which the technical modalities of ecological modernization are studied in light of social relations, with the understanding that social relations are also affected by the materiality of the environmental crisis. This actionalist regulationist approach also lends itself to anticipating likely trajectories in the future ecological modernization of economic institutions.

The effect of ISO 14001 on environmental regulatory compliance in China

- Ecological Economics---2014---William McGuire

Certification to the ISO 14001 environmental management standard is analyzed using data drawn from a survey of manufacturing firms in China. The analysis proceeds by first identifying predictors of ISO 14001 certification and then estimating the relationship between ISO 14001 certification and compliance with environmental regulations. Potential endogeneity between ISO 14001 certification and regulatory compliance is addressed by modeling certification and compliance simultaneously using the SURBP estimator. Results indicate that ISO 14001 certification increases compliance with environmental regulations, and this effect persists after implementing the appropriate controls for endogeneity.

Land-based greenhouse gas emission offset and leakage discounting

- Ecological Economics---2014---Man-Keun Kim, Denis Peralta, Bruce McCarl

This paper examines leakage from agricultural greenhouse gas reduction programs stimulated by reductions in regional commodity supply. This paper develops an extension of the leakage discount formula in Murray et al. (2004) that incorporates changes in input (land) usage rather than product output (crop or forest product quantity). Additionally the leakage discount developed here allows for land conversion and production replacement involving multiple alternative uses. In an empirical application in the Southeast Texas we compute leakage discounts of 14.8% for the conversion of rice to no-till sorghum and 14.9% for rice to pasture program. Most of the sources of GHG offset leakage come from conversions of cotton to rice and pasture to rice in the other regions.

The If, How and Where of assessing sustainable resource use

- Ecological Economics---2014---Frank Figge, Tobias Hahn, Ralf Barkemeyer

In today's economies those who sustain the burden of resource use, those using resources and those providing resources are not necessarily identical. With this

separation come three fundamental but interrelated decision-making perspectives on the sustainability assessment of resource use. These three perspectives correspond to the three assessment questions if, how, and where resources should be used. Most sustainability assessment approaches do not make their underlying assessment perspectives explicit. The goal of this paper is to provide structure and organisation to existing approaches. This structuring suggests that any discussion on the appropriateness and validity of different assessment approaches and their results must take into account the underlying assessment perspective. The three questions if, how, and where resources should be used correspond to the requirements of a sustainable resource use. While existing assessments do address the three questions in isolation, it is all the more important that the limitations and implications of focusing on a single perspective are spelled out. As the main contribution, the paper distinguishes the rationale of each assessment perspective and develops on their interlinkages and thus provides the context and structure for a more informed and fruitful debate on the assessment of sustainable resource use.

Valuing tradeoffs between agricultural production and wetland condition in the U.S. Mid-Atlantic region

- Ecological Economics---2014---Moriah B. Bostian, Alan T. Herlihy

This study uses the directional output distance function, a multi-output economic production frontier model, to value the physical tradeoffs between agricultural production and wetland condition in the U.S. Mid-Atlantic region Nanticoke River watershed. We combine detailed ecological indicator data to measure wetland condition with satellite imagery land use data on agricultural production in the watershed. Our estimation procedure adapts the bootstrap methods originally developed by Simar and Wilson (1998) for non-parametric efficiency estimates to the quadratic directional output distance function. We find substantial variation in tradeoff values across the watershed, which could be used to target wetland conservation efforts in

the region.

Wild food in Europe: A synthesis of knowledge and data of terrestrial wild food as an ecosystem service

- Ecological Economics---2014---C.J.E. Schulp, W. Thuiller, Peter Verburg

Wild food is an iconic ecosystem service that receives little attention in quantifying, valuating and mapping studies, due to the perceived low importance or due to lack of data. Here, we synthesize available data on the importance of wild food as ecosystem service, its spatial distribution and relations between supply, demand and benefits in the European Union (EU), covering all terrestrial wild food groups.

An Empirical Study of the Determinants of Green Party Voting

- Ecological Economics---2014---Ingmar Schumacher

I empirically study the determinants of individuals' green voting behavior. For this I make use of three datasets from Germany, a panel dataset and two cross-sectional datasets. The empirically strongest determinants are the voters' attitude or distance to nuclear sites, the level of schooling and net income. I show that those voters with deviant attitudes or alternative world views are more likely to vote green, a result of the fact that the green party has always had the position of a protest party. I find little role for demographic variables like gender, marital status or the number of children. This is in contrast to the stated preference literature. Age plays a role for explaining voting behavior only insofar as it proxies for health.

Prioritizing payment for environmental services: Using nonmarket benefits and costs for optimal selection

- Ecological Economics---2014---Joshua Duke, Steven Dundas, Robert Johnston, Kent Messer

This article provides a practical, applied analysis of optimal targeting in agricultural land preservation, comparing the performance of four alternative targeting strategies. Nonmarket benefit data and hedonic cost estimates are used for parcels in Sussex County, Delaware. The results show that branch-and-bound optimization (OPT) does not significantly outperform the much simpler benefit–cost ratio targeting (BCRT). However, significant losses of potential net benefits occur when applied methods overlook either benefits or costs. In this application, benefit targeting (BT) and cost targeting (CT) significantly underperform both OPT and BCRT, with BT underperforming all other methods.

Explaining the rank order of invasive plants by stakeholder groups

- Ecological Economics---2014---Julia Touza,Alicia Pérez-Alonso,María L. Chas-Amil,Katharina Dehnen-Schmutz

Debates surrounding the use of policies to avoid further spread of invasive species highlight the need to establish priorities in public resource allocations. We explore the consistency or discrepancy among stakeholder groups involved in the risk and control management of invasive species to identify the extent to which different factors influence stakeholder choices of major relevant plant invaders. Based on stakeholder ranking of invasive plants, we explore the reasons behind stakeholders' support for policy management. Data were collected in Galicia, Spain. A national catalogue of prohibited entry and trade of invasive species has been recently approved. We estimate a rank ordered logit model using information from semi-structured interviews conducted with respondents from four stakeholder groups: public administration sector, ornamental sector, research and social groups. The characteristics of plant invaders that provoke stakeholders to rank a species more highly are wide distribution of plant invaders, existence of public control programmes, use and sale of species in the ornamental sector and media coverage. The influence these aspects have in the selection of top-ranked invaders varies across different stakeholder groups and

with stakeholders' level of knowledge, awareness and attitudes towards different potential policy measures. A small group of invaders are perceived as top rated by all stakeholder groups.

An updated biodiversity nonuse value function for use in climate change integrated assessment models

- Ecological Economics---2014---Wesley R. Brooks,Stephen C. Newbold

The impacts on biodiversity and ecosystems are among the key reasons for concern about climate change. Integrated assessment models are the main tools used to estimate the global economic benefits of policies that would address climate change, but these models typically include only a partial accounting and idiosyncratic treatment of ecosystem impacts. Here, we review several recent studies of the impacts of climate change on biodiversity and show that the biodiversity value function in the FUND integrated assessment model is insensitive to predicted biodiversity loss, instead depending almost entirely on temperature changes per se. We use quantitative estimates of the influence of global warming on species extinction rates to re-calibrate the biodiversity loss function in FUND, and develop a new global biodiversity nonuse value function calibrated using results from two previous studies of people's willingness to pay to prevent the loss of tropical rainforests and to protect endangered species in the U.S. In contrast to the ecosystem damages function in FUND, our biodiversity value function depends on temperature only indirectly through its influence on biodiversity loss. Finally, we highlight areas where further research is needed for developing more comprehensive and reliable forecasts of ecosystem damages related to climate change.

Local consumption and territorial based accounting for CO2 emissions

- Ecological Economics---2014---Kristinn Hermannsson,Stuart McIntyre

We examine the complications involved in attributing

emissions at a local level. Specifically, we look at how functional specialisation within a city region can, via trade between sub-regions, create emissions interdependencies; and how this complicates environmental policy implementation in an analogous manner to international trade at the national level. For this purpose we use a 3-region emissions extended input–output model of the Glasgow City region (2 regions: city and wider city-region) and the rest of Scotland. The model utilises data on household consumption to account for consumption flows across sub-regions and plant-level data on emissions from electricity generation to augment the top-down disaggregation of emissions. This enables a carbon attribution at the sub-regional level, which is used to analyse emissions interdependencies within the city-region.

Ukraine and the great biofuel potential? A political material flow analysis

- Ecological Economics---2014---Anke Schaffartzik,Christina Plank,Alina Brad

Ukraine was once considered the breadbasket of the Soviet Union, its agriculture subject to both extensification and intensification measures. Following the dissolution of the Soviet Union, both these processes were reversed, giving modern-day Ukraine the image of untapped agricultural potential. Alongside the country's proximity to the European Union and its access to the Black Sea, this has made Ukraine a key candidate as a global supplier of feedstock for biofuel. Demand for the latter is rising noticeably, especially in the wake of current European and international blending targets for liquid biofuels. Ukraine has responded with a number of initiatives to further biofuel feedstock production. We have compiled a material flow account for Ukraine, focusing especially on the development of the agricultural sector since the early 1990s. By complementing this physical account with an in-depth analysis of political and economic developments, we are able to trace the impact of rising demand for biofuel feedstock on Ukraine. We find that the attempt to establish a biofuel sector based largely on rapeseed was not successful but has nonetheless left the country at

a cross-road in the development of both its economy and its resource use.

The ecosystem service cascade: Further developing the metaphor. Integrating societal processes to accommodate social processes and planning, and the case of bioenergy

- Ecological Economics---2014---Joachim H. Spangenberg,Christina von Haaren,Josef Settele

The ‘cascade model’ of ecosystem service generation and valuation highlights the links between biophysical aspects/biodiversity and human well-being, in particular for the case of marginal changes, but does not include societal processes. Services seem to flow effortlessly from ecosystems to beneficiaries, as free gifts of nature. We integrate such processes, strengthening the model's applicability to non-incremental changes, and to landscape planning. A process analysis shows how use value attribution turns biophysical ecosystem functions into ecosystem service potentials which (except for ‘final services’) have to be mobilised to provide ecosystem services. Once appropriated, these services generate ecosystem benefits which may be commercialised, or not.

Sustainability of the Dry Forest in Androy: A Viability Analysis

- Ecological Economics---2014---Pablo Andrés-Domenech,Patrick Saint-Pierre,Pascaux Smala Fanokoa,Georges Zaccour

We investigate the dynamic effect that the Tandroy's unsustainable practices have on the forest. The Tandroy people live in Androy, a region located in the southern part of Madagascar. They are mainly an agricultural and cattle herding society whose subsistence relies on the slash-and-burn farming agriculture (hat-sake) and the burning of cacti which are given as fodder to the livestock (ororaketa). These activities generate ecological pressure on the surrounding dry forest and socioeconomic risks related to the lack of sustainability of these practices in the long run. In this paper we address the notion of sustainability and confront it

with Tandroy's current productive and economic system. By means of the viability theory, we characterize the actions and scenarios that are compatible with a sustainable use of the forest in the region.

Wildlife corridor market design: An experimental analysis of the impact of project selection criteria and bidding flexibility

- Ecological Economics---2014---Md Sayed Iftekhar, John Tisdell

In this work we used controlled laboratory experiments to investigate the impact of project selection criteria and bidding flexibility on the economic performance of wildlife corridor auctions. Bidders coordinated their bids to form valid corridors and compete with other valid corridors to be successful. We tested the impact of bidding flexibility in terms of (a) bidders differentiating their offers for different eligible corridors and (b) bidders submitting a single offer that would automatically be considered for all eligible corridors. Within the bidding options, we compared the performance of the auctions under a net benefit and a benefit cost ratio selection criteria. We found that participants conditioned their offers in terms of corridor benefit information. As a consequence, allowing multiple offers significantly increased payment and rent extraction. On the other hand, a single offer restriction facilitated a higher proportion of valid agreements and reduced rent extraction and, as a result, the agency's payment. We could not find any significant difference between project selection criteria in terms of payment and rent extraction. These results provide important insights for policy makers engaged in conservation market design throughout the world.

There is no silver bullet: The value of diversification in planning invasive species surveillance

- Ecological Economics---2014---Denys Yemshanov, Frank H. Koch, Bo Lu, D. Barry Lyons, Jeffrey P. Prestemon, Taylor Scarr, Klaus Koehler

In this study we demonstrate how the notion of diversification can be used in broad-scale resource allocation for surveillance of invasive species. We consider the problem of short-term surveillance for an invasive species in a geographical environment. We find the optimal allocation of surveillance resources among multiple geographical subdivisions via application of a classical portfolio framework, which allocates investments among multiple financial asset types with uncertain returns in a portfolio that maximizes the performance and, by meeting the desired diversification targets, protects against errors in estimating the portfolio's performance.

Mindfulness and sustainability

- Ecological Economics---2014---Torgeir Ericson, Bjørn Gunaketu Kjønstad, Anders Barstad

Ecosystems are under pressure due to high levels of material consumption. Subjective well-being sought through other means than material rewards could make an important contribution to sustainability. A wealth of research indicates that mindfulness contributes to subjective well-being by focusing the mind on the here and now, giving rise to stronger empathy and compassion, facilitating clarification of goals and values, and enabling people to avoid the "hedonic treadmill". There is also a body of research that shows how subjective well-being, empathy, compassion, and non-materialistic/intrinsic values are associated with more sustainable behavior. Based on a review of the literature on these topics, we suggest that promoting mindfulness practice in schools, workplaces and elsewhere could be construed as a policy that pays a "double dividend" in that it could contribute both to more sustainable ways of life and to greater well-being.

Is there overshoot of planetary limits? New indicators of human appropriation of the global biogeochemical cycles relative to their regenerative capacity based on 'ecotime' analysis

- Ecological Economics---2014---Nicola J. Smith, Garry W. McDonald, Murray G. Pat-

The global biogeochemical cycles are recognised as extremely important processes operating within the Earth's (geo)biosphere. However, there are currently few methods available through which we can understand and communicate humanity's dependence on these cycles. This paper presents a novel method, based on input–output analysis, for deriving a suite of indicators describing the level at which the global economy, through its transformation of useful resources (i.e. raw materials) into residuals (i.e. wastes, pollutants, emissions), is appropriating biogeochemical processes. Furthermore, significant insight into the scale of the global economic system is gained by comparing the rate of human appropriation of biogeochemical cycling with that of the biosphere's regenerative capacity. In order to calculate these indicators, we create a new concept of 'ecotime', defined as the average biogeochemical cycling time available for matter held within differing types of environmental commodities (e.g. carbon dioxide, plants, fossil fuels) to reach biogeochemical processes under consideration. Resources used by the global economy generally have long ecotimes, while the residuals produced by economic activities generally have short ecotimes. Applying our method to an extensive database encompassing the key biogeochemical cycles, it is found that humans are placing significant pressure on these cycles.

Spatial Polarization of the Ecological Footprint Distribution

- Ecological Economics---2014---Jordi Teixido, Juan Duro

The international allocation of natural resources is determined, not by any ethical or ecological criteria, but by the dominance of market mechanisms. From a core–periphery perspective, this allocation may even be driven by historically determined structural patterns, with a core group of countries whose consumption appropriates most available natural resources, and another group, having low natural resource consumption, which plays a peripheral role. This article consists of

an empirical distributional analysis of natural resource consumption (as measured by Ecological Footprints) whose purpose is to assess how strongly countries cluster together based on their Ecological Footprints: this is the extent to which the distribution of consumption responds to polarization (as opposed to mere inequality). To assess this, we estimate and decompose different polarization indices for a balanced sample of 119 countries over the period 1961 to 2007. Our results point towards a polarized distribution which is consistent with a core–periphery framework.

Modeling experiential learning: The challenges posed by threshold dynamics for sustainable renewable resource management

- Ecological Economics---2014---Emilie Lindkvist, Jon Norberg

Adaptive management incorporates learning-by-doing (LBD) in order to capture learning and knowledge generation processes, crucial for sustainable resource use in the presence of uncertainty and environmental change. By contrast, an optimization approach to management identifies the most efficient exploitation strategy by postulating an absolute understanding of the resource dynamics and its inherent uncertainties. Here, we study the potential and limitations of LBD in achieving optimal management by undertaking an analysis using a simple growth model as a benchmark for evaluating the performance of an agent equipped with a 'state-of-the-art' learning algorithm. The agent possesses no a priori knowledge about the resource dynamics, and learns management solely by resource interaction. We show that for a logistic growth function the agent can achieve 90% efficiency compared to the optimal control solution, whereas when a threshold (tipping point) is introduced, efficiency drops to 65%. Thus, our study supports the effectiveness of the LBD approach. However, when a threshold is introduced efficiency decreases as experimentation may cause resource collapse. Further, the study proposes that: an appropriate amount of experimentation, high valuation of future stocks (discounting) and, a modest rate of adapting to new knowledge, will likely enhance the

effectiveness of LBD as a management strategy.

Floodplain conservation as a flood mitigation strategy: Examining costs and benefits

- Ecological Economics---2014---Carolyn Kousky,Margaret Walls

There is growing interest in floodplain conservation as a flood damage reduction strategy, particularly given the co-benefits that protected lands provide. We evaluate one such investment—a greenway along the Meramec River in St. Louis County, Missouri. We estimate the opportunity costs, the avoided flood damages, and the capitalization of proximity to protected lands into nearby home prices. To estimate avoided flood damages, we undertake a parcel-level analysis using the Hazus-MH flood model, a GIS-based model developed for FEMA that couples a hydrology and hydraulics model with a damage model relating flood depths to property damage. We examine the distribution of damages across parcels, demonstrating that careful spatial targeting can increase the net benefits of floodplain conservation. In addition, we estimate a hedonic model and find that the increased property values for homes near protected lands are more than three times larger than the avoided flood damages, stressing the continued importance of more traditional conservation values. The proximity benefits alone exceed the opportunity costs; the avoided flood damages further strengthen the economic case for floodplain conservation.

Relationship between urbanization, direct and indirect greenhouse gas emissions, and expenditures: A multivariate analysis

- Ecological Economics---2014---Sanna Alamaantila,Jukka Heinonen,Seppo Junnila

In this paper, we analyze the relationships between Finnish household types and their consumption-based carbon footprints. We calculate footprints by combining expenditure data with life-cycle greenhouse gas emission intensities derived from an environmentally extended input–output model. By applying regression

analysis, we explore the effects of expenditure, urbanity, and household size on total, direct, and indirect emissions. The separate analyses for direct and indirect GHGs provide insights, not previously found in the literature, on the relationship between urbanity and carbon footprints. Holding expenditure constant, a rural lifestyle seems to be related to the highest GHG emissions. However, keeping in mind that the absolute amount of indirect emissions is major to direct emissions from home energy and private driving, the less prominent or even reversed relationship between indirect emissions and urbanity is also worth noting. The existence of household size scale effects depends whether direct or indirect GHGs are explained. We demonstrate that in order to gain a comprehensive understanding of mitigation policies and their effects, not only the averages but the various patterns of direct and indirect emissions must be kept in mind. This paper complements the earlier carbon footprint assessments from the same authors by providing a comprehensive statistical analysis.

Forest owner perceptions of institutions and voluntary contracting for biodiversity conservation: Not crowding out but staying out

- Ecological Economics---2014---Eeva Primmer,Riikka Paloniemi,Jukka Similä,Anna Tainio

Although the concepts of institutions in economics and institutional analysis have been integrated in recent writings about payments for ecosystem services (PES), their joint operationalization and testing have been limited. To tackle this integration challenge, we empirically explore how Finnish non-industrial private forest owners' perceptions about voluntary biodiversity conservation contracting correspond with the institutional theories about PES. Further, we test whether the perceptions are related to PES contracting in the past or in the future. The results of the explorative factor analyses corresponded with the theoretical considerations of both economics and institutional analysis. The logistic regression analyses showed that the factors that related to past contracting differed notably from those

that explained future intentions to contract. Most consistently, perceptions about positive ecological impacts were positively related to past contracting, while social and moral normative perceptions had a negative effect. In other words, those who would conserve nature for altruistic reasons tended not to have entered a contract but rather stayed out. Local and social welfare expectations increased the willingness to contract in the future. Our analysis highlights the importance of normative conservation justifications as well as the expectations regarding non-economic benefits and welfare impacts for PES design and analysis.

Working time reduction policy in a sustainable economy: Criteria and options for its design

- Ecological Economics---2014---Martin Pullinger

Reducing per capita consumption, particularly amongst high income groups, is often deemed necessary to reduce the environmental impacts of the global economy. Far from implying a necessary reduction in wellbeing, some research suggests this could actually improve it: as reduced expenditure means a reduced need for income, and hence paid work, then there is the possibility for average working hours to fall, providing increased leisure time in which to pursue happiness through less consumption-intensive, but more time consuming, ways. To date, however, there has been little critical discussion of the details of what policy might need to cover to allow and encourage substantial working time reduction in a way that successfully reconciles these environmental and wellbeing goals. This article addresses this gap in the literature. It begins by reviewing the conditions under which working time reduction could bring environmental and wellbeing benefits. It then presents examples of innovative voluntary working time policies from the Netherlands and Belgium. Drawing these elements together, the article presents a new “green life course approach” for working time policy design. It argues that, as a complement to more conventional working time policies, this could be a valuable tool to combine environmental and wellbeing goals.

Civil unrest and the poaching of rhinos in the Kaziranga National Park, India

- Ecological Economics---2014---Adrian A. Lopes

Civil unrest and political instability have been associated with endangered species poaching. This paper accounts for a period of civil unrest in Assam, India, which saw a marked increase in rhino poaching. Census data on the greater one-horned rhinoceros (*Rhinoceros unicornis*) in the Kaziranga National Park in Assam are used to estimate a population growth function. In calibrating the growth function's parameters the census data are used in conjunction with rhino poaching data. The rhino population and poaching data are used to econometrically estimate a harvest function. The relationship between civil unrest and rhino poaching is identified as positive and significant. The analysis factors in the probable relationships between poaching and several additional variables — including black market rhino horn prices, potential size of black markets, and anti-poaching efforts. These variables are seen to have the predicted associations with poaching, and help isolate the latter's relationship with civil unrest in the regression models. The goodness of fit between the data on rhino population and poaching and the estimates from regression models are studied.

Ecosystem services as a boundary object for sustainability

- Ecological Economics---2014---D.J. Abson,H. von Wehrden,Stefan Baumgärtner,J. Fischer,J. Hanspach,W. Härdtle,H. Heinrichs,A.M. Klein,D.J. Lang,P. Martens,D. Walmsley

Ecosystem services research has become a major academic field, drawing in various academic disciplines, perspectives, and research approaches. The multifaceted concept of “ecosystem services” includes a normative component, which has strong implicit links to the notion of sustainability. Yet, how ecosystem services research relates to sustainability has received little attention. We reviewed the current state of research on ecosystem services, and examined whether the concept's original motivation has allowed it to act as an

effective boundary object for the integration of the diverse knowledge related to sustainability. A full-text, multivariate statistical analysis of 1388 peer-reviewed publications on ecosystem services from 1997 to 2011 revealed a rapidly growing but fragmented body of research, which has emphasized the development of descriptive understandings of human–nature interactions. Future challenges for the ecosystem services concept include greater integration of currently fragmented knowledge domains and stronger engagement with the concept’s normative foundations.

Do organic farmers feel happier than conventional ones? An exploratory analysis

- Ecological Economics---2014---Naoufel Mzoughi

We examine the relationship between organic farming and subjective well-being or life satisfaction. Applying an ordered probit model to a sample of French farmers located in the Provence-Alpes-Côte d’Azur (PACA) area (Southeast), we find that organic farmers report higher levels of life satisfaction, compared to the conventional ones. Moreover, this positive relationship holds for both recently-converted and earlier-converted farmers. Our findings also show that subjective well-being is positively associated with income, profitability, satisfaction at work, social recognition, and good health.

Payments for ecosystem services and landowner interest: Informing program design trade-offs in Western Panama

- Ecological Economics---2014---Esther Alice Duke, Joshua H. Goldstein, Tara L. Teel, Ryan Finchum, Heidi Huber-Stearns, Jorge Pitty, Gladys Beatriz Rodríguez P., Samuel Rodríguez, Luis Olmedo Sánchez

Experience with payments for ecosystem services (PES) highlights the effects of program design on landowner participation, impacting the program’s ability to achieve environmental and, where applicable, social objectives. We conducted an exploratory study

in western Panama at the initial stage of PES consideration to identify potential landowner interest in PES and factors that would affect landowner interest and eligibility. We report the results from a household survey of 344 farmers and ranchers (92% response rate). Eighty percent of the respondents expressed interest in PES participation. Respondents’ stated interest was significantly related to farm size, income, age, land tenure, and previous involvement in conservation. We also found that alternative specifications for landowner eligibility requirements, targeting criteria, and other parameters could greatly affect landowners’ ability to participate, most strongly for respondents lower in socioeconomic status. We provide a framework for exploring potential landowner interest in PES at the very first stage of program exploration, from which program design can be strategically advanced with realistic PES scenarios to explore efficient payment levels and projected environmental benefits. Our findings highlight the importance of making explicit trade-offs that result from alternative PES design choices in affecting landowners’ interest and eligibility to participate.

Innovation complementarity and environmental productivity effects: Reality or delusion? Evidence from the EU

- Ecological Economics---2014---Marianna Gilli, Susanna Mancinelli, Massimiliano Mazzanti

Innovation is a key element behind the achievement of desired environmental and economic performances. Regarding CO₂, mitigation strategies would require cuts in emissions of around 80–90% with respect to 1990 by 2050 in the EU. We investigate whether complementarity, namely integration, between the adoption of environmental innovation measures and other technological and organizational innovations is a factor that has supported reduction in CO₂ emissions per value added, that is environmental productivity. We merge new EU innovation and WIOD data to assess the innovation effects on sector CO₂ performances at a wide EU level. We find that jointly adopting different innovations is not a widespread factor behind

increases in environmental productivity. Nevertheless, even though complementarity is not a low hanging fruit, a case where ‘innovation complementarity’ arises is for manufacturing sectors that integrate eco-innovations with product innovations. One example of this integrated action is a strategy that pursues energy efficiency with product value enhancement. We believe that the lack of integrated innovation adoption behind environmental productivity performance is a signal of the current weaknesses economies face in tackling climate change and green economy challenges. Incremental rather than more radical strategies have predominated so far. The latter have been confined to industrial ‘niches’, in terms of the number of involved firms. This is probably insufficient when we look at long-term economic and environmental goals.

Lessons from resource management by indigenous Maori in New Zealand: Governing the ecosystems as a commons

- Ecological Economics---2014---Viktoria Kahui, Amanda C. Richards

The paradigm shift to holistic management rests on the insight that exploitation affects all aspects of the ecosystem. While scholars and policy-makers all want ecosystem based management (EBM), few, if any, have achieved it in practice. Adaptive governance promises effective EBM, but guidance remains elusive. Looking back to an ecosystem people such as the indigenous Maori in the south of New Zealand and analyzing their resource management system using Ostrom’s (1990) eight-principle framework for common property rights regimes allows us to answer three central questions. How did Ngai Tahu, the dominant tribe on the South Island, manage the complex linkages, uncertainty and interactions with nature while exploiting their environment? Was resource exploitation sustainable? And what can be drawn from their management system for modern governance structures? The application of Ostrom’s framework shows that kaitiakitanga (stewardship) as an integrated management system generally aligns with the principles necessary for successful EBM and provided Ngai Tahu with the necessary tools to

control and adapt measures across space and time, mirroring the modern tenets of adaptive management. Studying a people that practiced EBM successfully provides the insight that EBM may be achieved by governing ecosystems through an integrated common property management system.

Who gets what in environmental policy?

- Ecological Economics---2014---Dirk J. Wolfson

This paper shows how anticipated impacts of environmental projects and policies can be valued in terms of money as a common denominator, and costs and benefits assigned in an acceptable distribution. To that effect, a new mechanism design of situational contracting is introduced that generates information on willingness and ability to pay or to cooperate, in a realization-focused capability approach to fairness. The situational contract reveals preferences and merit considerations of the relevant stakeholders and deals with market failure in a structured combination of political guidance, expert opinions and co-production.

Agricultural public policy: Green or sustainable?

- Ecological Economics---2014---Lauriane Mouysset

The future of agriculture constitutes a major challenge to the achievement of sustainable development. There are new perspectives on greening (focusing on ecological objectives) and sustainability (combining both ecological and social goals). Academic papers mainly study the ecological efficiency of agricultural public policies, while real public policies, such as the European Common Agricultural Policy, examine both ecological and social considerations. The objective of this paper is to consider economic, social and ecological objectives within the design of agricultural public policies. Using a bio-economic model applied to France, we compare different optimal public strategies. We show that, when the biodiversity objectives are either very limited or very demanding, grassland subsidies are the best instruments from both green and sustainable points of view. However for medium objectives, reducing crops subsidies is the cheapest way to green the CAP, while

subsidies on grasslands are the only strategy from a sustainability perspective. Our work highlights new trade-offs related to policy implementation, such as social acceptance or technical difficulties, and the spatial equity of performance among regions.

Do non-users value coral reefs?: Economic valuation of conserving Tubbataha Reefs, Philippines

- Ecological Economics---2014---Rodelio F. Subade, Herminia A. Francisco

The main purpose of the study is to determine whether non-use values exist among residents of Quezon City, hundreds of kilometers away from Tubbataha Reefs. The dichotomous choice contingent valuation method (CVM) was employed across 800 randomly selected respondents, 400 of which were personally interviewed (PI) and 400 were asked to accomplish self-administered (SA) questionnaires, 198 of the latter were found useable for the study. Results showed that 46% of all respondents were willing to pay for conservation of the reefs, with bequest motive or concern for future generations as their main reason. The mean WTP ranged from 437 pesos for PI respondents to 233 pesos for SA respondents. These substantial non-use values justify the need for regular government appropriation for conserving Tubbataha Reefs.

Is Amartya Sen's sustainable freedom a broader vision of sustainability?

- Ecological Economics---2014---Thierry Demals, Alexandra Hyard

For several years now, the theme of sustainable development (thereafter “SD”) has been approached through the capability approach (CA). Recently this notion has been used by Sen to propose a redefinition of SD in terms of “sustainable freedom” (SF), meaning: enjoying the actual freedom to choose a standard of living rather than another without affecting negatively the freedom of generations to come. For Sen, this concept is aimed at broadening current understanding of SD. This article seeks to show that Sen's broader concept

of sustainability whilst it generates many questions has not actually expanded the concept itself.

Distribution of income and toxic emissions in Maine, United States: Inequality in two dimensions

- Ecological Economics---2014---Rachel Bouvier

Ecological distribution refers to inequalities in the use of environmental sinks and sources. This article explores one such dimension of ecological distribution — that of toxic air emissions. Using data from the Risk-Screening Environmental Indicators model and the United States Census Bureau, I analyze the distribution of both environmental risk and income at the block-group level in the state of Maine. The state of Maine was chosen for its historical dependence upon natural resources as well as its economic and spatial heterogeneity. Results clearly indicate that the toxic air emissions are distributed much more unequally than is income, and that those inequalities are reinforcing. While not in itself an indication of environmental injustice, such analyses may help us to rethink the assumption that there is a tradeoff between income and pollution.

Unveiling the dynamic relation between R&D and emission abatement

- Ecological Economics---2014---Massimiliano Corradini, Valeria Costantini, Susanna Mancinelli, Massimiliano Mazzanti

This paper examines investment decisions regarding innovation and emissions abatement in a dynamic framework, where knowledge stock is an impure public good. We take a sector perspective based on neo Schumpeterian theory that emphasises the role of both sector and innovation systems. We interpret results taking into account sector and country based institutional, market and policy conditions. Econometric outcomes, based on an original sector dataset which exploits the NAMEA source for 15 European Union (EU) countries and 23 manufacturing sectors in the time frame 1995–2006, show that innovation efforts are positively correlated

to various spillover effects. Those effects include the emissions abatement of the other sectors, thus pointing out the relevance of forces which oppose typical free riding behaviour in public or mixed public good frameworks. Different reactivity strengths for different global and local emissions also allow us to disclose the specific role of technological and economic complementarity. When considering CO₂ emissions, innovation is mainly triggered by national interactions, a fact which is coherent with a dominance of national innovation and policy systems in the EU. The result is also consistent with the fact that CO₂ abatement technologies heavily regard energy efficiency that provides joint private and public benefits. The fact that NMVOC abatement efforts by other sectors from abroad impact R&D investments positively means that, in some cases, a realm of sectoral systems of innovation is also relevant. The different evidence between local and global externalities is surely explained not only by the different technological and economic contents, but also by the fact that the EU has witnessed different policy implementation.

Solutions to the crisis? The Green New Deal, Degrowth, and the Solidarity Economy: Alternatives to the capitalist growth economy from an ecofeminist economics perspective

- Ecological Economics---2014---Christine Bauhardt

This article deals with three approaches conceived as alternative approaches to the capitalist growth economy: the Green New Deal, Degrowth, and the Solidarity Economy. Ecofeminist economics has much to offer to each of these approaches, but these contributions remain, as of yet, unrealized. The Green New Deal largely represents the green economy, which holds economic success as contingent upon the ecological restructuring of industrial production. The degrowth approach more fundamentally raises questions concerning the relationship between material prosperity and individual and social well-being. The principles of the solidarity economy involve the immediate implementation of the principles of self-determination and cooperation. None of these approaches takes into ac-

count the claims of ecofeminist economics; and none of them clearly view gender equity as essential to economic change. The three approaches are, however, deeply gendered in the sense that they are implicitly based on assumptions concerning women's labor in the sphere of social reproduction. This article demonstrates how each approach can be improved upon by the integration of ecofeminist economic principles in order to achieve economic change that also meets claims for gender equity.

Balance issues in monetary input–output tables

- Ecological Economics---2014---Stefano Merciai, Reinout Heijungs

Input–output tables (IOTs) are widely used in several types of analyses. Although born in an economic context, IOTs are increasingly used for the environmental impact assessment of product systems, e.g. in environmental policy analysis, and for several others such as the accounting of greenhouse gases.

Greenhouse gas emissions and subjective well-being: An analysis of Swedish households

- Ecological Economics---2014---David Andersson, Jonas Nässén, Jörgen Larsson, John Holmberg

In the contemporary discussion on society's transformation towards long-term climate targets, it is often implicitly assumed that behavioral changes, unlike technological changes, would lead to reductions in human well-being. However, this assumption has been questioned by researchers, who instead argue that people may live better lives by consuming less and reduce their environmental impact in the process. In this study we explore the relationship between greenhouse gas emissions and subjective well-being, using a sample of 1000 Swedish respondents.

Integrating life-cycle assessment and choice analysis for alternative fuel valuation

- Ecological Economics---2014---Matthew Winden, Nathan Cruze, Tim Haab, Bhavik Bakshi

This study monetizes the environmental damage and human health risk externalities associated with the life-cycle production and use of ethanol biofuels from corn-based and cellulosic feedstocks. An integrated economic-environmental assessment framework couples the measured emission impacts from the fuels with individuals' preferences regarding each fuel's externalities. This framework allows the welfare values associated with gasoline and ethanol's externalities to be derived and compared. The results of the study reveal that the production and consumption of corn starch ethanol produce declines in environmental and health outcomes of \$1.23 per gallon relative to gasoline for an 85% blend. Depending on the feedstock source, cellulosic based ethanol blends produce modest gains in environmental and health outcomes valued at between \$0.04 and \$0.06 per gallon relative to gasoline.

Using a coupled behavior-economic model to reduce uncertainty and assess fishery management in a data-limited, small-scale fishery

- Ecological Economics---2014---Liam M. Carr, William D. Heyman

This paper examines how fishers' ecological knowledge (FEK) and the analysis of their decision-making process can be used to help managers anticipate fisher behavior and thus be able to efficiently allocate scarce resources for monitoring and enforcement. To examine determinants of fisher behaviors, this study develops a coupled behavior-economic model examining how physical, market, and regulatory forces affect commercial fishers' choice of fishing grounds in a small-scale fishery (SSF) in St. Croix, U.S. Virgin Islands. The model estimates that fishing operations land $\$396 \pm 110$ per trip (mean ± 1 SD; $n=427$ trips), with the highest value in landings arriving from Lang Bank. The model explains 62% of the variation in fishers' choice to fish at Lang Bank, the most productive, yet farthest fishing grounds. The coupled behavioral-economic model is focused on the small temporal and spatial scales of fishing effort and FEK in an SSF. Therefore the model can be used to predict how a range of physical and

regulatory conditions and changes in demand will drive overall (fleet) fishing effort allocation in space and time. By illustrating and quantifying these social-ecological causes and effects, the model can assist managers to efficiently allocate limited monitoring and enforcement resources.

Erosive runoff events in the European Union: Using discrete choice experiment to assess the benefits of integrated management policies when preferences are heterogeneous

- Ecological Economics---2014---Romain Crastes, Olivier Beaumais, Ouerdia Arkoun, Dimitri Laroutis, Pierre-Alexandre Mahieu, Bénédicte Rulleau, Salima Hassani-Taïbi, Vladimir Stefan Barbu, David Gaillard

This paper assesses the value of mitigating erosive runoff events in a severely prone watershed of France using a discrete choice experiment approach. Good farming practices are integrated together with flood protection programs within a common management policy. The inclusion of risk exposure and socio-demographic variables in a random parameter logit model allows accounting for both latent and observed heterogeneity in preferences. Results show substantial benefits for each of the management alternatives valued. Results also identify that preferences significantly vary across respondents which suggests that policy makers should consider heterogeneity in preferences when designing policies for various area profiles in order to closely monitor welfare improvements.

To shut down or to shift: Multinationals and environmental regulation

- Ecological Economics---2014---Helen Naughton

According to the pollution haven effect mobile capital responds to environmental regulation by moving from countries with high regulation to countries with low regulation. Previous tests of the pollution haven effect focus on host country regulation effect. This study also examines the effect of home country regulation on foreign direct investment (FDI). Using a panel of 28

OECD countries for 1990–2000 to estimate host and home country environmental regulations' effect on FDI, this study finds that host regulation decreases FDI. In contrast, home environmental regulation increases FDI at low levels of home regulation and decreases FDI at high levels of home regulation.

Adapting to the impacts of global change on an artisanal coral reef fishery

- Ecological Economics---2014---Iliana Cholett, Steven W.J. Canty, Stephen J. Box, Peter J. Mumby

When assessing future changes in fishing, research has focused on changes in the availability of the resource. Fishers' behaviour, however, also defines fishing activity, and is susceptible not only to changes in weather but also to changes in the economy, which can be faster and more ubiquitous. Using a novel modelling approach and spatially explicit predictors we identified the current drivers of artisanal fishing activity and predicted how it is likely to change in 2025 and 2035 under two climate and two economic scenarios. The model is effective at explaining the activity of fishers (AUC=0.84) and suggests that economic variables overwhelm the importance of climate variables in influencing the decisions of fishers in our case study area (Utila, Honduras). Although future changes in the overall incidence of fishing activity are modest, decreases in the number of accessible fishing grounds with projected increases in fuel prices will increase localised fishing effort depleting fish resources near the port. Compelling adaptation strategies in the area require the intervention of the market chain to make the sale price of fish more responsive to fuel price fluctuations and changes in fishing behaviour to improve fuel efficiency, including the revival of traditional ways of fishing.

Migration and fuel use in rural Mexico

- Ecological Economics---2014---Dale Manning, J. Edward Taylor

Many households in developing countries rely on renewable natural resources as their main source of energy. Collecting and burning firewood requires a considerable amount of time, has negative health consequences, and can cause deforestation and depletion of local resources if forests are not properly managed. A transition from traditional to modern fuels can benefit households by reducing these negative effects. Migration, a quintessential feature of development, may facilitate this transition, but its impacts on fuel choice are theoretically ambiguous. It can reduce the household labor available for firewood collection and provide cash to purchase substitutes; however, it has an income effect that changes the demand for home-cooked food and energy to cook it. Firewood or gas could be used to meet the increase in energy demand. To resolve this theoretical ambiguity, we use an instrumental-variables method with household panel data from rural Mexico and investigate the impact of Mexico-to-US migration and remittances on gas expenditures and household labor allocated to firewood collection. Sending a migrant to the United States causes a significant decrease in reliance on firewood collection and an increase in both stove and gas purchases. These findings have potentially far-reaching environmental implications as labor moves off the farm.

Intellectual mercantilism and franchise equity: A critical study of the ecological political economy of international payments for ecosystem services

- Ecological Economics---2014---Katharine Farrell

This text addresses the ecological political economy of international payment for ecosystem services (IPES). Taking the United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD) as a case in point, it asks: in what ways may IPES schemes impinge upon the political and economic autonomy of local and indigenous peoples in tropical countries? It is argued that PES schemes like REDD should be assessed not only with respect to questions of distributional equity (does everyone have enough pie?) but also with respect to franchise equity (does everyone want

pie?) and that failure to take questions of franchise equity into account in IPES schemes reflects a form of intellectual mercantilism, where wealth transfers from new economies to old ones are achieved by redefining existing locally available resources as internationally tradable speculative commodities. This proposition is considered through exploration of two illustrative cases – the REDD+ Social and Environmental Standards (REDD+ SES) and the Yasuní-ITT initiative – and through normative political theory recommendations building on Dryzek and Stevenson’s discussion of deliberative systems, regarding how it might be possible to ensure franchise equity within REDD+ in particular and within global environmental governance, more generally.

Quantifying ecosystem services trade-offs from agricultural practices

- Ecological Economics---2014---Marit Kragt,Michael J. Robertson

The concept of ecosystem services (ESS) is widely used to highlight the interdependencies between agricultural and environmental systems. However, few studies have attempted to quantify the potential of agriculture to produce multiple ESS, and to estimate the possibilities for joint production of marketed and non-marketed ESS. A quantification of the trade-offs between non-marketed ESS and production of farm commodities (marketed ESS) may help to better target agricultural policies.

Discounting, climate and sustainability

- Ecological Economics---2014---Erling Moxnes

Climate policy recommendations differ widely because of disagreements over what discount rates to use. Disagreement reduces the impact of economic models and signals a need for improved methodology. The problem is related to the choice of intergenerational welfare functions. A first questionnaire finds that the standard welfare function (SWF) fails to capture people’s dislike of overshooting and fluctuating consumption paths. A second questionnaire reveals that when very-long-term

sustainability of well-being is threatened, people’s implicit discount rates resemble the low estimates used by the Stern Review. An alternative welfare function (AWF) reflecting consumption growth can potentially capture the preference structure revealed in both questionnaires. This makes the AWF an interesting candidate when searching for policies for sustainable development under uncertainty. Importantly, the questionnaires demonstrate that people are able to choose among policies by inspecting time graphs of policy consequences. Thus, it is possible to circumvent the complexities and disagreements introduced by welfare functions and discounting.

The ‘Environmentalism of the Poor’ revisited: Territory and place in disconnected glocal struggles

- Ecological Economics---2014---Isabelle Anguelovski,Joan Martínez Alier

In 2002, the year it was published, *The Environmentalism of the Poor* was one of the first books examining in a multidisciplinary perspective three parallel environmental movements around the world. Eleven years later, we re-examine these movements – the Cult of Wilderness, the Gospel of Eco-Efficiency and the Mantra of Environmental Justice, – focusing on the increased visibility of struggles representing Environmental Justice and *The Environmentalism of the Poor*. Even if they are often disconnected from an organizational standpoint, glocal manifestations of resistance have emerged since the 1990s. Today, environmental movements assert common values related to place, identity, and culture. Activists’ concepts such as ecological debt, environmental justice, environmental liabilities, land grabbing, environmental gentrification, corporate accountability, climate justice, food sovereignty, or economic degrowth are the keywords of the networks of the global Environmental Justice movement. At the same time, such concepts support the rural and urban movements that remake place for marginalized groups, re-assert traditional practices, and protect territory from contamination, land appropriation, and real estate speculation. Some possibilities exist for

cooperation between Environmental Justice and the other varieties of environmentalism. Here, comparative research can help unravel the use of valuation languages different from “green” economic growth or sustainable development.

Dynamics and determinants of energy intensity in the service sector: A cross-country analysis, 1980–2005

- Ecological Economics---2014---Peter Mulder, Henri de Groot, Birte Pfeiffer

We present a detailed analysis of energy intensity developments across 23 service sectors in 18 OECD countries over the period 1980–2005. We find that the shift towards a service economy has contributed to lower overall energy intensity levels in the OECD, but this contribution would have been considerably larger if the service sector had realized the same degree of energy efficiency improvements as the manufacturing sector. In most OECD countries energy intensity levels in services tend to decrease relatively slow, especially after 1995. If we control this trend for the impact of structural changes within the services sector – by means of a decomposition analysis – we find that in about one-third of the OECD countries, energy intensity levels in services have increased over time. The impact of structural changes on aggregate energy intensity dynamics in services has increased considerably after 1995, highlighting a relatively poor energy efficiency performance within a wide range of service sectors. We show that the introduction of Information and Communication Technology (ICT) plays a potentially important role here. Using panel data regression analysis, we find a limited role for energy prices in explaining variation in energy productivity, while climate conditions clearly impact energy productivity.

How green is my firm? Workers’ attitudes and behaviors towards job in environmentally-related firms

- Ecological Economics---2014---Joseph Lanfranchi, Sanja Pekovic

The implementation of environmental standards can be facilitated by motivating workers with pro-social preferences. Therefore, we study if employees working for firms achieving registration for environmental-related standards are more likely to display positive attitudes towards their job, to be actively involved in their jobs and to donate effort. Using a French matched employer–employee database, we find that these “green employees” report a significantly higher perception of usefulness and equitable recognition at work. Besides, they are more likely to work uncompensated overtime hours. Finally, if the adoption of environmental standards is shown to have no direct influence on job involvement, we expose how it indirectly impacts job involvement through the mediation of employees’ reported perception of usefulness and equitable recognition at work.

Exploring an environmental conflict from a capability perspective

- Ecological Economics---2014---Yuliana Griewald, Felix Rauschmayer

Using the capability approach, we analyse a recent environmental conflict in the city of Leipzig, Germany. Following its concept of flood protection, a state authority felled thousands of trees in a highly popular nature protection area, which culminated in public protests and lawsuits. In analysing this conflict, we pursue a twofold aim: (1) to better understand the conflict at hand, and (2) to explore the advantages and limitations of using the capability approach for addressing an environmental conflict involving collective actors. We use qualitative research methods to examine the case, relying upon semi-structured interviews with key stakeholders as well as a document analysis. The freedom-agency lens of the capability approach proves helpful in analysing the actors’ positions and interplay in the conflict. However, its limitations also become visible. We suggest that one should go beyond the variables included in a typical capability generation framework to understand the case better: certain variables need to be elaborated in more detail while some further variables need to be added to the framework.

The economic and environmental impact of a carbon tax for Scotland: A computable general equilibrium analysis

- Ecological Economics---2014---Grant Allan,Patrizio Lecca,Peter McGregor,John Swales

Using a disaggregated energy–economy–environmental model, we investigate the economic and environmental impact of a Scottish specific carbon tax under three alternative assumptions about the use of the revenue raised by the tax: revenues raised are not recycled within Scotland; revenues are used to increase general government expenditure or to reduce Scottish income tax. We find that by imposing a tax of £50 per tonne of CO₂ the 37% CO₂ reduction target is met with a very rapid adjustment in all three cases if the model incorporates forward-looking behaviour. However, the adjustment is much slower if agents are myopic. In addition, the results of the model suggest that a carbon tax might simultaneously stimulate economic activity whilst reducing emissions and thus secure a double dividend, but only for the case in which the revenue is recycled through income tax.

The added value from a general equilibrium analysis of increased efficiency in household energy use

- Ecological Economics---2014---Patrizio Lecca,Peter G. McGregor,John Swales,Karen Turner

This paper investigates the economic impact of a 5% improvement in the UK household energy efficiency, focussing specifically on total energy rebound effects. The impact is measured through simulations using models that have increasing degrees of endogeneity but are calibrated on a common data set, moving from a basic partial equilibrium approach to a fully specified general equilibrium treatment. The size of the rebound effect is shown to depend on changes in household income, aggregate economic activity and relative prices that can only be captured through a general equilibrium model.

Firm-level ecosystem service valuation using mechanistic biogeochemical modeling and functional substitutability

- Ecological Economics---2014---Stephen D. Comello,Gabriel Maltais-Landry,Benedict R. Schwegler,Michael D. Lepech

Increasingly, private firms are focusing on environmental sustainability. However, such entities continue to experience difficulty in operationalizing sustainable practices in management decisions. For firms that own natural ecosystems, part of the difficulty stems from their inability to balance the environmental value of conserving these ecosystems against potential profits that could be captured through their development. To overcome this, we present a new comparative framework for natural and engineered systems, which allows for a rigorous valuation of ecosystem services based on functional equivalence with engineered systems. This framework allows for the opportunity of such value to be represented within international accounting standards, thus aligning biological ecosystem service valuation with current, rigorous, accepted accounting norms. Looking specifically at the removal of phosphorus via wetland, we characterize an ecosystem service using a mass-balance mechanistic biogeochemical model. We then simulate the ecosystem performance under various loading conditions to determine the limit state for which the wetland can perform the service of phosphorus removal in the long-term. Finally, using functional substitutability, we apply an appropriately scaled price of the engineered equivalent system to determine a market-based value of the ecosystem service. As a demonstration, we apply this methodology to an estuary located in Southern California.

Trajectory economics: Assessing the flow of ecosystem services from coastal restoration

- Ecological Economics---2014---Rex H. Caffey,Hua Wang,Daniel Petrolia

Monetized estimates of ecosystem services are increasingly cited as partial justification for a wide range of

environmental restoration initiatives, yet parallel applications of these values in performance assessment have been limited. Incorporated into traditional economic models, such values can offer potential insight on programmatic efficiency and help to inform policy tradeoffs within and between competing methods. For this analysis, acreage trajectories and cost functions are developed for dredge- and diversion-based land reclamation methods in coastal Louisiana, USA. Benefit–cost models are constructed from which ecosystem service values are initially derived via break-even analysis and then specified to inform comparative case studies. Results indicate that the minimum service value required to offset project expenditures is typically higher for “natural” diversion-based restoration relative to “rapid” dredge-based methods under historic project conditions. Accounting for climatological and socioeconomic risks widens this gap, with benefit–cost ratios for dredge-based reclamation exceeding that of diversions in 16 benefit–cost simulations conducted over a 50-year project horizon. Taken together, these results highlight the influence of time and risk in the assessment of competing project alternatives, and suggest the need to reframe restoration efficiency in terms of the aggregate flow of ecosystem services, versus the per unit costs of terminal stocks.

Assessing the potential demand for biofuel by combining Economics and Psychology: A focus on proximity applied to Jatropha oil in Africa

- Ecological Economics---2014---Dorian Litvine,Laurent Gazull,Marie-Hélène Dabat

Bio-energy demand is known to be influenced by geographical origin and social equity. This paper aims to highlight the influence of the proximity between biomass production and energy consumption on the demand for alternative bio-fuels. In the context of Burkina Faso, we explore potential demand for Jatropha oil (*Jatropha curcas*) as a diesel substitute among engine owners. Survey data are based on a between-groups design: one group of respondents experiencing a local supply chain, while the other a global one. Results show that proximity has a significant effect on poten-

tial demand itself and on the formation and strength of beliefs regarding Jatropha oil. In a local supply chain context, the demand is superior and seems to be guided more by a certain economic and technical rationality. Conversely, the prospect of a Jatropha oil produced outside the village restrains demand and this latter is more determined by contextual factors and social interaction. Our analysis confirms that demand does not only depend on technical and economic factors such as price but also on the integration of the biomass production and processing in the socioeconomic life of local rural populations. Understanding demand construction and assessing underlying beliefs are key success factors for bio-energy projects.

The effect of globalisation on water consumption: A case study of the Spanish virtual water trade, 1849–1935

- Ecological Economics---2014---Rosa Duarte,Vicente Pinilla,Ana Serrano

This paper aims to analyse the impact on water consumption of trade expansion in the first era of globalisation. To that end, we have chosen the case of Spain, a semi-arid country with significant cyclical water shortages.

Long-term impacts of major water storage facilities on agriculture and the natural environment: Evidence from Idaho (U.S.)

- Ecological Economics---2014---Zeynep K. Hansen,Scott E. Lowe,Wenchao Xu

This paper investigates the long-term impacts of water storage infrastructure (dams) on agriculture and the natural environment in the semi-arid U.S. West. We conduct an empirical analysis of the agricultural impacts associated with major dams in Idaho, focusing on their crop mixes, crop productivities, and overall agricultural land values using an integrated county-level repeated cross section dataset. Our results suggest that the presence of a dam resulted in significant increases in total crop acreage, particularly in those counties in which farmers have predominantly junior

water rights. Dams led to an increase in the acreage of the higher-valued, more water-intensive crops and positively impacted some crop productivities, particularly during periods of severe droughts. In contrast to the traditional literature, we find that the presence of a dam had a small, positive, but non-significant effect on farmland values. Finally, we evaluate long-term patterns in stream flow change and examine the impacts of dams on the natural environment. We find that the presence of dams enabled the spatiotemporal transfer of water resources from cold (non-agricultural) to warm (agriculturally-intensive) seasons, reduced the potential availability of water resources for ecosystem use, and increased the seasonal volatility in water supplies.

A soil change-based methodology for the quantification and valuation of ecosystem services from agro-ecosystems: A case study of pastoral agriculture in New Zealand

- Ecological Economics---2014---E. Dominati,A. Mackay,S. Green,M. Patterson

This paper tests the steps required to transform a theoretical natural capital/ecosystem service framework for soils into an operational model. Each of the services provided by a volcanic soil under a pastoral dairy use are quantified and valued. The six guiding principles underpinning the method developed include differentiating soil services from supporting processes; identifying key soil properties and processes behind each service; distinguishing natural capital from added/built capital; identifying how external drivers affect natural capital stocks; analysing the impact of degradation processes on soil properties and basing the economic valuation on measured proxies. Proxies to quantify ecosystem services focus on the part played by soil in generating each service. This new approach highlights the importance of soil change in quantifying services, and goes beyond simply determining the status of soil natural capital. The total value of the ecosystem services provided by a volcanic soil under dairy in the Waikato region in New Zealand was estimated at \$16,390/ha/year on average over 35 consecutive years. The services with the highest value were the filtering

of nutrients and contaminants (58–63% of total value), followed by the provision of food and then flood mitigation. Regulating services had an economic value 2.5 times more important than provisioning services.

Time preferences and the management of coral reef fisheries

- Ecological Economics---2014---Ayana Elizabeth Johnson,Daniel Saunders

To investigate a potential relationship between financial and marine resource use decisions, we conducted a time preference experiment with 153 fishers and 197 SCUBA divers on Curaçao and Bonaire. The experiment was part of a socioeconomic survey wherein interviewees were asked about their fishing and diving practices, views on fish population and coral reef health, and preferred marine resource management approaches. We use a β δ -model to identify discounting and present bias. Divers had a mean individual discount factor (IDF) of 0.91, significantly higher than fishers' mean of 0.82. Fishers and divers had similar distributions of IDFs and present bias; overall 66% of interviewees were non-biased, 22% future-biased, and 12% present-biased. IDFs and present bias were able to predict management preferences after controlling for demographic factors. However, the effect of discount factors is unique to divers, and the effect of present bias is concentrated among fishers on Curaçao. Differences in time preferences between fishers and divers should be considered when developing management strategies. Transfer payments from the dive industry could facilitate a transition to sustainable fishing practices. Establishing property rights alone may not be sufficient for ensuring sustainability if fishers are present-biased and greatly discount the future.

Does trading non-timber forest products drive specialisation in products gathered for consumption? Evidence from the Brazilian Amazon

- Ecological Economics---2014---Carla Morsello,Juliana Aparecida da Silva Delgado,Thiago Morello,Alice Dantas Brites

Diversification is a hallmark of family-based rural production, but what happens when autarkic rural communities integrate into markets? Economic theory predicts that households will maintain diversified strategies when faced with risk; however, many studies have claimed that openness to markets drives specialisation to enhance returns. Nevertheless, there is little evidence about the association between trade in non-timber forest products (NTFPs) and the diversity of NTFPs consumed. Relying on a household survey and systematic observations of Brazilian Amazonian Caboclos, we evaluated whether exposure to NTFP markets (effort and cash income) correlates with the diversity of NTFPs consumed (richness and Simpson diversity). The results were conflicting. First, there was variation across NTFP subtypes: although the variety (richness) of terrestrial NTFPs consumed (vegetables and hunted animals) was greater in households trading NTFPs, the richness of fish consumed was lower because fishing could not be pursued concurrently with activities related to NTFP trade. Second, the observed effects differed across indicators of diversity, which shows that intensification in the use of a few resources may occur. Third, the associations with alternative definitions of exposure to the NTFP market also differed. These results indicate that NTFP markets do not necessarily undermine local consumption diversity.

The German energy transition as a regime shift

- Ecological Economics---2014---Sebastian Strunz

In this paper, I use the resilience framework to interpret the project of transforming the German energy system into a renewable energy sources (RES)-based system, the so-called *Energiewende*, as a regime shift. This regime shift comprises several transformations, which are currently altering the technological, political and economic system structure. To build my argument, I first sketch how technological, political and economic developments reduced the resilience of the conventional fossil-nuclear energy regime and created a new RES-regime. Second, I depict recent changes in German public discourse and energy policy as the shift to the RES-regime. Third, I highlight the challenges involved

with increasing the resilience of the RES-regime. In particular, sufficient resilience of the electricity transmission grid appears to be crucial for facilitating the transformation of the whole energy system.

A multi-regional input–output analysis of domestic virtual water trade and provincial water footprint in China

- Ecological Economics---2014---Chao Zhang, Laura Diaz Anadon

China's booming economy has brought increasing pressures on its water resources. The water scarcity problem in China is characterized by a mismatch between the spatial distributions of water resources, economic development and other primary factors of production, which leads to the separation of production and consumption of water-intensive products. In this paper, we quantify the scale and structure of virtual water trade and consumption-based water footprints at the provincial level in China based on a multi-regional input–output model. We found that virtual water withdrawals and consumption embodied in domestic trade amounts to 184billionm³ and 101billionm³ in 2007, respectively, which is equivalent to 38% and 39% of national total fresh water withdrawals and consumption, respectively. Virtual water trade embodied in domestic trade is about two times as much as virtual water embodied in China's international exports. Water footprint in all four municipalities, i.e., Beijing, Tianjin, Shanghai and Chongqing, depends heavily on virtual water inflow from other provinces. China has a north-to-south net VWT pattern which is roughly the opposite of the distribution of its water resources. In addition to water efficiency improvement measures, re-shaping the water-trade nexus can be a significant complementary tool to address local water scarcity problems.

An intertemporal approach to measuring environmental performance with directional distance functions: Greenhouse gas emissions in the European Union

- Ecological Economics---2014---Andres Picazo-Tadeo, Juana Castillo-Giménez, Mercedes Beltrán-Esteve

The impact of economic activity on the environment is a matter of growing concern for firm managers, policy-makers, researchers and society as a whole. Building on previous work by Kortelainen (2008) [Dynamic environmental performance analysis: A Malmquist index approach. *Ecological Economics* 64, 701–715], we contribute an approach to assessing intertemporal environmental performance at the level of the management of specific pollutants, as the result of change in eco-efficiency and environmental technical change, which identify catching-up with best available environmental practices and eco-innovation, respectively. In doing so, we use Data Envelopment Analysis techniques, directional distance functions and Luenberger productivity indicators. Our approach is employed to assess environmental performance in the emission of greenhouse gases in the European Union-28 over the period 1990–2011. The main result is that environmental performance has been boosted by environmental technical change rather than by increases in eco-efficiency, although with certain differences among air pollutants. Accordingly, policy measures aimed at enhancing eco-efficiency are recommended to improve environmental performance in European countries regarding greenhouse gas emissions.

Decomposing inequality in CO2 emissions: The role of primary energy carriers and economic sectors

- Ecological Economics---2014---Nicole Grunewald, Michael Jakob, Ioanna Mouratiadou

Emission inequality across countries and the contribution of the energy mix and the sectoral composition of a country's energy use are of central importance

to the climate debate. We analyze the evolution of inequality in global CO₂ per-capita emissions using both historical data on energy-related CO₂ emissions and future emission scenarios generated with the integrated assessment model REMIND. Within our sample of 90 countries the results indicate that the Gini index declined from about 0.6 in 1971 to slightly above 0.4 in 2008. A decomposition of the Gini index of total emissions into primary energy carriers indicates that this reduction is mainly attributed to declining shares of emissions from coal/peat and oil in total emissions, and decreasing emission inequality within all fossil primary energy sources. From the perspective of economic sectors, the decline in overall inequality is almost entirely due to a decline of the contribution of emissions from manufacturing & construction. Our analysis also suggests that an equally spread emission reduction from any one source would not have a major impact on overall emission inequality. The analysis of future scenario data indicates that climate policy reduces absolute emission inequality, while inducing drastic progressive emission reductions in all regions.

Are younger generations higher carbon emitters than their elders?

- Ecological Economics---2014---Lucas Chancel

Proper understanding of the determinants of household CO₂ emissions is essential for a shift to sustainable lifestyles. This paper explores the impacts of date of birth and income on household CO₂ emissions in France and in the USA. Direct CO₂ emissions of French and American households are computed from consumer budget surveys, over the 1980–2000 time period. Age Period Cohort estimators are used to isolate the generational effect on CO₂ emissions — i.e. the specific effect of date of birth, independent of the age, the year and other control variables. The paper shows that French 1935–55 cohorts have a stronger tendency to emit CO₂ than their predecessors and followers. The generational effect is explained by the fact that over their lifespan, French baby boomers are better off than other generations and live in energy and carbon inefficient dwellings. In the USA, the absence of a gen-

erational effect on CO₂ emissions can be explained by the fact that intergenerational income inequalities are weaker than in France. Persistence of the generational effect once income and housing type is controlled for in France can be explained by the difficulty for French 1935–55 cohorts to adapt to sober energy consumption patterns.

A ‘component-based’ approach to discounting for natural resource damage assessment

- Ecological Economics---2014---Edi De-francesco, Paola Gatto, Paolo Rosato

The paper proposes a ‘component-based’ approach to guide the choice of the social discount rate in natural resources damage assessment, where time and discounting are key features. It is a multi-rate discounting scheme, which draws on concepts from dual-rate and time-declining approaches. Each damage component is discounted at a component-specific constant rate, related to its time-trajectory. Assuming a normatively defined declining schedule of rates as a starting reference, components with longer time profiles – generally represented by welfare losses – are discounted at lower rates than short-term damage components — mainly remedial costs. The rationale behind this choice is that the longer the duration of the damage component, the higher the related nonincident specific uncertainty on the resource values and the more relevant the equity issues. When estimating the total damage, the resulting implicit average discount rate depends on the duration of each component and its relative relevance in the total damage in each moment. From an operational point of view, anchoring the rates to government prescriptions would support the robustness of the damage estimates in a court of law, whereas the dual-based environmental discount rate is based on ad-hoc assumptions that are more difficult to justify.

The effects of rules and communication in a behavioral irrigation experiment with power asymmetries carried out in North China

- Ecological Economics---2014---Ilona M. Otto, Frank Wechsung

In our field experiment carried out with stakeholders from the Chinese Haihe River Basin, a group of five players located along an irrigation channel first decide on the amount they would invest in a public fund for channel maintenance. In the next step, they choose the amount of water to withdraw from the channel to irrigate their plots of land. We compare the effects of different rules of water distribution and communication on three types of group participants: farmers, water administrators and students.

Accounting methods for international land-related leakage and distant deforestation drivers

- Ecological Economics---2014---Sabine Henders, Madelene Ostwald

International agricultural trade flows are increasingly important as distant drivers in global land-use changes, creating teleconnections between geographically separated locations of consumption and production. Land-use displacement and associated carbon emissions can undermine the effectiveness of land-use and climate policies, such as activities to reduce emissions from deforestation and forest degradation (REDD). Nevertheless, few accounting methods exist for international emissions leakage from land-use change, due to methodological and policy challenges. In this paper we review methods to quantify international land-use displacement and teleconnections through international trade. Weaknesses and strengths of those methods are assessed as well as the conclusiveness of results. We identify limitations and potential ways forward for the quantification of land-related leakage in general, while highlighting implications for REDD-leakage accounting in particular. Results show that land-related leakage assessments are facilitated by applying a weak

leakage definition, without the requirement to demonstrate causal leakage effects. Suitable quantification approaches combine method elements such as economic modeling, trade-flow analysis, biophysical accounting and life-cycle assessments. Depending on the use of monetary or physical input data the results can change considerably. All reviewed methods face limitations such as uncertainties and data gaps in emission factors.

Would border carbon adjustments prevent carbon leakage and heavy industry competitiveness losses? Insights from a meta-analysis of recent economic studies

- Ecological Economics---2014---Frederic Branger,Philippe Quirion

The efficiency of unilateral climate policies may be hampered by carbon leakage and competitiveness losses. A widely discussed policy option to reduce leakage and protect competitiveness of heavy industries is to impose border carbon adjustments (BCAs). The estimation of carbon leakage as well as the assessment of different policy options led to a substantial body of literature in energy-economic modeling.

Combining expert elicitation and stated preference methods to value ecosystem services from improved lake water quality

- Ecological Economics---2014---George Van Houtven,Carol Mansfield,Daniel Phaneuf,Roger von Haefen,Bryan Milstead,Melissa A. Kenney,Kenneth H. Reckhow

With increasing attention on the contribution of ecosystems to human well-being, there is a need for tools that integrate ecological and economic models for valuing ecosystem services. To address this, we develop a protocol for linking ecological processes and outcomes to human preferences, which combines environmental modeling, expert elicitation, and nonmarket valuation methods. Our application values reductions in nutrient loads to lakes in the southeastern US. The innovation centers on how biochemical measures of water quality (e.g., chlorophyll a) are translated into terms that

are meaningful to individuals who derive ecosystem services from them. Using expert elicitation data, we estimate a model linking changes in biochemical measures to an index of eutrophication in lakes. We then develop a stated preference survey including (a) detailed descriptions of the perceptible outcomes – e.g., water color, clarity – associated each eutrophication index level; and (b) policy scenarios involving state-level changes in lake eutrophication conditions. We estimate a function that predicts households' willingness to pay for changes in lake water quality. We demonstrate the protocol through a case study examining the benefits of lake quality improvement in Virginia as a result of recent policies to reduce nutrient loads in the Chesapeake Bay watershed.

Managing ecosystem services for agriculture: Will landscape-scale management pay?

- Ecological Economics---2014---Rong-Gang Cong,Henrik G. Smith,Ola Olsson,Mark Brady

Agriculture's reliance on ecosystem services creates economic and ecological interdependencies between crop production and biodiversity. Interactions with mobile organisms are particularly complex because they depend on the spatial configuration of habitat at large scales. As such conserving habitat is likely to benefit multiple farmers whereas conservation costs are born individually, creating potential interdependencies among farmers. We explore under what conditions landscape-scale management of ecosystem services is likely to benefit farmers compared to managing them at the farm-scale. To do this we develop an agent-based model (ABM) to predict the landscape configuration emerging from farm-scale management under different conditions: initial landscape, crop and pollinator characteristics. As a benchmark, the landscape configuration from landscape-scale management is derived through a global optimization procedure. Not only do we find that efficiency improves with landscape-scale management, but also that all farmers would benefit from it (given dependence of crop yields on ecosystem services). However, we also find that the individual incentives to avoid maintaining habitat on one's own

land are relatively high; therefore creating conditions for a Prisoner's Dilemma-type problem. On the other hand we also demonstrate that an incentive-compatible contract exists that can promote efficient landscape management (by combining side-payments with fines for defection).

The role of ancillary benefits on the value of agricultural soils carbon sequestration programmes: Evidence from a latent class approach to Andalusian olive groves

- Ecological Economics---2014---Macario Rodríguez-Entrena, Maria Espinosa, Jesús Barreiro-Hurlé

Agriculture is a key sector for climate change mitigation strategies due to its CO₂ sequestration potential. However, in order to increase mitigation changes in current crop and land management are required, which in many cases imply additional costs to farmers. Thus, this research assesses society's willingness to pay using a discrete choice analysis for a soil management programme in Andalusian olive groves identifying different groups based on preference heterogeneity. We identify three groups and characterise them on the basis of socio-demographics. Willingness to pay is higher in areas and for individuals who would directly benefit from the programme. Additionally, the ancillary benefits associated to carbon sequestration capture an important share of the overall benefits. Our results show that soil carbon sequestration in olive groves provides net social value and can be a cheap and cost-effective way of combating climate change.

Determinants of conservation among the rural poor: A charitable contribution experiment

- Ecological Economics---2014---Deanna Karapetyan, d'Adda, Giovanna

This paper examines how conservation decisions are affected by environmental degradation. Donations to an environmental NGO and participation in actual conservation activities capture individual preferences for environmental conservation. Environmental degradation is measured both through survey-based data on

experiences of deforestation and environmental shocks, and through indices of deforestation constructed with GIS data. The results show that being exposed to environmental degradation is correlated both with higher donations and conservation behavior. The relationship between conservation choices and individual social preferences is also explored. Experimental measures of individual altruism and inequality aversion, and survey measures of trust, time preferences and civic engagement are correlated with donations and real world conservation decisions respectively. These findings show the role of environmental awareness in fostering environmental conservation even in very poor settings. They also highlight the potential of experiments, which closely mirror real world decisions, to generate conclusions generalizable to individual behavior outside the laboratory.

To what extent does air pollution affect happiness? The case of the Jinchuan mining area, China

- Ecological Economics---2014---Zhengtao Li, Henk Folmer, Jianhong Xue

This paper presents a structural equation model of happiness, as influenced by inter alia perceived risk due to (i) intensity of exposure to polluted air, and (ii) hazard of pollutants. In addition, objective risk measured as proximity to the pollution source, is considered. The main finding is that both types of perceived risk negatively and significantly influence people's happiness, although in absolute terms, the total perceived risk effect is less than the (positive) effect of ability, measured by income and education. Other important determinants of happiness are family size, age, proximity to the pollution source, work environment and current health condition. Perceived risk due to intensity of exposure is influenced by environmental knowledge and proximity to the pollution source; perceived risk of hazard by ability, environmental knowledge, family size, family health experience and proximity to the pollution source. Environmental knowledge is found to be a function of age, ability and work environment. On the basis of the findings, we conclude that reducing air

pollution is an important policy measure to ameliorate happiness. As environmental knowledge is an important determinant of perceived risk, reduction policies should be accompanied by disclosure of the state of air quality.

Model of the social–ecological system depends on model of the mind: Contrasting information-processing and embodied views of cognition

- Ecological Economics---2014---Janne I. Hukkinen

Two core concerns of ecological economists have for decades been to consider the economy as embedded in broader social–ecological systems (SESs) and to include multiple perspectives in knowledge production. To address these concerns, I argue, ecological economists need to return to the ontological question of what constitutes the SES and the epistemological question of how to obtain knowledge about it. The article shows that autopoiesis complemented with the theory of embodied cognition addresses (1) the ontological challenge by articulating socio-cultural artifacts and ecological artifacts as a single entity, and (2) the epistemological challenge with universally shared schemas that describe goal-oriented activity. The power of autopoiesis is illustrated by outlining an embodied SES model of reindeer management as an alternative framing to the predominant information-processing SES model. An environmental policy measure that from the information-processing perspective looks like an adjustment of a control variable may from the embodied perspective disrupt an interconnected structure of social–ecological interaction. The article proposes a way to integrate the information-processing and embodied models. The results pose significant challenges for future research and policy efforts by ecological economists.

Risk versus economic performance in a mixed fishery

- Ecological Economics---2014---S. Gourguet,O. Thébaud,C. Dichmont,Sarah Jennings,L.R. Little,Sean Pascoe,R.A. Deng,Luc Doyen

Balancing bio-economic risks and high profit expectations is often a major concern in fisheries management. We examine this trade-off in the context of the Australian Northern Prawn Fishery (NPF). The fishery derives its revenue from different prawn species with different dynamics and recruitment processes. A multi-species bio-economic and stochastic model is used to examine the trade-offs between mean profitability of the fishery and its variance, under a range of economic scenarios, fishing capacities and distributions of fishing effort across the various sub-fisheries that comprise the NPF. Simulation results show that the current fishing strategy diversifying catch across sub-components of the fishery entails a compromise between expected performance and risk. Furthermore, given the current economic conditions, increases in fleet size would improve the expected economic performance of the fishery, but at the cost of increased variability of this performance.

Measuring the impact of nuclear accidents on energy policy

- Ecological Economics---2014---Zsuzsanna Cserekllyei

This paper investigates the effects of nuclear accidents on energy policy with the help of a panel dataset of 31 countries from 1965 to 2009, using annual data on the capacity of reactor construction starts, as well as the timing of three nuclear accidents scaled five or higher on the International Nuclear and Radiological Event Scale. After determining the extent of the accident impact in the different countries, I find that neither the Three Mile Island (TMI) nor the Lucens accidents had a worldwide negative effect on construction starts, while Chernobyl did. Three Mile Island had a lasting impact in the United States, however. I show that the effect of Chernobyl wore off in certain geographical clusters, after ten to thirty years. An accident is likely to have a negative and long lasting impact in the country where it happened, and possibly in countries affected by the direct consequences. I find that nuclear capacity enlargement shows a significant lock-in effect, but it was also driven by primary energy consumption

and energy security considerations in the past five decades.

Climate change and the willingness to pay to reduce ecological and health risks from wastewater flooding in urban centers and the environment

- Ecological Economics---2014---Marcella Veronesi,Fabienne Chawla,Max Maurer,Judit Lienert

Climate change scenarios predict an increase of extreme rain events, which will increase the risk of wastewater flooding and of missing legal water quality targets. This study elicits the willingness to pay to reduce ecological and health risks from combined sewer overflows (CSOs) in rivers and lakes, and wastewater flooding of residential and commercial zones under the uncertainty of climate change. We implement a discrete choice experiment on a large representative sample of the Swiss population. We find that about 71% of the respondents are willing to pay a higher annual local tax to reduce the risk of CSOs in rivers and lakes. Swiss households strongly value the protection of water bodies, and mostly, the avoidance of high ecological risks and health risks for children related to CSOs in rivers and lakes. Our findings also show that climate change perception has a significant effect on the willingness to pay to reduce these risks. These results are important to support policy makers' decisions on how to deal with emerging risks of climate change in the water sector and where to set priorities.

Organising for socio-ecological resilience: The roles of the mountain farmer cooperative Genossenschaft Gran Alpin in Graubünden, Switzerland

- Ecological Economics---2014---Douglas K. Bardsley,Annette M. Bardsley

Risks are increasing for agriculture, particularly for marginal systems like the cereal production systems of the Swiss Alps. The article critically examines the

outcomes of innovative governance responses to socio-ecological risk through an analysis of the roles of the cooperative organisation Genossenschaft Gran Alpin, according to the perceptions of its farmer members. Gran Alpin provides a secure premium price for cereal producers in Graubünden linked to the uniqueness of local organic mountain cropping systems, and all the values of local identity, landscape stewardship, biodiversity conservation and regional development that such systems represent. Gran Alpin is enabling an alternative approach for rural development to evolve around key elements, including: high quality breads, pastas, flours and beer; the mountains; the extreme production system; organic production and animal welfare; landscapes aesthetics in a core tourism region; and the cooperation of like-minded farmers. Resilience within the socio-ecological system is enhanced as the cooperative exploits evolving forms of collaboration, market niches, and private and public governance relationships to respond implicitly and explicitly to agro-ecological, economic and political risks.

Drivers of greenhouse gas emissions in the Baltic States: A structural decomposition analysis

- Ecological Economics---2014---Janis Brizga,Kuishuang Feng,Klaus Hubacek

Since the mid-1990s three Baltic States have significantly increased their per capita gross domestic product (GDP) and at the same time have managed to keep the CO₂ equivalent (CO₂e) emissions low. We used structural decomposition analysis to identify the drivers of change for CO₂e emissions in these countries between 1995 and 2009, a period that includes the collapse of the Soviet Union, restructuring and economic growth and the great recession. The results show that final demand has been the main driving force for increasing emissions in the Baltic States and would have caused an 80%, 64% and 143% emission increase in Estonia, Latvia and Lithuania, respectively, all other factors kept constant. This increase has been partly offset by a declining emission intensity of the economy, especially in Latvia and Lithuania; whereas in Estonia,

which has one of the highest emission intensities in Europe, a shift in consumption patterns towards low carbon consumption items and a decarbonizing economic structure were the main balancing factors. It is likely that the Baltic States will experience a continuation of economic growth given their relatively low per capita GDP, which is less than half of the European Union average thus adequate carbon policies are paramount.

Reconciling interests concerning wildlife and livestock near conservation areas: A model for analysing alternative land uses

- Ecological Economics---2014---Petronella Chaminuka,Rolf Groeneveld,Ekko van Ierland

Land use decisions are central to both biodiversity conservation and rural development goals at local, national and international levels. Transfrontier Conservation Areas (TFCAs), now common in Southern Africa, present an opportunity to address these goals simultaneously. This paper proposes a theoretical spatial land allocation model that enables analysis of alternative scenarios for realising rural development and biodiversity conservation within TFCAs. The model includes socioeconomic and ecological factors such as income, fencing, connectivity, predation and disease costs and allows for clarification of opportunities and tradeoffs in land use. The model demonstrates alternative spatial options for diversification in land use, whilst accommodating the connectivity requirements and endogenous effects of wildlife on other land uses. The model is illustrated using several scenarios which include changes in key parameters, and limitations on total land allocated per land use. Illustrated scenarios show that land allocated to different land uses varies with output prices and costs such as fencing and wildlife damages, resulting in different spatial land use allocations. In addition, total revenue also changes when limitations are placed on land allocated to wildlife and tourism uses. The model can be used to reconcile interests where conservation and agricultural development activities compete for land.

Using a choice experiment framework to value conservation-contingent development programs: An application to Botswana

- Ecological Economics---2014---Elizabeth F. Pienaar,Lovell S. Jarvis,Douglas M. Larson

Community Based Natural Resource Management (CB-NRM) programs in Botswana have had limited conservation effect because the provision of development benefits is not contingent on wildlife conservation. Building on existing discussions about which development initiatives these programs should implement, we use choice experiment data to empirically determine what value CBNRM community members place on both private and quasi-public development interventions. We show that these interventions are sufficient to incentivize households to engage in anti-poaching enforcement, revegetation of wildlife habitat and wildlife monitoring. Our methodology may be adapted to investigate a range of potential development interventions for which in-kind labor contributions are required.

Farmer identity, ethical attitudes and environmental practices

- Ecological Economics---2014---Iddisah Sulemana,Harvey S. James

There is increasing concern for environmental degradation caused by agricultural activity. Although large-scale agribusinesses are generally implicated, farmers themselves are often seen as culpable. We investigate whether farmer identity is an important factor affecting their attitudes toward the environment and farm management and conservation practices. Identity refers to a general outlook or perspective, whereas attitudes refer to beliefs or preferences about specific things. We investigate which identities matter most for affecting how farmers view the appropriateness of specific ethical situations relating to environmental management practices. We use a social-psychological model of ethical decision-making, and data from a survey of Missouri farmers, to examine the relationship between the identity of farmers and their attitudes toward ethical issues

affecting the environment. We find that a conservation identity, in contrast to a productivist one, is most closely correlated with attitudes toward ethical environmental issues, although there is also an important interaction effect with one's view about the future.

World oil production trend: Comparing Hubbert multi-cycle curves

- Ecological Economics---2014---Douglas B. Reynolds

Worldwide shale oil resources in the U.S., China, Russia, Poland and France could mean that potential world oil production could double or triple in the next few decades. However, not all of these new reserves may be as large or as productive as North Dakota's Bakken shale oil. In addition reserves of shale oil look to be a lot less in relative terms than the reserves of shale gas as evidenced by the price of natural gas in the U.S. compared to the price of oil. This suggests that the U.S. and world supplies of shale oil may be limited. In this article, we will look to attempt a different type of forecast for oil using a modified Hubbert curve oil production forecast. We look at possible world oil production trends rather than just U.S. oil production trends. Two interesting comparisons of the world oil production trend to other regional trends are the former Soviet Union's oil production trend and the U.S. oil production trend. If we compare the current world oil production trend to those previous trends using indexation, then we can get an idea of what may happen to world oil production in the future.

Ecosystem services within agricultural landscapes—Farmers' perceptions

- Ecological Economics---2014---Helen F. Smith,Caroline A. Sullivan

A two way relationship exists between agricultural production and ecosystem services where farmers act as significant contributors to as well as potential detractors to societal well-being. To date, there has been a limited amount of research investigating farmers'

values through the ecosystem services concept, particularly in Australia. In this paper we address this research gap through focusing on farmers' perceptions of four different attributes towards 12 ecosystem services. Results from our survey indicate that farmers place a high value on the importance of all ecosystem services, whilst perceiving most of them to be moderately manageable. The farmers identified a variety of threats towards ecosystem services that were mostly agricultural in origin, whilst perceiving themselves to be moderately vulnerable to the loss of services. To overcome any potential loss of services, market-based instruments such as schemes paying for ecosystem services can be applied. These economic tools do appear to be needed, as the farmers in this study directly identified the economic cost of maintaining native habitat as a threat. Through more explicit understanding of the social dimension of the two-way relationship between ecosystem services and agricultural production, natural resource policies to overcome this potential negative cycle can be implemented more effectively.

Trans-border public health vulnerability and hydroelectric projects: The case of Yali Falls Dam

- Ecological Economics---2014---John Polimeni,Raluca Iorgulescu,Ray Chandrasekara

The need for energy due to economic and population pressure has resulted in a great expansion of hydroelectric dam projects around the world, especially in Asia. These hydroelectric projects have resulted in considerable environmental, economic, and social damage. Typically, the economic development—environmental degradation dynamic has been examined. However, rarely has the economic development, environmental degradation, public health connection been made. This paper, using primary data collected from household surveys, completes the economic, environment, public health circle by examining how economic and environmental changes from the Yali Falls dam in Vietnam has impacted the health of people living in three remote villages in Cambodia.

Valuing biodiversity enhancement in New Zealand's planted forests: Socioeconomic and spatial determinants of willingness-to-pay

- Ecological Economics---2014---Richard Yao,Riccardo Scarpa,James A. Turner,Tim D. Barnard,John Rose,João H.N. Palma,Duncan R. Harrison

Planted forests are increasingly recognised for the provision of habitats for species threatened with extinction. Despite this development, a limited number of empirical studies have been undertaken to estimate the economic value of this ecosystem service. New Zealand's planted forests provide habitat to at least 118 threatened species. These forests can be managed to increase the abundance of many of these species. We present findings from survey data obtained in a discrete choice experiment designed to estimate the non-market values for a proposed biodiversity enhancement programme in New Zealand's planted forests. We used a two-stage modelling process. First we estimated the individual specific willingness to pay values and then we explored their socio-economic and spatial determinants. The first stage modelling process, which used a random parameters logit model with error components, suggested that willingness to pay was higher for increasing the abundance of native bird than for non-bird species. The second stage model used a least squares panel random-effects regression. Results from this method suggested that socioeconomic characteristics, such as attitudes toward the programme and distance from large planted forests, influenced willingness to pay for biodiversity enhancement.

Ecosystem services as substitute inputs: Basic results and important implications for conservation policy

- Ecological Economics---2014---R. David Simpson

In recent decades conservation advocates have often emphasized the contributions of ecosystem services to the production of other products. A demonstration of the value of ecosystems as inputs into production would motivate their conservation. Such arguments

often offer the observation that ecosystem services can substitute for purchased inputs, and thus reduce costs. If this is true, however, it has another important implication: a producer who is preserving local ecosystems so as to maximize her own profit will produce less output if she further increases her reliance on ecosystem services. This may induce "leakage," by which one producer's greater reliance on ecosystem services indirectly motivates others to preserve fewer natural ecosystems. I demonstrate this result in a simple but canonical model, and calibrate my findings to a celebrated example to show they could be quantitatively significant. My results suggest another reason that appeals to ecosystem services as a motivation for conservation should be made with care. At the most basic level, they emphasize the importance of being clear about what we mean by conservation: do we want to save some diversity in many places, or nearly all indigenous diversity in a few places?

Effects of a policy-induced income shock on forest-dependent households in the Peruvian Amazon

- Ecological Economics---2014---L'Roe, Jessica,Lisa Naughton-Treves

This paper describes how forest-dependent communities in the Peruvian Amazon responded to forest policy changes meant to improve sustainability. These new laws emphasized block-based, collectivized extraction — a strategy incompatible with local communities' logging traditions and technical capacity. Field surveys before and after the policy change revealed a drastic reduction in local logging activities for households at all income levels. Non-Timber Forest Products (NTFPs) subsequently became more important to household cash incomes. However, only some households were able to shift to a more intensive and far-ranging pattern of NTFP harvest, particularly households with boats and motors. Others lost income from both logging and NTFP extraction because for many households, these income sources were interdependent. An increasing Gini coefficient signals potentially escalating household income inequality. Key lessons for biodiversity and

forest–carbon interventions in tropical forests include 1) regulations designed to control large-scale extraction can lead to unnecessarily restricted access for small-scale extractors, and 2) potential shifts in extractive pressure should be taken into account when access to forest resources is curtailed.

Twenty thousand sterling under the sea: Estimating the value of protecting deep-sea biodiversity

- Ecological Economics---2014---Niels Jobstvogt,Nick Hanley,Stephen Hynes,Jasper Kenter,Ursula Witte

The deep-sea includes over 90% of the world's oceans and is thought to be one of the most diverse ecosystems in the world. It supplies society with valuable ecosystem services, including the provision of food, the regeneration of nutrients and the sequestration of carbon. Technological advancements in the second half of the 20th century made large-scale exploitation of mineral, hydrocarbon and fish resources possible. These economic activities, combined with climate change impacts, constitute a considerable threat to deep-sea biodiversity. Many governments, including that of the UK, have therefore decided to implement additional protected areas in their waters of national jurisdiction. To support the decision process and to improve our understanding for the acceptance of marine conservation plans across the general public, a choice experiment survey asked Scottish households for their willingness-to-pay for additional marine protected areas in the Scottish deep-sea. This study is one of the first to use valuation methodologies to investigate public preferences for the protection of deep-sea ecosystems. The experiment focused on the elicitation of economic values for two aspects of marine biodiversity: (i) the existence value for deep-sea species and (ii) the option value of deep-sea organisms as a source for future medicinal products.

Sustainable value of degraded soils in China's Loess Plateau: An updated approach

- Ecological Economics---2014---Lingling Hou,Dana Hoag,Catherine M.H. Keske,Changhe Lu

China's Loess Plateau is a highly distressed region where intensive crop production has been undermined by high soil erosion rates that threaten the long-term livelihood of its inhabitants. Regional policy goals aim to balance economic performance with the sustainable use of natural resources. From a practical perspective, challenges arise when measuring sustainability levels that mix multiple dimensions, scales, and benchmarks. This study addresses these challenges by comparing the sustainability of agricultural systems across varied crops, land types, and cropping techniques in China's Loess Plateau. Sustainability levels for each system are compared to benchmarks using data envelopment analysis, which is then used to calculate a sustainable value (SV). The SV approach provides a monetary measure of sustainability that includes economic, environmental and social dimensions. Results demonstrate that the most sustainable agricultural systems in the Loess Plateau involve machine intensive cropping systems, a corn–soybean–corn rotation, mulching, furrows ridging, and bench terracing.

K. William Kapp's theory of social costs: A Luhmannian interpretation

- Ecological Economics---2014---Vladislav Valentinov

In developing his famous theory of social costs, K. William Kapp claimed to draw inspiration from the theory of open systems. The present paper reconstructs the notion of social costs from the perspective of the Luhmannian theory of autopoietic social systems, an alternative systems-theoretic paradigm. According to Luhmann, these systems build up their internal complexity at the cost of lowering their sensitivity to the complexity of their environment, both societal and ecological. From the Luhmannian perspective, social costs can be understood as those segments of environmental feedback that are thus ignored by social systems. This

perspective is not only consistent with Kapp's own vision of social costs as a systematic outcome of private business enterprise, but also even more radical as it traces these costs back to the regime of functional differentiation of society, and thus to human civilization generally. It follows from the Luhmannian perspective that social costs can be reduced by improving the coordination between the individual functional systems, such as economy, law, politics, and science.

Willingness-to-pay and the perfect safari: Valuation and cultural evaluation of safari package attributes in the Serengeti and Tanzanian Northern Circuit

- Ecological Economics---2014---Nitin Sekar, Jack M. Weiss, Andrew P. Dobson

Governments and NGOs worldwide aim to develop models of tourism that realize the economic, environmental, and cultural ideals of ecotourism. This is true in the national parks of the Northern Safari Circuit of Tanzania, which attract hundreds of thousands of tourists annually. To better understand what tourists to Tanzania were willing to pay for various attributes of their tour package, we used a linear mixed effects model to analyze what attributes of 72 tour packages from 32 tour operators contributed to the price of tour packages. We found that the number of days spent on tour, the number of days spent in the Serengeti, the type of accommodation (basic camping versus lodges or luxury tents), the mode of transport into the park (flying versus driving), and the inclusion of cultural tourism helped predict the price of a tour package. Our findings suggest that tour operators charge 92% more for a day in the Serengeti than other Northern Circuit attractions, but we do not examine what happens to the additional rent generated by the Serengeti. Additionally, the utility of cultural tourism in attracting foreign tourists presents both tremendous opportunities and potential challenges to efforts to realize culturally sensitive ecotourism.

Labeling energy cost on light bulbs lowers implicit discount rates

- Ecological Economics---2014---Jihoon Min, Inês L. Azevedo, Jeremy Michalek, Wändi Bruine de Bruin

Lighting accounts for nearly 20% of overall U.S. electricity consumption and 18% of U.S. residential electricity consumption. A transition to alternative energy-efficient technologies could reduce this energy consumption considerably. To quantify the influence of factors that drive consumer choices for light bulbs, we conducted a choice-based conjoint field experiment with 183 participants. We estimated discrete choice models from the data, and found that politically liberal consumers have a stronger preference for compact fluorescent lighting technology and for low energy consumption. Greater willingness to pay for lower energy consumption and longer life was observed in conditions where estimated operating cost information was provided. Providing estimated annual cost information to consumers reduced their implicit discount rate by a factor of five, lowering barriers to adoption of energy efficient alternatives with higher up-front costs; however, even with cost information provided, consumers continued to use implicit discount rates of around 100%, which is larger than that experienced for other energy technologies.

The future of food — Scenarios and the effect on natural resource use in agriculture in 2050

- Ecological Economics---2014---I.Y.R. Odegard, E. van der Voet

Do we have the natural resource base to feed future populations? This study gives a quantification of global land use, water use and fertilizer use for the year 2050, for a complete diet and four different futures. Agriculture will need to develop substantially to feed future populations. It is shown that there is a negative correlation between fertilizer use and land use, which makes the necessity of incorporating both in such assessments clear. Water use increases relative to total production and this is going to be a problem unless drastic

measures are taken. The high wastage and high consumption of animal products in the developed regions are major contributors to the total global demand. Developing countries' aspirations to such practices are a major factor in increases in diet demand, as are population increases in those regions. In creating a more sustainable food system, a one-solution approach will not do and solutions should combine supply-side and demand-side options. Demand-side solutions should target wastage and animal product consumption. On the supply side, technological development and better feeding efficiency will increase yields. Feeding the future global population, which is necessary to increase living standards worldwide, will require a concerted effort.

Modeling the links between biodiversity, ecosystem services and human wellbeing in the context of climate change: Results from an econometric analysis of the European forest ecosystems

- Ecological Economics---2014---Helen Ding,Paulo Nunes

This paper constitutes a first attempt to model the relationship between climate change, biodiversity, and ecosystem services, with a specific emphasis on European forests. Firstly, we construct a composite biodiversity indicator that integrates quantitative and qualitative changes of biodiversity projected to 2050 for the EU-17 under future IPCC scenarios. Secondly, this indicator is integrated into two simultaneous equation models to capture the marginal impacts of changes in biodiversity on the value of ecosystem goods and services (EGS) due to climate change.

The valuation of off-site ecosystem service flows: Deforestation, erosion and the amenity value of lakes in Prescott, Arizona

- Ecological Economics---2014---James Yoo,Silvio Simonit,John P. Connors,Ann P. Kinzig,Charles Perrings

One of the most important services provided by forests

is the control of erosion. We investigated the value of forest cover in protecting water quality in five urban lakes around Prescott, AZ. We first estimated the role of forest cover in regulating sediment loadings into each lake via a sediment delivery model. We then used 8301 single-family residential property transactions that occurred between 2002 and 2005 in Prescott, AZ, to estimate a hedonic price function. This yielded an estimate of the marginal willingness-to-pay (MWTP) for avoiding 1t of sediment per lake-acre, from which we were able to infer the marginal willingness to pay for the erosion control services associated with a 10% change in current canopy cover. We found that the marginal value of the erosion control services of forest cover varies widely across the watersheds depending on the accessibility of affected lakes, the current level of canopy cover, and the number and value of affected residential properties among other factors.

Biofuel as social fuel: Introducing socio-environmental services as a means to reduce global inequity?

- Ecological Economics---2014---Sandra Venghaus,Kirsten Selbmann

The increasing cultivation of energy crops for biofuel production has significantly altered the focus of the agricultural sector, but the impact of biofuel production and use is not merely an agricultural one. Even more importantly, it is an issue, which likely promotes inequitable conditions and the social conflict of different (basic) needs. Within this context, the dominant argument criticizes the growing demand for biofuels in the north to compromise food security and sovereignty in the south. In order to address these trade-offs and conflicts, the objective of this paper is the introduction of a conceptual framework of socio-environmental services. By expanding the construct of environmental services to explicitly include the social dimension, it shall accommodate for the fact that the provision of environmental services is often embedded in a complex system of global (economic, ecological as well as social) interdependencies. Recently, the concept of payments for environmental services (PES) has received much

attention with respect to its potential contribution to both environmental sustainability and the economic alleviation of poverty. By linking the idea of payments for socio-environmental services (PSES) to the three functions of justice, its beneficial impact may be more fully tapped.

Measuring emissions avoided by international trade: Accounting for price differences

- Ecological Economics---2014---Iñaki Arto,Jordi Roca,Mònica Serrano

Net Emissions Avoided by trade (NEA) are the difference between the pollution that would have been produced in a country if it had not exported any products and all the imports required to satisfy its domestic demand had been produced internally, and its actual emissions. The Domestic Technology Assumption (DTA) applied to an Input–Output model is the appropriate method to estimate the NEA. The usual implementation of the DTA involves that the country analyzed should produce a quantity of products equivalent to the monetary value of the imports required to satisfy its final demand (i.e. ‘monetary DTA’). However, due to price differences, the same physical quantity of goods in different countries could have a different monetary value and the estimation of the NEA would be biased. We show that a ‘physical DTA’, focused on the pollution to produce domestically the imports measured in physical units, would be a better approach. We have applied both methodologies to analyze greenhouse gas emissions in Spain 1995–2007. Both methodologies show that Spain is avoiding emissions through trade. However, the NEA increases up to three times when applying the ‘physical DTA’, showing that results from the ‘monetary DTA’ are biased by price differences.

Detecting the presence of depensation in collapsed fisheries: The case of the Northern cod stock

- Ecological Economics---2014---Jose M. Maroto,Manuel Moran

Motivated by the evidence that many collapsed stocks have failed to recover despite the fact that fishing mortality has been reduced, or even when a moratorium is in effect, we develop a methodological approach using splines to analyze the stochastic population dynamics of fish stocks at low stock levels. Considering the aggregate Northern cod stock by way of illustration, we find that the species’ lack of recovery, despite the moratorium which still remains in force, is consistent with the hypothesis of depensatory population dynamics at low population sizes, as opposed to the compensation estimated by the conventional regression methods used in classic bioeconomic models.

Giving birds a starting date: The curious social solution to a water resource issue in the U.S. West

- Ecological Economics---2014---Insa Theesfeld,Anne MacKinnon

Examining a natural resource management system, we show that what first looks like rigid path dependency is actually stepped incremental change. The theoretical question then arises of whether it is possible to predict when a natural resource governance system will follow such an incremental path of institutional change. Our investigation of the prior appropriation water rights system as administered in the state of Wyoming reveals that mental models, based on factors such as strong personal connections with administrators, plus strong confidence in the system, tend to favor incremental change. We note that choosing incremental change is not without risk. While systems that undertake wholesale and rapid change risk a good deal – exposing themselves to a potential shower of unanticipated consequences – systems that follow the path of incremental change also take risks. Incremental change may mean successful accommodation of new needs that demand attention, or it may be “too little too late,” ultimately allowing the pent-up pressure of unmet needs to push the system over a threshold into collapse.

Spatial patterns of organic agriculture adoption: Evidence from Honduras

- Ecological Economics---2014---Meike Wollni,Camilla Andersson

In low potential agricultural areas like the Honduran hillsides characterized by soil degradation and erosion, organic agriculture can provide a means to break the downward spiral of resource degradation and poverty. We use original survey data to analyze the factors influencing the decision to convert to organic agriculture. Previous studies have emphasized the role of spatial patterns in the diffusion and adoption of agricultural technologies in general and organic agriculture in particular. These spatial patterns can result from a variety of underlying factors. In this article we test various potential explanations, including the availability of information in the farmer's neighborhood, social conformity concerns and perceived positive external effects of the adoption decision, in a spatially explicit adoption model. We find that farmers who believe to act in accordance with their neighbors' expectations and with greater availability of information in their neighborhood network are more likely to adopt organic agriculture. Furthermore, perceived positive productivity spillovers to neighboring plots decrease the probability of adoption. We discuss the implications of our findings for the dissemination of sustainable agricultural technologies in low-potential agricultural areas in developing countries.

Heterogeneity and emotions in the valuation of non-use damages caused by oil spills

- Ecological Economics---2014---Carmelo J. León,Jorge E. Araña,Michael Hanemann,Pere Riera

Oil spills are capable of causing major environmental insults that raise the emotional loads of individuals across society. In this paper we consider the role of emotions in heterogeneous responses of individuals in the non-market valuation of an oil prevention program in Spain. Heterogeneity is modeled with a smoothly mixing regression (SMR) model that allows researchers

to explain the probability that individuals belong to the latent segments of WTP. The results show that heterogeneity in WTP responses is explained by the specific emotional reactions of individuals (upset, sadness, indifference) rather than by their socioeconomic characteristics. Thus, the investigation of the emotional reactions of individuals can provide useful tools for the design of non-market valuation studies, providing more accurate predictions of the potential behavior of individuals in constructed markets for damage assessment.

Valuing insurance services emerging from a gene bank: The case of the Greek Gene Bank

- Ecological Economics---2014---Anastasios Xepapadeas,Parthenopi Ralli,Eva Kougea,Sofia Spyrou,Nikolaos Stavropoulos,Vasiliki Tsiaousi,Athanasios Tsivelikas

We develop a conceptual framework for determining insurance values associated with a gene bank and we apply the methodology to the Greek Gene Bank (GGB), the largest ex situ conservation program in Greece. To evaluate the insurance value generated by the holdings of the GGB genetic resources, the current study examined scenarios for alternative arrival probabilities of an adverse event that would negatively affect production of seven major staple crops held at the GGB within the next 100years. Within the range of our estimates, it is indicated that insurance values considerably exceed the current operating costs of maintaining the GGB.

Compensating for environmental damages

- Ecological Economics---2014---Pascal Gastineau,Emmanuelle Taugourdeau

This paper examines a situation in which a decision-maker determines the appropriate compensation that should be awarded for a given amount of ecological damage. The compensation can take the form of either or both monetary and environmental units to meet three goals: i) minimisation of the cost associated with the compensation, ii) no aggregate welfare loss, and iii) minimal environmental compensation requirement.

The findings suggest that – in some cases – providing both monetary and environmental compensation can be the cost-minimising option. Minimal compensation constraints can increase total compensation costs but reduce individual gains and losses relative to the initial situation that arise from heterogeneous tradeoffs between income and environmental quality.

Impacts of access and benefit sharing on livelihoods and forest: Case of participatory forest management in Ethiopia

- Ecological Economics---2014---Aklilu Ameha,Oystein Juul Nielsen,Helle Overgard Larsen

The introduction of participatory forest management (PFM) may involve the exclusion of previous forest users from accessing forest resources. This is the case for PFM in the two Ethiopian pioneer sites, Dodola and Chilimo that represent two distinct PFM approaches in Ethiopia. This paper analyses how PFM, after controlling pre-PFM differences, affects members of forest user groups (FUGs) and non-members' total annual incomes, forest incomes, expenditures and livestock asset holdings. Income and asset data were collected from 635 randomly selected households. Data were analysed using propensity score matching models. Results show that in Dodola, where commercial timber harvest is allowed, the introduction of PFM means that FUGs have higher livestock assets and forest income than non-members. The average total income and the expenditure for members and nonmembers, however, were not significantly different. In Chilimo site, the result is the opposite —the introduction of PFM means that FUG members have lower total incomes and assets than non-members. Based on our findings we recommend that the PFM scaling up approaches in Ethiopia, which currently allow FUGs only subsistence use from forest resources, need to be revised.

Estimating the cost of air pollution in South East Queensland: An application of the life satisfaction non-market valuation approach

- Ecological Economics---2014---Christopher L. Ambrey,Christopher Fleming,Andrew Yiu-Chung Chan

Making use of data from the Household, Income and Labour Dynamics in Australia (HILDA) survey coupled with air pollution data on PM10 exceedances generated by The Air Pollution Model (TAPM), this paper employs the life satisfaction approach to estimate the cost of PM10 exceedances from human activities in South East Queensland. This paper offers an estimate of the cost of PM10 exceedances from anthropogenic activities for the region of South East Queensland and provides further evidence on the association between air pollution (PM10 exceedances) and life satisfaction. A negative relationship is found between life satisfaction and the average number of days that ambient concentrations of PM10 exceed health guidelines. This yields an implicit willingness-to-pay, in terms of annual household income, for pollution reduction of approximately AUD 5000.

Pasture conversion and competitive cattle rents in the Amazon

- Ecological Economics---2014---Michael L. Mann,Robert Kaufmann,Dana Marie Bauer,Sucharita Gopal,Mallory Nomack,Jesse Y. Womack,Kerry Sullivan,Britaldo S. Soares-Filho

The economic incentives for conversion to pasture in Mato Grosso Brazil are investigated using pastureland rents. Pastureland rents are estimated from physical and geographic determinants, and verified by predicting the location of conversion to pasture between 2001 and 2004. Results indicate that a one-hundred dollar increase in mean cattle rent increases the probability of conversion to pasture from 8.6 to 11.1%. The use of economic rent allows the direct study of fiscal policy levers on land conversion behavior, expanding policy discussions beyond the role of roads and road improve-

ment towards the use of excise and conversion taxes, or conservation subsidies.

Technological diffusion and preference learning in the world of Homo sustinens: The challenges for politics

- Ecological Economics---2014---Christian Cordes, Georg Schwesinger

This article relates agents' learning of a preference for a technology, competition of technologies, and their relative diffusion among potential adopters. Competitive interactions between two technologies are captured by an extended Lotka–Volterra model. To also incorporate preference learning on the part of potential adopters of these technologies, we combine it with a model of cultural learning based on role model, conformist, and hedonistic learning. Our theoretical analysis is illustrated by a concrete example: the competition between electric mobility and conventional forms of individual mobility. The model enables an evaluation of specific policy instruments as to the promotion of sustainable technology.

Conversion, intensification, and abandonment: A human appropriation of net primary production approach to analyze historic land-use dynamics in New Zealand 1860–2005

- Ecological Economics---2014---Tamara Fetzl, Markus Gradwohl, Karl-Heinz Erb

This study presents a national level analysis of changes in land use and land cover in New Zealand from 1860 to 2005. We employ the Human Appropriation of Net Primary Production (HANPP) framework to assess land use induced impacts on ecological energy flows by accounting for socioeconomic harvest and productivity losses through land use change. By analyzing the interplay of socioeconomic dynamics, changes in land use, land use efficiency, and ecosystems we distinguish four stages of land use dynamics: 1) between 1860 and 1920 HANPP increased from 34% to 53% of the potential Net Primary Production, accompanied by low HANPP efficiency. 2) After 1920, driven by legislation that

ended deforestation, HANPP declined to 32.7%, and then stagnated until 1950. 3) This was followed by a new period of growth which ended in 1980, when HANPP had reached 41%. Increased agricultural inputs resulted in increasing HANPP efficiency between 1920 and 1965, when high subsidization and land expansion caused stagnation in this trend. 4) After 1980, HANPP declined and reached 32% by 2005, reflecting efficiency improvements. We discuss these observed trajectories in the context of socio-economic dynamics such as land use policies and trade.

A great fish war model with asymmetric players

- Ecological Economics---2014---Michèle Breton, Michel Yevenunye Keoula

This paper analyzes the coalitional Great Fish War model under the assumption that players differ in their time preferences and use different discount rates. We derive the equilibrium payoffs of this coalitional game and investigate the impact of the asymmetry assumption on the extreme schemes of cooperative and non-cooperative equilibria. We then proceed to the computation of stable coalitions using time-consistent harvest-sharing policies for the partial coordination scheme, in the case where players are divided into two groups (high and low discount rates). We find that asymmetry has a significant impact on the way the resource is shared and on the profitability of coalitions. We also find that asymmetry is not a sufficient feature to overcome the puzzle of small coalitions.

The role of consumption patterns, demand and technological factors on the recent evolution of CO2 emissions in a group of advanced economies

- Ecological Economics---2013---Rosa Duarte, Alfredo Mainar, Julio Sánchez-Chóliz

Changes in production structures and modifications of patterns of consumption are key factors in the fight against environmental harm. Initiatives such as Agenda 21, promoted by the UN, highlight the need

to evaluate the relationships among factors of production and consumption, innovation and demographics, and the environment, in the attainment of sustainable development. In this context, our work studies in depth those factors underlying the economic activity of households, in a representative group of European Union countries and the US. Within the framework of an input–output model, a Structural Decomposition Analysis is considered in order to identify the weight that growth in demand, changes in patterns of consumption, changes in the distribution of income, the substitution of inputs, and changes in energy intensity have all had on the evolution of CO₂ emissions. The work specifically seeks to identify common patterns and differential behaviors among productive sectors in the European social environment. The results show that growth in demand, and therefore in production, largely absorbs the limited effect of technological and efficiency improvements and the incipient changes observed in consumption patterns.

Leveraging private capital for climate mitigation: Evidence from the Clean Development Mechanism

- Ecological Economics---2013---Patrick Bayer,Christopher Marcoux,Johannes Urpelainen

To mitigate climate change, states must make significant investments into energy and other sectors. To solve this problem, scholars emphasize the importance of leveraging private capital. If states create institutional mechanisms that promote private investment, they can reduce the fiscal cost of carbon abatement. We examine the ability of different international institutional designs to leverage private capital in the context of the Kyoto Protocol's Clean Development Mechanism (CDM). Empirically, we analyze private capital investment in 3749 climate mitigation projects under the CDM, 2003–2011. Since the CDM allows both bilateral and unilateral implementation, we can compare the two modes of contracting within one context. Our model analyzes equilibrium private investment in climate mitigation. When the cost of mitigation is high, unilateral project implementation in one host country,

without foreign collaboration, draws more investment than bilateral contracting, whereby foreign investors participate in the project.

What are the consequences of ignoring attributes in choice experiments? Implications for ecosystem service valuation

- Ecological Economics---2013---Sergio Colombo,Michael Christie,Nick Hanley

This paper investigates the sensitivity of choice experiment values 3AL for ecosystem services to ‘attribute non-attendance’. We consider three cases of attendance, namely that people may always, sometimes, or never pay attention to a given attribute in making their choices. This allows a series of models to be estimated which addresses the following questions: To what extent do respondents ignore attributes in choice experiments? What is the impact of alternative strategies for dealing with attribute non-attendance? Can respondents reliably self-report non-attendance? Do respondents partially attend to attributes, and what are the implications of this? Our results show that allowing for the instance of ‘sometimes attending’ to attributes in making choices offers advantages over methods employed thus far in the literature.

Explaining institutional persistence, adaptation, and transformation in East German recreational-fisheries governance after the German reunification in 1990

- Ecological Economics---2013---Katrin Daedlow,Volker Beckmann,Maja Schlüter,Robert Arlinghaus

We investigated the capacity of a natural resource governance system to absorb a disturbance while maintaining its major structures and functions (defined as institutional resilience). Exemplified by East German recreational fisheries governance being disturbed by the German reunification, we studied why in five out of six East German states the former centralized governance system persisted while in one state a decentralized governance system was implemented. Based

on resilience thinking and new institutional economics, three analytical steps were developed to assess: (1) the structure and function of the governance system, (2) the attributes of the disturbance and the reorganization process, and (3) human motivations. The centralized system persisted because leading managers wanted to preserve customary structures and functions, minimize transaction costs of change, and maintain powerful positions. This was possible because of their influential positions in the reorganization process. Our results suggest that in externally induced, fundamental, and rapid disturbances decision-makers tend to prevent transformations in their governance system. However, key managers in the sixth state faced the same disturbance but their lack of leadership and an emerging rivalry for fishing rights facilitated a transformation to decentralized governance. Thus, attributes of disturbances can be leveraged by actors' motivations in the reorganization process.

Economic growth and the evolution of water consumption in Spain: A structural decomposition analysis

- Ecological Economics---2013---Ignacio Carro, Rosa Duarte, Julio Sánchez-Chóliz

The aim of this paper is to examine how technology, processes of input substitution, and changes in final demand, all of which underlie economic growth, influence water consumption. This analysis is undertaken for Spain during a significant socio-economic period, from 1980, the beginning of the democratic era, to 2007, the onset of the current economic crisis.

Macroeconomic narratives in a world of crises: An analysis of stories about solving the system crisis

- Ecological Economics---2013---Emil Urhammer, Inge Røpke

Since the financial crisis in 2008, a series of publications on macroeconomic responses to the compound crises of the economy and the environment have emerged. Under labels such as green new deal, green growth

and the great transition, attempts at offering coherent responses to the crises have been made. These responses have in common that they all present a large number of policy proposals for ways in which to solve the current crises and achieve a sustainable economy. This article provides a mapping of a selection of such responses and an analysis of their content. The analysis combines discourse theory and narrative analysis and investigates discourses by studying the narratives they produce. The study thus contributes to the long line of analyses on discourses on sustainable economy: empirically, by investigating and analysing a number of macroeconomic proposals for solving the system crisis, and theoretically, by elaborating on the concept of narrative dynamics in relation to persuasive strength in political decision-making.

Are emotions to blame? — The impact of non-analytical information processing on decision-making and implications for fostering sustainability

- Ecological Economics---2013---Susanne Menzel

Policy advice based on a rationalist perspective to foster sustainable behaviour has approached its limits; and gaps in the established models are becoming more and more obvious. To better understand how unsustainable choices are made, and to foster sustainable decision-making, alternatives to the rationalist models of human decision-making need to be investigated. Such alternative models have already demonstrated their usefulness in other fields than ecological economics. The paper begins with a presentation of conventional models of human behaviour, as well as their advances and limitations in ecological and behavioural economics. In most of these models, the dominance of analytical thinking still prevails. I identify this as problematic given the evidence for the influence of emotion and intuition in decision-making. To offer a perspective on human behaviour that acknowledges this influence, dual-process models are presented. Established applications of these models are then used to propose four basic types of explanations for unsustainable behaviour. Based on these explanations preliminary ideas to promote sus-

tainable decision-making are developed. These ideas are considerably different from policy implications of the established economic model.

The god of the mountain and Godavarman: Net Present Value, indigenous territorial rights and sacredness in a bauxite mining conflict in India

- Ecological Economics---2013---Leah Temper,Joan Martinez-Alier

This article provides an environmental and institutional history of the highly politicized and contested process of setting a Net Present Value (NPV) for forests in India, in a context of increasing conflicts over land for development, conservation and indigenous rights. Decision-making documents in the Supreme Court and in one specific case of a bauxite mining conflict involving Vedanta in the Niyamgiri hills are studied to come to conclusions about how economic valuation of forests has moved through the political process. We argue that establishing NPV for forests is neither conducive to conservation nor to environmental justice for the following three reasons. The technical and political process of setting prices deepens and reproduces structural inequalities with negative distributive effects. NPV encourages economistic decision-making procedures that exclude participation. Finally NPV does not recognize or take into account cultural difference or plural values. We thus conclude that economic valuation of forest products and services has not managed to “save” forests in India and is not an effective or viable strategy for expressing the value of forests or for environmental conservation and environmental justice activism.

Class/racial conflict, intolerance, and distortions in urban form: Lessons for sustainability from the Detroit region

- Ecological Economics---2013---Igor Vojnovic,Joe T. Darden

In this qualitative analysis into the equity conditions of urban sustainability, an examination is presented into the complexity of one particular aspect of intra-generational equity, racial and class discrimination and

its role in distorting urban form and in generating resource inefficient and environmentally destructive human activity patterns. The article, therefore, focuses on the role of discrimination itself in encouraging ecological degradation. The Detroit region shows that racial and class conflicts can facilitate the shaping of the urban built environment as one population subgroup, largely white and upper-income, attempts to distance itself from another sub-group that is largely black, lower income, and considered a threat. The outcome is not only disinvestment and decline in the urban core, but also excessive suburbanization, as whites seek homogenous urban environments and use space to increase the distance between themselves and the black population. The study shows that the lack of cooperation and tolerance across ethnic/racial and class subgroups facilitates inefficient low-density and scattered developments, and excessive degradation of natural ecological systems.

Beyond inducement in climate change: Does environmental performance spur environmental technologies? A regional analysis of cross-sectoral differences

- Ecological Economics---2013---Claudia Ghisetti,Francesco Quatraro

This paper contributes to the debate on the inducement of environmental innovations by analyzing the extent to which endogenous inducement mechanisms spur the generation of greener technologies in contexts characterized by weak exogenous inducement pressures. In the presence of a fragile environmental regulatory framework, inducement can indeed be endogenous and environmental innovations may be spurred by firms' reactions to their direct or related environmental performance. Cross-sector analysis focuses on a panel of Italian regions, over the time span 2003–2007, and is conducted by implementing zero-inflated regression models for count data variables. The empirical results suggest that in a context characterized by a weak regulatory framework, such as the Italian one, environmental performance has significant and complementary within- and between-sector effects on the generation of

green technologies.

The poverty–vulnerability–resilience nexus: Evidence from Bangladesh

- Ecological Economics---2013---Sonia Akter, Bishawjit Mallick

Vulnerability and resilience lie at the core of the new paradigm governing natural disaster risk management frameworks. However, empirical understandings of socio-economic resilience and its links with poverty and vulnerability are limited. This paper presents an empirical investigation of socio-economic resilience to natural disasters in a tropical cyclone-prone coastal community in Bangladesh. The results indicate that the cyclone in question had negative impacts on the community, particularly in terms of income, employment and access to clean water and sanitation. Consistent with the findings of the social vulnerability literature, our results also suggest that the poor were more vulnerable and suffered significantly higher economic, physical and structural damage. However, this high vulnerability did not necessarily lead to low resilience, as these individuals exhibited a greater ability to withstand the shock compared to their non-poor neighbors. This refutes the flip-side hypothesis of the link between vulnerability and resilience (i.e. vulnerability is the flip side of resilience). The findings imply that the increased risk of tropical cyclones is likely to reduce incomes and standards of living among the tropical coastal communities. However, the burden of these adverse impacts is unlikely to be disproportionately borne by the poorer segment of the society.

On sustainability and materiality. Homo faber, a new approach

- Ecological Economics---2013---Emilia Ferraro, Louise Reid

This paper explicitly engages with recent debates in Ecological Economics on what mode of humanity and person the sustainability project requires (e.g. Becker, 2006; Siebenhüner, 2000) and responds to calls to widen our understanding of the human being beyond homo

economicus (e.g. Bina and Guedes Vaz, 2011). Using the example of the increasing attention to well-being, both within policy and academic circles, we seek to contribute to current critical considerations of ‘the sustainable person’ (Becker, 2010, 2012). We do this by incorporating often neglected perspectives from disciplines rooted in the Arts and Humanities – specifically anthropology and philosophy – introducing to debates on sustainability the notion of ‘homo faber’. Our aim is threefold: (1) to invite creative thinking about the role that materiality and practice play in the constitution of alternative notions of ‘being’; (2) to soften the anthropocentrism of western worldviews by considering the possibility of a different mode of humanity based upon “connection rather than separation, interdependence rather than autonomy” (Gibson-Graham, 2011:2), and (3) to encourage deeper reflection about the need for, and the challenge of interdisciplinary sustainability research.

Justifying precautionary policies: Incommensurability and uncertainty

- Ecological Economics---2013---Jonathan Aldred

When decisions are taken in conditions of Keynesian or Knightian uncertainty, and when there is a threat of serious or irreversible environmental damage, the Precautionary Principle is often recommended to guide decision-making. However, the Precautionary Principle has been widely criticised. In response to these criticisms, a qualitative version of the Precautionary Principle is developed which draws its normative content from a blend of formal decision theory and political philosophy. It is argued that precautionary action can be justified by some flexible combination of uncertainty and incommensurability. The ‘greater’ the uncertainty, the ‘less’ incommensurability is required to justify precautionary action, and vice versa. Throughout the paper, the arguments are explored using the example of climate change decision problems.

The effects of a spruce bark beetle outbreak and wildfires on property values in the wildland–urban interface of south-central Alaska, USA

- Ecological Economics---2013---Winslow D. Hansen, Helen Naughton

Climate warming is causing the frequency, extent, and severity of natural disturbances to increase. To develop innovative approaches for mitigating the potential negative social consequences of such increases, research is needed investigating how people perceive and respond to natural disturbance. This study uses spatial econometric techniques in a hedonic pricing framework to estimate how wildfires and a spruce bark beetle (*Dendroctonus rufipennis*) outbreak affect assessed property values on the Kenai Peninsula of south-central Alaska in 2001 and 2010. We find that large wildfires and the spruce bark beetle outbreak increase property values while small wildfires decrease property values. These findings suggest that homeowners may form complex viewpoints, weighing enhancements to environmental amenities with negative consequences that stem from the occurrence of natural disturbance.

Development of a cost-effective diversity-maximising decision-support tool for in situ crop genetic resources conservation: The case of cacao

- Ecological Economics---2013---Aurelia F. Samuel, Adam G. Drucker, Sven B. Andersen, Henner Simianer, Maarten van Zonneveld

This paper undertakes an exploration of the potential application of the Weitzman prioritisation approach to the conservation of plant genetic resources (PGR). Using a case study approach and assuming limited conservation resources, this approach is applied to calculate the maximum diversity which can be conserved based on a clustering of cacao species (*Theobroma cacao* L.). A conservation budget allocation model applied across a set of ten clusters and nine subclusters of cacao, together with the use of alternative diversity and risk measures, allowed for an evaluation of

a range of potential conservation outcomes. Alternative risk measures generally resulted in the allocation of conservation funds to the same priority clusters of cacao (Criollo and Curaray). However, the use of the number of locally common alleles as an alternative to the original Weitzman diversity measure produced a markedly different result, prioritising the Purús cluster in Western Amazonia. The Curaray cluster was highly prioritised under both diversity measures, indicating its distinctiveness relative to both the Criollo and Purús clusters. We conclude that the Weitzman approach can indeed allow diversity comparisons to be made between the outcomes of different PGR conservation strategies, although subjective decisions regarding the choice of diversity and risk measures remain.

The cost of useful knowledge and collective action in three fisheries

- Ecological Economics---2013---James A. Wilson, James M. Acheson, Teresa R. Johnson

In a complex environment knowledge is valuable and its acquisition is costly; as a result people are careful about what to learn and how to learn it. We suggest that the dynamics of the “local” environment strongly influences the method that individuals choose to acquire useful knowledge and is one of the principal determinants of the way they compete and cooperate. We focus on the way different environments lead to different costs, especially the relative opportunity costs, of search and communication and, consequently, to the emergence of different patterns of persistent cooperation and competition. In predictably regular and in predictably random environments, the cost of autonomous search is low and little social structure emerges. In complex environments, the relative costs of communication are high, leading to persistent social structure. Our presumption is that the characteristics of the emergent, or informal, social structure are a major determinant of successful collective action. We investigate the hypothesis through a comparison of three fisheries in which the costs of acquiring useful knowledge are different. Because of these differences, fishers’ acquisition of useful knowledge leads to dif-

ferent social structure and different preconditions for successful collective action in each fishery. The lobster fishery is characterized by strong collective action and appears sustainable; the urchin and groundfisheries, worked by the same communities, are not even though almost all their participants are familiar with and often participate in the lobster fishery.

An assessment of two environmental and economic benefits of ‘Cash for Clunkers’

- Ecological Economics---2013---Shoshannah M. Lenski, Gregory A. Keoleian, Michael R. Moore

This research aims to provide a more comprehensive, life cycle accounting of two categories of environmental and economic benefits associated with the \$3billion US “Cash for Clunkers” vehicle scrappage program. First, using a life cycle emissions methodology developed in Lenski et al. (2010), we find that about 29,000 metric tons of criteria pollutant emissions were avoided, for a benefit of about \$23million; avoided carbon dioxide emissions, by comparison, provided a benefit worth \$90million. Second, we compare the market value of scrapped vehicles to the rebates provided, calculating the consumer surplus or “gift” to participants to be up to \$2billion (about \$2000 to \$3000 per vehicle). This is significantly more than offered in previous vehicle scrappage programs, and suggests opportunities to get more environmental and economic “bang for the buck.” Finally, these two categories of benefits are found to be heavily concentrated geographically around urban centers. About 2% of US counties (50 counties) received 50% and 30% of the aggregate benefits from avoided criteria pollutant emissions and consumer surplus from the rebates, respectively.

Addressing dependency in the sportfishing valuation literature: Implications for meta-regression analysis and benefit transfer

- Ecological Economics---2013---Arvin B. Vista, Randall S. Rosenberger

Meta-regression analysis is a statistical summary or synthesis of a body of evidence. However, when primary

studies provide more than one estimate, the presence of dependence in the metadata has implications for the statistical efficiency of estimated moderator variables. Previous meta-analyses have adjusted for within study dependence through ad hoc procedures (e.g., selecting one estimate per study and study average) or regression-based methods (e.g., weighted and panel data models). This paper defines dependency based on the underlying primary data (i.e., from the same sample) and examines the effect of different models and treatments on meta-regression estimation and implications for benefit transfer performance. The models are applied to the sportfishing literature that contains 140 papers providing 833 estimates of access values for fishing in the United States and Canada. The different methods of adjusting for dependency within the sportfishing metadata result in differences in the estimated model coefficients; hence, different transferred values and transfer errors.

The marginal cost of carbon abatement from planting street trees in New York City

- Ecological Economics---2013---Kent Kovacs, Robert G. Haight, Suhyun Jung, Dexter H. Locke, O’Neil-Dunne, Jarlath

Urban trees can store carbon through the growth process and reduce fossil fuel use by lowering cooling and heating energy consumption of buildings through the process of transpiration, shading, and the blocking of wind. However, the planting and maintenance of urban trees come at a cost. We estimate the discounted cost of net carbon reductions associated with planting and caring for street trees in New York City (NYC) over 50- and 100-year horizons. Depending on the species planted, the cost of reducing carbon, averaged across planting locations, ranges from \$3133 to \$8888 per tonne carbon (tC), which is higher than current cost estimates of forest-based carbon sequestration. The London plane tree is the most cost-effective species because of its long life span and large canopy, and the marginal cost of carbon reduction for the species ranges from \$1553 to \$7396/tC across planting locations. The boroughs of Staten Island and Queens have

planting locations with the lowest average costs of carbon reduction (\$2657/tC and \$2755/tC, respectively), resulting from greater reductions in energy consumption in nearby buildings, which have fewer stories and more residential use than buildings in the other boroughs.

Democracy and climate change policies: Is history important?

- Ecological Economics---2013---Per Fredriksson, Eric Neumayer

This paper argues that it is countries' historical experience with democracy, the democratic capital stock, rather than current levels of democracy that determines current climate change policies. Empirical evidence using data starting as far back as year 1800 for 87 countries, which together are responsible for 93.7% of global carbon emissions, suggests that the democratic capital stock has an important and robust effect on climate change policies. A history of executive constraints is particularly important. The current level of democracy does not play a role once democratic capital has been accounted for.

Designing a payments for ecosystem services (PES) program to reduce deforestation in Tanzania: An assessment of payment approaches

- Ecological Economics---2013---David Kaczan, Brent Swallow, Wiktor Adamowicz

Payments for ecosystem services (PES) programs aim to improve environmental outcomes by providing direct incentives to land managers for the provision of ecosystem services. Participation in PES programs is voluntary, so effective program design requires careful consideration of farmers' preferences. This study quantifies such preferences using a choice experiment. The study site is the East Usambara Mountains, Tanzania, an internationally recognized 'biodiversity hotspot.' We assess preferences for four payment approaches: constant and variable annual cash payments to individual farmers, a constant annual cash payment to

a village fund on behalf of farmers, and an upfront manure fertilizer payment. We find that the manure fertilizer payment was statistically significant in motivating farmer participation while the group payment was non-significant. In addition, the relationship between the likelihood of participation and the stringency of conditionality is surprisingly non-linear. In a test of external validity, average willingness to accept (WTA) values are found to be similar to the average opportunity cost of maintaining land uses consistent with conservation objectives.

Groundwater management: The effect of water flows on welfare gains

- Ecological Economics---2013---Todd Guilloos, Andreas D. Pape, Neha Khanna, Karen Salvage

We construct a spatially explicit groundwater model that has multiple cells and finite hydraulic conductivity to estimate the gains from groundwater management and the factors driving those gains. We calibrate an 246-cell model to the parameters and geography of Kern County, California, and find that the welfare gain from management for the entire aquifer is significantly higher in the multi-cell model (27%) than in the bathtub model (13%) and that individual farmer gains can vary from 7% to 39% depending of their location and relative size of demand for water. We also find that when all farmers in the aquifer simultaneously behave strategically the aggregate gains from management are significantly smaller. However, individual farmers do not have the incentive to behave strategically even with finite hydraulic conductivity when other farmers behave myopically.

The role of market-based instruments for biodiversity conservation in Central and Eastern Europe

- Ecological Economics---2013---Veronika Chobotová

This paper analyses the development and emergence of market based instruments for biodiversity conserva-

tion in Central and Eastern European (CEE) countries. The development of market-based instruments for biodiversity conservation has been receiving increased attention as a possible cheaper and more effective alternative to the global regulatory approach. The implementation of such instruments is particularly challenging in post-socialist countries, where the former state command-and-control economy disturbed the normal functioning of markets. Our analysis indicates that market-based instruments can increase the effectiveness of biodiversity conservation, but are not always suitable and appropriate. The following preconditions for the effective design of market-based instruments in CEE countries have been identified: clear property rights and decision making structure, transparent rules for information dissemination, and monitoring responsibilities. Our results show that the successful implementation of market-based instruments for biodiversity conservation in CEE countries is furthermore influenced by pre-existing formal and informal institutions, in which reputation and trust may play a role. However, market-based instruments should complement rather than substitute regulatory approaches, and in combination with traditional regulation, such can become critical in achieving the objectives of biodiversity conservation.

Co-managing common-pool resources: Do formal rules have to be adapted to traditional ecological norms?

- Ecological Economics---2013---Björn Volan, Sebastian Prediger, Markus Frölich

We examine the effectiveness of three democratically chosen rules that alleviate the coordination and cooperation problems inherent in collectively managed common-pool resources. In particular we investigate how rule effectiveness and rule compliance depend on the prevailing local norms and ecological values held by resource users. For this purpose, we employ a framed field experiment that is based on a rangeland model for semi-arid regions and carried out with communal farmers in Namibia and South Africa. Participants could vote for three ‘best practice’ management

rules found in many places around the world that are discussed for implementation in the study area: (temporary) private property rights, rotational grazing or limitation of livestock numbers. All rules were designed in a way that facilitated cooperation or coordination of actions. The focus of this study lies on the interactions between these rules and prevalent ecological norms exhibited in the rounds prior to rule implementation. In contrast to previous lab experimental studies, we find that democratic voting of rules is not sufficient for high rule compliance and an overall enhancement in cooperation. Rules turned out to be inefficient if they were in conflict with the prevalent ecological norm.

Nature, roads or hospitals? An empirical evaluation of ‘sustainable development preferences’

- Ecological Economics---2013---Lara Lázaro-Touza, Giles Atkinson

While a key proposition is that a sustainable path is one where wealth does not decline, whether losses in natural capital can be compensated in wellbeing terms by more produced, social or natural capital remains an area of controversy. In this paper, we seek to better understand preferences for different combinations of assets that comprise (part of) the asset portfolio of a nation. In a study of coastal and marine natural assets, we test for the existence of weak or strong sustainability preferences using different compensation options (respectively produced capital and natural capital) offered to a sample of the public in Spain in the case of possible future oil spills. As a further element of this test, we provide an empirical reflection on Aldred (2002, 2006) and Turner (2007) who speculate that individuals may not view money as compensating for certain environmental losses whereas investments in social assets may offer a more acceptable compensation option. Our results do appear to circumscribe in some way the acceptability of investing in produced capital and reveal a tendency towards a preference for social capital compensation. Nevertheless, the size of the oil spill and the environmental beliefs of respondents also influence choices over the natural capital compensation

option.

Does offshoring contribute to reducing domestic air emissions? Evidence from Belgian manufacturing

- Ecological Economics---2013---Bernhard Michel

Since the mid-90s, production-related air emissions in Belgian manufacturing have fallen substantially and it can be shown that the pace of the fall has been fastest for domestic intermediates. It is widely debated whether offshoring has played a role in this fall by replacing domestic intermediates by imported intermediates. This paper develops a decomposition analysis to measure the contribution of offshoring – the share of imported intermediates in total intermediates – to the fall in air emissions for domestic intermediates. Based on the results from this decomposition analysis, it was possible to calculate that 17% of the fall in greenhouse gas emissions, 6% of the fall in acidifying emissions and 7% of the fall in tropospheric precursor emissions in Belgian manufacturing between 1995 and 2007 can be attributed to offshoring.

Climate change driven shifts in the extent and location of areas suitable for export banana production

- Ecological Economics---2013---Brian Machovina,Kenneth J. Feeley

Species distribution modeling (SDM) is used to map areas predicted to be suitable for commercial banana production in Central and northwestern South America. Using the downscaled climate projections for 2060 from seven leading global climate models we then predict the geographical shifts in areas suitable for banana production. We repeat this process for conventional and organic banana production. Approximately half of the existing conventional plantations included in the analysis are located in areas predicted to become unsuitable for banana production by 2060. The overall extent of areas suitable for conventional banana cultivation is predicted to decrease by 19%, but all countries are predicted to maintain some suitable areas. The

extent of areas suitable for organic banana cultivation is predicted to nearly double due primarily to climatic drying. Several countries (e.g., Colombia and Honduras) are predicted to experience large net decreases in the extent of areas suitable for banana cultivation. Some countries (e.g., Mexico) are predicted to experience large net increases in the extent of suitable areas. The shifts in the location of areas that will be suitable for banana cultivation are predicted to occur mainly within areas outside of protected areas and that are already under agricultural production.

Social influence and consumer preference formation for pro-environmental technology: The case of a U.K. workplace electric-vehicle study

- Ecological Economics---2013---Jon Axsen,Caroline Orlebar,Stephen Skippon

We investigate the roles of social influence in the formation of consumer perceptions and preferences for pro-environmental technologies, using the example of battery electric vehicles (BEVs). The context was a technology-based workplace in the U.K. with around 500 members of staff, 57 of whom took part in a BEV experience project in 2010. Several months later, we recruited a diverse sample of 21 staff to complete semi-structured interviews. Following a multi-method approach, we elicited details about their perceptions and valuation of BEVs, experiences with BEVs, and social interactions relating to BEVs. Participants reported a wide variety of perceptions of BEV attributes, including environmental benefits and functional drawbacks. The majority of participants indicated that their BEV perceptions were “highly influenced” by at least one social interaction. We use the reflexive layers of influence conceptual framework to categorize social influence according to three processes: diffusion, the sharing of BEV-related information; translation, the discussion of uncertain BEV benefits and drawbacks; and reflexivity, the relating of BEV technology to self-concept. Findings suggest that participant perceptions change in part through social negotiation of meaning, lifestyle and identity. Neglect of social influence processes will underestimate the potential for

shifts in consumer preferences regarding emerging pro-environmental technologies.

Explaining the appearance and success of open space referenda

- Ecological Economics---2013---Martin Heintzelman, Patrick Walsh, Dustin J. Grzeskowiak

Many communities in the United States have begun enacting policies to preserve open space, often through local voter referenda. New Jersey sponsors such municipal action through the Green Acres Program by providing funding and low interest loans to towns that choose to increase property taxes and spend the money raised on open space preservation for the purposes of conservation and/or recreation. This paper endeavors to understand which factors contribute to the appearance and success of these measures. Although previous literature has examined this issue, this is the first study to account for spatial dependence/spatial autocorrelation and to explore dynamic issues through survival analysis. The traditional two stage model from the literature is extended by incorporating a Bayesian spatial probit for the first stage and a maximum-likelihood spatial error model in the second stage. A Cox-proportional hazard model is used to examine the timing of referenda appearance. Spatial dependence is found in the second stage of the analysis, indicating that future studies should account for its influence. There is no strong evidence for spatial dependence or correlation in the first stage. The survival model is found to be a useful complement to the traditional probit analysis of the first stage.

Consumer stated purchasing preferences and corporate social responsibility in the wood products industry: A conjoint analysis in the U.S. and China

- Ecological Economics---2013---Zhen Cai, Francisco X. Aguilar

The impacts of disclosed level of corporate social responsibility (CSR), domestic versus imported origin and type of construction on consumers' stated wood

product purchasing preferences were examined in the U.S. and China. Hierarchical logit models based on a Bayesian framework were utilized to test the magnitude and statistical significance of each wood product attribute using survey data. Results indicate that U.S. and Chinese respondents: (a) were more likely to choose products from manufacturing companies with a higher level of CSR rating compared with an unknown one; (b) preferred domestically manufactured wood products compared to imported ones; and (c) expressed higher interest in wood products made of solid wood compared with composites. In terms of demographics, respondents' higher education levels corresponded with higher preferences for products from companies with the highest (five-star) CSR rating in the U.S. Statistically-significant income effects were detected only in the Chinese sample when respondents indicated their purchasing preferences for wood products with three-star or five-star CSR levels. Implications for improving wood products companies' managerial performance and suggestions for future studies are provided.

Water users associations and irrigation water productivity in northern China

- Ecological Economics---2013---Lei Zhang, Nico Heerink, Liesbeth Dries, Xiaoping Shi

Traditional irrigation water management systems in China are increasingly replaced by user-based, participatory management through water users associations (WUAs) with the purpose to promote, economically and ecologically beneficial, water savings and increase farm incomes. Existing research shows that significant differences exist in the institutional setup of WUAs in China, and that WUAs have not been universally successful in saving water and improving farm incomes. This paper aims to examine the underlying causes of differences in WUA performance by analyzing the impact of WUA characteristics on the productivity of irrigation water. Explanatory variables in our analysis are derived from Agrawal's user-based resource governance framework. Applying a random intercept regression model to data collected among 21 WUAs

and 315 households in Minle County in northern China, we find that group characteristics, particularly group size and number of water users groups, and the existing pressure on available water resources are important factors in water productivity. Resource characteristics, i.e. resource size and degree of overlap between the WUA boundaries and natural boundaries, do not significantly affect water productivity in our research area.

The ultrasocial origin of the Anthropocene

- Ecological Economics---2013---John Gowdy,Lisi Krall

The current geological epoch has been dubbed the Anthropocene—the age of humans. We argue that the roots of the Anthropocene lie in the agricultural revolution that began some 8000 years ago. Unique human psychological and cultural characteristics were present in our distant hunter–gatherer past, but in terms of the biophysical impact of our species, agriculture represented an unequivocal and decisive evolutionary break. With the transition to agriculture human society began to function as a superorganism functioning as a single unit designed by social natural selection to produce economic surplus. Where environmental conditions were permitted, early human agricultural societies followed the same pattern as a few social insects and exhibited explosive population growth, complex and detailed division of labor, intensive resource exploitation, territorial expansion, and a social organization favoring the survival and growth of the supergroup over the well-being of individuals within the group. Similar economic forces lie behind ultrasociality in social insects and humans—increased productivity from the division of labor, increasing returns to scale, and the exploitation of stocks of productive resources. Exploring the evolutionary mechanisms behind ultrasociality offers insights into the growth imperative that threatens the stability of the earth’s life support systems.

The incentives of private companies to invest in protected area certificates: How coalitions can improve ecosystem sustainability

- Ecological Economics---2013---Nathalie Meißner

Since the early 80’s, the global demand on nature has exceeded the earth’s capacity. To reduce the overuse of the very resources on which human life depends, protected areas have been developed worldwide. Typically, national states, NGOs and charities have funded protected areas, with limited investment from private companies. This paper analyzes one option to increase private investment: an international market for protected area certificates. Following a cost–benefit analysis, a three-stage coalition game is developed. The corporate dependency on ecosystems is modeled through the ecological footprint. By implementing instruments such as side payments, membership restriction and non-compliance penalties, the model shows that corporate environmental agreements reduce the individual cost of ecological protection and enhance social welfare. The findings are supported by a sensitivity analysis conducted for the German tourism sector in Zanzibar.

Conserving metapopulations in human-altered landscapes at the urban–rural fringe

- Ecological Economics---2013---Dana Marie Bauer,Stephen Swallow

The conversion of natural areas to human-dominated land uses results in loss, degradation, and fragmentation of wildlife habitat which often lead to species endangerment and local extinction. The risk of endangerment may be particularly acute for species that exist as metapopulations in which viability of the species is contingent upon dispersal of individuals among local sub-populations. This paper uses an optimization framework to investigate the problem of conserving metapopulations residing in areas at the urban–rural fringe. We compare the optimal allocation of preservation to outcomes of four other policy alternatives including the reserve-site-selection option that fully preserves habitat patches while allowing full development of the intervening dispersal matrix. In general,

the optimal allocation includes some amount of preservation in both habitat patches and dispersal matrix, with the level of protection typically greater in habitat patches. The reserve-site-selection conservation option is optimal in only a few cases. Heterogeneity in terms of land use and landscape structure adds complexity to the optimal solution such that no one policy works well across all land units and in situations where the landscape structure is skewed, full protection of some land units and full development of others becomes more common.

On the relation between ecosystem services, intrinsic value, existence value and economic valuation

- Ecological Economics---2013---Marc D. Davidson

Various attempts have been made to amalgamate the concepts of intrinsic value and ecosystem services, often with a stop-over at the economic concept of existence value. These attempts are based on a confusion of concepts, however. In this article, two types of non-use values are distinguished: warm glow value, related to the satisfaction people may derive from altruism towards nature, and existence value, related to the satisfaction people may derive from the mere knowledge that nature exists and originating in the human need for self-transcendence. As benefits to humans, warm glow and existence values can be considered ecosystem services. Neither warm glow value nor existence value represents benefits to nature itself, however. Intrinsic value lies outside the scope of the wide palette of ecosystem services.

Forest certification in Russia: Challenges of institutional development

- Ecological Economics---2013---Olga Ulybina, Shailaja Fennell

This article examines the implementation of voluntary forest certification in Russia and the role it has played so far as a mechanism of multi-level governance with the potential to create sustainable forestry. The evidence was gathered from a data-set of over a hundred

in-depth interviews with individuals from business, communities, state and non-governmental organizations in several major forestry regions in the European and Far-Eastern parts of Russia. The respondents' views regarding the nature and effects of certification were wide ranging. Certification is associated with new and powerful tools that are an alternative to coercive state governance, which may become instrumental in ensuring law enforcement and sustainability. At the same time, the combination of commercial drivers behind certification and the lack of social controls may lead to the institutionalization of existing, not necessarily desirable, forestry practices. Our paper shows that the inconsistent outcomes of certification are highly related to path-dependent social institutions and local practices. The expectations for internationally-devised schemes aimed at establishing sustainable forest management can be easily thwarted by the behavior of individuals involved at the local level. Greater focus on low-level actors is required for effective realization of multi-level governance in Russian forestry.

Assessment of the theory of comprehensive national accounting with data for Portugal

- Ecological Economics---2013---Rui Pedro Mota, Tiago Domingos

We present time-series tests of the quality of genuine savings and green net national income for predicting welfare changes. These tests check the validity of the theory of comprehensive national accounting, and more broadly of the theory of economic growth. The value of technological progress is included, as well as the effects of business cycles. We use estimates for Portugal as inputs. Overall, our results indicate that both genuine savings and changes in green net national income have the same sign as changes in welfare, but reject the hypothesis that the estimated comprehensive national accounting measures coincide with the theoretical expressions. The results also suggest that comprehensive accounting indicators perform better than conventional national accounting indicators, implying that, in general, the corrections proposed by the comprehensive accounting theory add explanatory

power to conventional measures. The exception is the inclusion of education expenditures and technological progress, which decrease explanatory power. Excluding business cycles from green net national income increases the agreement with the theory. Comparing both indicators, in general, genuine savings presents better results.

Transforming market–nature relations through an investigative practice

- Ecological Economics---2013---Paavo Järvensivu

Degrowth theorists and practitioners have challenged the economic growth paradigm and sought for economic, cultural and political alternatives that would respect the planetary boundaries. Their strategy has generally been to either reject the formal market system as a whole and experiment with alternative practices outside markets or suggest changes in the policies that regulate markets. They have paid less attention to potential changes in market cultures. This paper seeks to foster the cultural transformation of current market–nature relations while retaining the radical core of degrowth. The paper presents an investigative practice that was found in an ethnographic study of an evolving forest-based market in Finland. The practice seems to have the potential to disrupt habitual ways of approaching nature and of turning it into exchangeable and consumable objects. According to practice theory, this kind of disruption creates space for emerging alternatives to the dominant practices. In this sense, the investigative practice works similarly to an environmental shock, without the harmful material effects. In addition, the investigative practice involves a critical approach that supports a transition toward sustainable market–nature relations.

A two-stage econometric method for the estimation of carbon multipliers with rectangular supply and use tables

- Ecological Economics---2013---João F.D. Rodrigues, José Rueda-Cantuche

The Supply-Use Based Econometric (SUBE) approach

was proposed to calculate stochastic input–output multipliers from rectangular supply-use tables under the product technology assumption. However, the resulting total use of direct requirements stimulated by final demand (be they carbon emissions, labor, etc.) may differ from the actual total use of direct requirements. To solve this problem, we propose in this paper a two-stage SUBE approach, which takes as prior the initially estimated SUBE multipliers and obtains a posterior set of two-stage SUBE multipliers by constrained least squares minimization. We illustrate the results with an empirical application for carbon emissions in the Portuguese economy in 2005.

Prospects for sustainable land-use policy in Germany: Experimenting with a sustainability heuristic

- Ecological Economics---2013---Beate Fischer, Bernd Klauer, Johannes Schiller

Land is an essential yet limited natural resource. Its current unsustainable use highlights the need for sustainability policies. In order to explore potential policy strategies, we use the concepts of stocks and durable institutions as tools for analysing temporal structures in nature and society. These concepts are incorporated into a heuristic aimed at reducing complexity and finding windows of opportunity for policy action. The heuristic is applied to current German land-use policy. We show that the German government is highly unlikely to achieve its declared sustainability goal to reduce the rate of land conversion to 30ha/day by 2020. Analysis of the inherent dynamics of major stocks and institutions reveals that, even in a situation with stagnating or declining population, the inertia of institutions such as local municipal self-administration and the municipal financial system prevents the government's sustainability goals from being achieved.

How do investors respond to Green Company Awards in China?

- Ecological Economics---2013---Thomas Lyon, Yao Lu, Xinzhen Shi, Qie Yin

We find that firms winning Green Company Awards in China from 2008 to 2011 experienced on average insignificant and in some cases significantly negative effects on shareholder value. Various robustness checks suggest that these findings are not driven by the inefficiency of the Chinese stock market or a lack of perceived credibility of the award. In addition, we find important variation in the responses across firms: shareholders of firms in low-pollution industries and firms with primarily private ownership responded more negatively to award announcements. Furthermore, the peers of winning firms showed higher announcement returns than the award winners. Our results suggest that a key benefit of corporate environmentalism in China comes through building stronger relationships with government, and that otherwise the market generally discourages firms from environmental leadership.

Using resident perceptions of values associated with the Australian Tropical Rivers to identify policy and management priorities

- Ecological Economics---2013---Silva Larson,Natalie Stoeckl,Barbara Neil,Riccardo Welters

Many rivers in the world are facing changes due to increased development needs, and these changes impact on a range of values people associate with these rivers. We use a non-monetary tool in a mail-out survey of 291 households to assess the importance of social and cultural values of the Australian Tropical Rivers and identify associated management priorities. Nine river values were included in the assessment: bequest, existence, recreational fishing, other types of recreation, aesthetics, teaching, water for human life, water for other life and commercial use. Of these, the most important values identified by respondents were biodiversity, human life, and bequest, with widespread agreement across respondents about their importance. Management priorities were assessed using the Index of Dissatisfaction (IDS). Although commercial values ranked sixth out of nine in terms of importance they emerged as the highest priority using IDS. This is because they received the lowest levels of satisfaction,

associated with concerns over issues such as pollution, overuse and lack of monitoring. Thus, the main policy issue in this region might not be one of protecting commercial values, but of addressing concerns relating to the commercial use of water, and its potential negative impact on ecological and social values.

Material use and material efficiency in Latin America and the Caribbean

- Ecological Economics---2013---James West,Heinz Schandl

Different world regions have followed very different trajectories for natural resources use over the recent decades. Latin America has pursued a development path based largely on exports of primary resources. Adopting this path has characteristic environmental and social impacts. In this paper, we provide the first broad based estimate of material use and material efficiency for the region, beginning in 1970 and extending to the onset of the global financial crisis in 2008. The results show a region with rapidly growing primary materials consumption, which is simultaneously becoming less efficient at converting those resources into national income. Using an IPAT framework, we found that population growth and rising per-capita incomes made comparable contributions to growing material use, while technological change as reflected in material intensity, did not moderate consumption. Increasing materials intensity, observed for the region as a whole, is also observed for most individual countries. This contrasts with some other world regions, and implies that many countries in Latin America and the Caribbean will confront higher environmental pressures than expected when expanding their extractive industries to take advantage of new demand from other world regions, while simultaneously supplying the requirements for their own domestic industrial transformations and urbanization.

Understanding environmental policy preferences: New evidence from Brazil

- Ecological Economics---2013---Michaël Aklin,Patrick Bayer,S.P. Harish,Johannes Urpelainen

We examine the relationship between socio-economic factors and public opinion on environmental policies in Brazil, drawing on a survey conducted in June 2012. There are few systematic studies of the determinants of environmental preferences in emerging economies, and Brazil is a particularly interesting case because of its democratic political system, rapid economic growth, and importance for the global environment. In general, we find that the Brazilian public is highly supportive of environmental protection. To explain variation in environmental preferences, we focus on the effects of income and education. Many previous studies suggest that both should have positive effects, but the empirical evidence is mixed. Indeed, we find that income has no effect on environmental preferences. However, education is a strong predictor of environmental preferences. While college education is not necessary for environmental awareness, there is a large difference between Brazilians with primary and secondary education. For policy, the findings imply that investment in secondary education can raise environmental awareness, regardless of income levels.

Amenity values of proximity to National Wildlife Refuges: An analysis of urban residential property values

- Ecological Economics---2013---Xiangping Liu,Laura Taylor,Timothy Hamilton,Peter E. Grigelis

This research quantifies the property value benefits of National Wildlife Refuges near urban areas on the eastern coast of the U.S.A. Our approach is made possible through access to confidential U.S. Census data identifying property values surrounding all refuges with high geographic resolution. Results from hedonic property value models suggest that the amenity values of refuges located near urbanized areas are capitalized into the value of homes in very close proximity, averaging \$11million per refuge. These capitalized values add directly to the local tax base and are considerable complements to the annual economic value created by the refuge system.

The design of an environmental index of sustainable food consumption: A pilot study using supermarket data

- Ecological Economics---2013---Luca Panzone,Ada Wossink,Dale Southerton

Monitoring of the environmental impacts of consumption is necessary for the evaluation of current performance and to support the understanding of how initiatives for change can be implemented. We discuss design issues and methodology for an Environmentally Sensitive Shopper (ESS) index to measure the environmental sustainability of food consumption at the household level. The ESS index is based on revealed consumer preferences and uses scanner data provided by the largest UK food retailer. As a pilot illustration of the methodology, we use the index to identify environmentally critical periods during the calendar year.

Valuing water quality improvement in China: A case study of Lake Puzhehei in Yunnan Province

- Ecological Economics---2013---Hua Wang,Yuyan Shi,Yoonhee Kim,Takuya Kamata

Even though surface water has been polluted almost everywhere in China, few economic valuation studies have been conducted to value water quality changes. This paper reports an economic valuation study conducted in Yunnan, China, which estimates the total value of a real investment project to improve the water quality of Lake Puzhehei by one grade level. Located in Qiubei County far from big cities, the lake has been experiencing rapid water quality deterioration in past several years. Based on the multiple bounded discrete choice approach, an average household in Qiubei County is estimated to be willing to pay 30 yuan per month continuously for 5years for the water quality improvement by one grade level, roughly equivalent to 3% of the average household income. The elasticity of willingness-to-pay with respect to income is estimated to be 0.21. The economic rate of return of the proposed project is estimated to be 18%, indicating an economically favorable investment in water quality

improvement. This study also demonstrates that the previous knowledge about the water quality changes and about the project can have significant positive impacts on people's willingness to pay, whereas the interviewer effect on valuation can be negative.

Combining analytical frameworks to assess livelihood vulnerability to climate change and analyse adaptation options

- Ecological Economics---2013---M.S. Reed,G. Podesta,I. Fazey,N. Geeson,R. Hessel,K. Hubacek,David Letson,D. Nainggolan,C. Prell,M.G. Rickenbach,C. Ritsema,G. Schwilch,L.C. Stringer,A.D. Thomas

Experts working on behalf of international development organisations need better tools to assist land managers in developing countries maintain their livelihoods, as climate change puts pressure on the ecosystem services that they depend upon. However, current understanding of livelihood vulnerability to climate change is based on a fractured and disparate set of theories and methods. This review therefore combines theoretical insights from sustainable livelihoods analysis with other analytical frameworks (including the ecosystem services framework, diffusion theory, social learning, adaptive management and transitions management) to assess the vulnerability of rural livelihoods to climate change. This integrated analytical framework helps diagnose vulnerability to climate change, whilst identifying and comparing adaptation options that could reduce vulnerability, following four broad steps: i) determine likely level of exposure to climate change, and how climate change might interact with existing stresses and other future drivers of change; ii) determine the sensitivity of stocks of capital assets and flows of ecosystem services to climate change; iii) identify factors influencing decisions to develop and/or adopt different adaptation strategies, based on innovation or the use/substitution of existing assets; and iv) identify and evaluate potential trade-offs between adaptation options. The paper concludes by identifying interdisciplinary research needs for assessing the vulnerability of livelihoods to climate change.

International trade of scarce water

- Ecological Economics---2013---Manfred Lenzen,Daniel Moran,Anik Bhaduri,Keiichiro Kanemoto,Maksud Bekchanov,Arne Geschke,Barney Foran

Recent analyses of the evolution and structure of trade in virtual water revealed that the number of trade connections and volume of virtual water trade have more than doubled over the past two decades, and that developed countries increasingly import water embodied in goods from the rest of the world to alleviate pressure on domestic water resources. At the same time, as demand continues to increase and climate change threatens to alter hydrological cycles, water scarcity is a growing problem. Does research into virtual water trade need to consider water scarcity and differentiate flows out of water-scarce regions from flows out of water-abundant regions? Previous studies sum and compare virtual water volumes originating in countries experiencing vastly different degrees of water scarcity. We therefore incorporate water scarcity into an assessment of global virtual water flows. We use input-output analysis to include indirect virtual water flows. We find that the structure of global virtual water networks changes significantly after adjusting for water scarcity.

The economic relevance of sustainable agroforestry practices — An empirical analysis from Tanzania

- Ecological Economics---2013---Anja Faße,Ulrike Grote

This paper investigates the economic relevance of sustainable behavior of agroforestry practices for smallholders using the example of firewood exploitation in rural Tanzania. Three questions are addressed: (1) To what extent do households behave sustainably regarding firewood extraction from agroforestry? (2) Which factors determine the likelihood of households practicing sustainable agroforestry? (3) Are sustainably behaving households better off in terms of income compared to households practicing unsustainable agroforestry? The analysis is based on cross-sectional data

of 314 households. A sustainability indicator shows that the share of sustainable households varies between 14 and 41% depending on the underlying wood growth rate. The results of the logistic regression indicate that property rights regarding the ownership of agricultural land and environmental awareness increase the likelihood of sustainable firewood extraction. Empirical evidence from the quantile regression reveals that poorest households generate higher income if they extract firewood unsustainably. The opposite is true for households of upper income percentiles. Thus, the poor are likely to increase environmental degradation to generate more income causing a ‘downward spiral’ of the poverty–environment trap resulting in income losses in the long run. Households with a per capita income of 524 TZS or more manage their tree stocks sustainably.

To value or not to value? That is not the question

- Ecological Economics---2013---Giorgos Kallis,Erik Gómez-Baggethun,Christos Zografos

Should we reject money when we value nature? Like most environmentalists, ecological economists are increasingly divided on this question. Synthesizing political ecology with ecological economics, we argue that this way of framing the question is limited. We propose a reformulation of the question into “when and how to value with money?” and “under what conditions?” We recommend four criteria for a sound choice: environmental improvement; distributive justice and equality; maintenance of plural value-articulating institutions; and, confronting commodification under neo-liberalism. We call for due attention to the socio-political context within which a valuation is placed and the political goals it serves. The relevance of this framework is demonstrated by applying it to three practical cases: pollution damages, water pricing and payments for ecosystem services.

Socio-ecological accounting: DPSWR, a modified DPSIR framework, and its application to marine ecosystems

- Ecological Economics---2013---Philip Cooper

In contrast to institutionally focussed environmental accounting, socio-ecological accounting frameworks organise information concerned with human–environment interactions at scales relevant to ecosystem change and thus encapsulate information more relevant to ecosystem-based management. The DPSIR (Driver–Pressure–State–Impact–Response) framework has been used to identify relevant information in a number of ecosystem contexts but suffers limitations in terms of its definitional clarity and conceptual foundations, which undermine comparability between studies. These limitations are addressed in the DPSWR (Driver–Pressure–State–Welfare–Response) framework, which defines information categories based on a synthesis of concepts in DPSIR and its predecessors so as to more clearly identify the object of measurement in each category and isolate information relating to social systems. Consequently, its categories dealing with social systems are better suited to assessing anthropocentric trade-offs in environmental decision-making, such as through cost–benefit analysis. A conceptual input–output analysis is used to highlight measurement issues connected with the inter-relations between information categories, particularly with regard to scale, and the application of the framework is illustrated by reference to issues affecting marine ecosystems included in a Europewide study for the European Commission. However, DPSWR’s definitions are designed to be sufficiently general as to support application in other ecosystem contexts.

Dynamite in the EKC tunnel? Inconsistencies in resource stock analysis under the environmental Kuznets curve hypothesis

- Ecological Economics---2013---Julianne H. Mills Busa

Recent studies incorporating consumption into the relationship between GDP and conservation increasingly reveal that economic prosperity does not lead to improvements in environmental quality, even in cases where rich countries may appear to protect a greater proportion of their domestic resources. This study reinforces those findings for forest and species conser-

variation across two groups of countries. Additionally, through explicit comparison with two previous EKC studies, I enable an illustration of precisely how EKC results are affected by the incorporation of consumption and highlight persistent problems with EKC analyses. Despite general linear modeling results showing that wealthy countries drive deforestation in poorer countries through the import of forest resources, EKC analyses can still indicate improvements in conservation for wealthier countries. Such contradictions suggest that recent methodological improvements to the EKC cannot guarantee the validity of evidence from EKC analyses. Poor quality of resource stocks data, the restrictive time scales that can be examined with those data, and the lack of consistent results across different groups of countries all speak to continued inadequacies of the EKC hypothesis and the need to focus on approaches that address actual behavior patterns exhibited by different income groups.

An institutional theory of hydraulic fracturing policy

- Ecological Economics---2013---Robert Holahan, Gwen Arnold

The use of high-volume horizontal hydraulic fracturing (fracking) has increased substantially over the past five years in the United States. Use of this drilling technology to extract natural gas from hitherto impermeable shale is expected to increase even more in coming decades. Two institutions, integration contracts and well spacing requirements, evolved to mitigate the common-pool economic wastes associated with conventional oil and gas drilling. U.S. regulators have applied these institutions to fracking. However, shale plays differ geologically from conventional plays and are subject to different extractive technologies. We theorize that the point-source pollution characteristics of conventional drilling allowed integration contracts and well space requirements to minimize local negative environmental externalities as an unintended byproduct of minimizing common-pool economic wastes. The non-point source pollution characteristics of fracking, however, make these institutions insufficient to mini-

mize negative environmental externalities associated with drilling in shale plays, because the economic waste problem is different. If policymakers understand the crucial differences between conventional oil and gas plays and shale plays and the drilling technologies applied to them, they should be better equipped to craft fracking regulatory policies that internalize problematic externalities.

Teaching (un)sustainability? University sustainability commitments and student experiences of introductory economics

- Ecological Economics---2013---Tom L. Green

The three largest public universities in British Columbia, Canada have signed the Talloires Declaration, committing themselves to promoting sustainability and creating expectations that they will integrate sustainability across the curriculum in order to improve students' environmental literacy and stewardship. About 40% of North American university students take a mainstream introductory economics course; few of these students take economics at more advanced levels. As such, introductory economics courses are an important vehicle for students to learn economic theory; they have the potential to contribute to the knowledge that students can mobilize to foster sustainability. Interviews were held with 54 students who had recently completed an introductory level mainstream economics course at one of the three universities. Students reported that introductory economics courses place little emphasis on the environment and sustainability, they recalled course content with normative connotations that are problematic from a sustainability perspective and they described how discussion of the limitations of mainstream theory was set aside. Student reports of the insights introductory economics offers into environmental problems imply that these courses are failing to substantively increase students' understanding of sustainability and linkages between the environment and the economy. Findings suggest that current introductory economics curriculum undermines the universities' sustainability commitments.

Exploring heterogeneity in the value of a statistical life: Cause of death v. risk perceptions

- Ecological Economics---2013---Anna Alberini,Milan Ščasný

Most current environmental policy analyses use Value of a Statistical Life (VSL) figures inferred from workplace safety and traffic accident contexts to compute the benefits of environmental programs that avoid premature deaths. There is considerable debate about the appropriateness of this practice, in part because the effect of cause of death may be partly confounded with latency, initial risks, and competing risks. Preference for reducing risks can be also affected by individual-assessed risk attributes that are rarely controlled in valuation studies. This paper explores reasons for differences in preferences for mortality risk reductions (if any), and establishes the magnitude of the effects of such risk attributes as compared to other sources of VSL heterogeneity. In our conjoint choice experiments, cause of death, the size of the risk reduction, and latency, the “price” of the risk reduction and the mode of delivery of the risk reduction are explicit attributes of the alternatives to be examined by the respondent. Our statistical models also control for actual and perceived exposure to risks, initial risks, risk attributes such as dread, and sensitivity to and controllability of specific risks. We find that there is significant heterogeneity in the valuation of mortality risks and thus in the VSL. The VSL increases with dread, exposure to risk, and the respondents’ assessments of the baseline risks. It is higher when the risk reduction is delivered by a public program, and increases with the effectiveness rating assigned by the respondent to the mode of the risk reduction. Even when we control explicitly for all of these factors, the cause of death per se accounts for a large portion of the VSL. All else the same, the fact that the cause of the death is “cancer” results in a VSL that is about one million euro above the amount predicted by dread, exposure and other risk perception variables. The VSL in the road safety context is about one million euro less than what is predicted by dread, exposure, or beliefs compared to VSL for the respiratory risk context. The

effect of cause of death is thus as large as the effect of other sources of VSL heterogeneity. Our respondents do not seem to discount future risks.

A new insight into environmental innovation: Does the maturity of environmental management systems matter?

- Ecological Economics---2013---Emiko Inoue,Toshi Arimura,Makiko Nakano

Technological innovation has recently become more essential than ever. To examine the factors that might induce environmental technological innovation, we focus on ISO 14001, a voluntary approach to environmental management, and scrutinise how the proficiency or maturity level of ISO 14001 in facilities influences environment-related research and development (R&D) expenditures that promote environmental technological innovation. We measure the maturity level based on the length of time since a given facility adopted ISO 14001. Using Japanese facility-level data from “Environmental Policy Tools and Firm-Level Management and Practices: An International Survey” (OECD Survey), we estimate two Tobit models by addressing an endogeneity issue in ISO 14001. The estimation results provide empirical evidence that as the ISO 14001 is improved in facilities, those facilities are likely to spend more on environmental R&D. The facility age and market concentration also positively affect environmental R&D. These findings suggest that the maturity level of ISO 14001 is an important factor influencing the investment in environmental R&D.

Traditional vs. modern production systems: Price and nonmarket considerations of cacao producers in Northern Ecuador

- Ecological Economics---2013---Pilar Useche,Trent Blare

Many factors besides profit maximization, such as non-market ecological and social benefits, influence smallholder households to adopt a specific agricultural production system or sell in a particular market. Thus, different analytical techniques are needed that take

into consideration more than monetary income to fully capture these additional benefits to better understand the production decisions of smallholder farmers. We build on previous work on the household model and shadow wage estimation to develop a shadow wage for Ecuadorian cacao producers that includes these nonmarket benefits. We found that the shadow wage correctly indicated that, on average, these households would prefer to use an agroforestry production system instead of the more profitable modern system because of the nonmarket benefits received from the former system.

Communication, competition and social gift exchange in an auction for public good provision

- Ecological Economics---2013---Nora Vogt,Andrew Reeson,Kilian Bizer

Reverse auctions are an established policy instrument for allocating conservation contracts. While the auction mechanism has been the subject of a number of studies, less attention has been paid to the post-bidding contract phase. As contracts involving natural resource management are usually incomplete, trust becomes crucial for the effectiveness of the programme. We test the effect of communication between auctioneer and bidders on bidding behaviour and contract fulfilment using experimental economics. We combine a repeated reverse auction with an effort-level game and use a bilateral chatting tool as treatment variable. Without communication, auctioneers tended to select the lowest-priced bidders, who invested substantially less than the socially optimal level of effort when fulfilling their contract to provide the public good. Relational contracting proved important, with effort levels and profits tending to be higher when auctioneers and bidders entered into consecutive contract relationships. In the communication treatment there was no evidence of price competition, as auctioneers were more likely to accept high-priced bids. However, an overall higher price level did not lead to efficiency losses, since contractors realised higher effort levels in return, establishing a ‘social gift exchange’. Our results demonstrate the importance of trust-based relationships between the

auctioneering institution and landholders.

A human well-being approach for assessing the value of natural land areas

- Ecological Economics---2013---Angela Kopmann,Katrin Rehdanz,Angela Fasshauer

To decide on the policy measures to be implemented, policymakers need comprehensive information on the costs and benefits of land conversion for society. Accordingly, the EU Biodiversity Strategy requires the member countries to assess their ecosystems and the economic value of their ecosystem services by 2020. This paper takes up and extends the subjective well-being approach to valuing changes in natural land cover, which provides information on willingness-to-pay for landscape amenities such as scenic views or recreational opportunities. Results at the NUTS 2 level for European countries indicate (a) that marginal willingness-to-pay estimates tend to be higher for natural areas that are scarcer, and (b) that a nonlinear relationship between land cover and well-being is preferred to a linear relationship indicating decreasing benefits from individual landscape amenities.

Ecological footprint inequality across countries: The role of environment intensity, income and interaction effects

- Ecological Economics---2013---Juan Duro,Jordi Teixido

Recently, White (2007) analysed the international inequalities in ecological footprints per capita (EF hereafter) based on a two-factor decomposition of an index from the Atkinson family (Atkinson, 1970). Specifically, this paper evaluated the separate role of environment intensity (EF/GDP) and average income as explanatory factors for these global inequalities. However, in addition to other comments on their appeal, this decomposition suffers from the serious limitation of the omission of the role exerted by probable factorial correlation (York et al., 2005). This paper proposes, by way of an alternative, a decomposition of a conceptually similar index like Theil's (1967) which, in

effect, permits clear decomposition in terms of the role of both factors plus an inter-factor correlation, in line with Duro and Padilla (2006). This decomposition might, in turn, be extended to group inequality components (Shorrocks, 1980), an analysis that cannot be conducted in the case of the Atkinson indices. The proposed methodology is implemented empirically with the aim of analysing the international inequalities in EF per capita for the 1980–2007 period and, amongst other results, we find that, indeed, the interactive component explains, to a significant extent, the apparent pattern of stability observed in overall international inequalities.

A game theory analysis of market incentives for US switchgrass ethanol

- Ecological Economics---2013---Yi Luo,Shelie Miller

The Renewable Fuel Standard (2007) set aggressive cellulosic biofuel goals that have not been realized. Corn ethanol dominates the market and penetration of cellulosic ethanol is unlikely in the near term due to economic and technical barriers. This paper uses game theory to model biomass and ethanol production decisions and calculate the incentives that would be necessary to drive the industry to obtain the cellulosic ethanol goals. After identifying the desired performance of a cellulosic ethanol supply chain, a non-linear optimization model is developed to analyze two major scenarios that estimate conservative and optimistic technological improvements in cellulosic biomass and ethanol production. A potential carbon market is explored to determine its efficacy as an incentive mechanism. Results indicate that a carbon market would only be sufficient to incentivize a cellulosic ethanol industry under the optimistic improvement scenario with the highest switchgrass price. For all other scenarios, the carbon price needed to incentivize the industry would exceed the reasonable range and additional incentives would be needed to achieve the production goals of the Renewable Fuel Standard.

Beyond GDP: Measuring and achieving global genuine progress

- Ecological Economics---2013---Ida Kubiszewski,Robert Costanza,Carol Franco,Philip Lawn,John Talberth,Tim Jackson,Camille Aylmer

While global Gross Domestic Product (GDP) has increased more than three-fold since 1950, economic welfare, as estimated by the Genuine Progress Indicator (GPI), has actually decreased since 1978. We synthesized estimates of GPI over the 1950–2003 time period for 17 countries for which GPI has been estimated. These 17 countries contain 53% of the global population and 59% of the global GDP. We compared GPI with Gross Domestic Product (GDP), Human Development Index (HDI), Ecological Footprint, Biocapacity, Gini coefficient, and Life Satisfaction scores. Results show a significant variation among these countries, but some major trends. We also estimated a global GPI/capita over the 1950–2003 period. Global GPI/capita peaked in 1978, about the same time that global Ecological Footprint exceeded global Biocapacity. Life Satisfaction in almost all countries has also not improved significantly since 1975. Globally, GPI/capita does not increase beyond a GDP/capita of around \$7000/capita. If we distributed income more equitably around the planet, the current world GDP (\$67trillion/yr) could support 9.6billion people at \$7000/capita. While GPI is not the perfect economic welfare indicator, it is a far better approximation than GDP. Development policies need to shift to better account for real welfare and not merely GDP growth.

Conservation when landowners have bargaining power: Continuous conservation investments and cost uncertainty

- Ecological Economics---2013---Gareth D. Lennox,Kevin J. Gaston,Szvetlana Acs,Martin Dallimer,Nick Hanley,Paul R. Armsworth

Spatially heterogeneous costs of securing conservation agreements should be accounted for when prioritizing properties for conservation investment. Most researchers incorporating conservation costs into analyses

have relied on estimates of landowners' opportunity costs of accepting a conservation agreement. Implicitly assumed in such studies is therefore that those who "produce" biodiversity (landowners) receive none of the surplus available from trade. Instead, landowners could use their bargaining power to gain profits from conservation investments. We employ game theory to determine the surplus landowners could obtain in negotiations over conservation agreements, and the consequent effects on conservation outcomes, when enrolment decisions are governed by continuous variables (e.g. the proportion of a property to enrol). In addition, we consider how landowner uncertainty regarding the opportunity costs of other landowners affects these outcomes. Landowners' ability to gain surplus is highly variable and reflects variation in the substitutability of different properties for achieving a specified conservation objective. The ability of landowners to obtain profits from conservation agreements results in conservation outcomes that are substantially diminished relative to when landowners accept investment at opportunity costs. Uncertainty increases landowner profits, leading to a greater diminution in conservation benefits.

The art of long-term thinking: A bridge between sustainability science and politics

- Ecological Economics---2013---Bernd Klauer,Reiner Manstetten,Thomas Petersen,Johannes Schiller

Policy makers are dependent upon scientific knowledge. However, scientific results cannot be applied straightforwardly in practical decision making. We deploy Kant's term "power of judgment" – the human capacity to apply general insights to specific, contingent situations – to show that this problem is systematic rather than coincidental: decision making requires the power of judgment to make use of scientific knowledge. Power of judgment, in turns, can be supported by heuristics. Against this background, we focus on sustainability politics and outline a heuristic for framing and analyzing sustainability problems. Because time is a key factor in relation to sustainability we distinguish three

distinct concepts of time and argue that the economic concepts of "stocks" and "institutions" can be used to foster power of judgment with respect to these time concepts. Based on these concepts, the heuristic serves to bridge the gap between scientific knowledge and practical decision making in sustainability politics.

Cropping system diversification, conservation tillage and modern seed adoption in Ethiopia: Impacts on household income, agrochemical use and demand for labor

- Ecological Economics---2013---Hailemariam Teklewold,Menale Kassie,Bekele Shiferaw,Gunnar Köhlin,Menale Kassie Berresaw

The type and combination of sustainable agricultural practices (SAPs) adopted have a significant effect on agricultural productivity and food security. This study develops a multinomial endogenous switching regression model of farmers' choice of combination of SAPs and impacts on maize income and agrochemicals and family labor use in rural Ethiopia. Four primary results were found. First, adoption of SAPs increases maize income and the highest payoff is achieved when SAPs are adopted in combination rather than in isolation. Second, nitrogen fertilizer use is lower in the package that contains system diversification and conservation tillage. Third, conservation tillage increased pesticide application and labor demand, perhaps to compensate for reduced tillage. However, when it is used jointly with system diversification, it does not have a significant impact on pesticide and labor use. Fourth, in most cases adoption of a package of SAPs increases women workload, suggesting that agricultural intensification technology interventions may not be gender neutral. This implies that policy makers and other stakeholders promoting a combination of technologies can enhance household food security through increasing income and reducing production costs, but need to be aware of the potential gender related outcomes.

Assessing sustainable forest management under REDD+: A community-based labour perspective

- Ecological Economics---2013---Patrick Bottazzi,Andrea Cattaneo,David Crespo Rocha,Stephan Rist

Reducing emissions from deforestation and forest degradation plus (REDD+) encourages economic support for reducing deforestation and conserving or increasing existing forest carbon stocks. The way in which incentives are structured affects trade-offs between local livelihoods, carbon emission reduction, and the cost-effectiveness of a REDD+programme. Looking at first-hand empirical data from 208 farming households in the Bolivian Amazon from a household economy perspective, our study explores two policy options: 1) compensated reduction of emissions from old-growth forest clearing for agriculture, and 2) direct payments for labour input into sustainable forest management combined with a commitment not to clear old-growth forest. Our results indicate that direct payments for sustainable forest management – an approach that focuses on valuing farmers' labour input – can be more cost-effective than compensated reduction and in some cases is the most appropriate choice for achieving improved household incomes, permanence of changes, avoidance of leakages, and community-based institutional enforcement for sustainable forest management.

Impact of alternative information requirements on the coexistence of genetically modified (GM) and non-GM oilseed rape in the EU

- Ecological Economics---2013---Gunnar Breustedt,Uwe Latacz-Lohmann,Jörg Müller-Scheeßel

We use spatial simulation techniques to estimate both cross pollination damages and net producer benefit from genetically modified (GM) oilseed rape under alternative information requirements about individual farmers' cropping plans. Simulations were carried out for two study regions in Germany. The results suggest that, especially in landscapes with small plots, information requirements implemented in most EU Member

States may result in inefficient coexistence to the extent that GM farmers lack important information to adjust their cropping plans to non-GM rape farmers' crop choices. We conclude that, in such fragmented landscapes, more comprehensive information requirements which oblige both GM and non-GM farmers to announce their cropping plans can: (1) substantially increase producer benefits, (2) reduce cross pollination damages and dispute and thus (3) contribute to the local diffusion of GM varieties.

Economic/ecological tradeoffs among ecosystem services and biodiversity conservation

- Ecological Economics---2013---Abul Maala Hussain,John Tschirhart

An integrated economic/ecological model is built to address tradeoffs between biodiversity conservation and two marketable rangeland ecosystem services: cattle grazing and elk hunting. The ecology is represented by an eleven species food web in which individual optimizing plants and animals engage in competitive and predator/prey relationships. The ecological model defines a steady-state set of sustainable grazing and hunting options, and for each option, biodiversity is measured using an index defined over the eleven species. In linking the ecology to the economics, social welfare depends on grazing profits and hunter net benefits. The problem can be stated as maximizing economic welfare over two ecosystem services, subject to their sustainable use and subject to a target level of biodiversity. A numerical application with economic and biological data from the Western United States is used to determine sustainable grazing and hunting options for alternative biodiversity levels, and to select the option that maximizes welfare.

Comparing land-use alternatives: Using the ecosystem services concept to define a multi-criteria decision analysis

- Ecological Economics---2013---Veronika Fontana,Anna Radtke,Valérie Bossi Fedrig-

In landscape planning, land-use types need to be compared including the ecosystem services they provide. With multi-criteria decision analysis (MCDA), ecological economics offers a useful tool for environmental questions but mostly case-specific criteria are applied. This, however, makes it difficult to compare findings. Therefore, we present a systematic framework that includes the ecosystem services as criteria into MCDA. The ecological quantification of the provided ecosystem services is combined with the assigned importance of the single ecosystem services. In a case study from the central Alps, we compared three land-use alternatives resulting from land-use change caused by socio-economic pressures: traditional larch (*Larix decidua*) meadow, spruce forest (abandonment) and intensive meadow (intensification).

Valuing forest ecosystem services: What we know and what we don't

- Ecological Economics---2013---Karachepone Niran,Makoto Inoue

Ecosystem services valuation has achieved considerable prominence in research and policy circles in recent years. This paper reviews the studies that have tried to estimate the value of forest ecosystem services. Broadly, this study addresses the following questions: (1) What insights do these studies provide on the value of forest ecosystems? (2) What lessons do they offer from an economic and policy perspective? (3) What are the shortcomings of the existing studies, and what are the challenges and issues for future research? Evidence from a cross section of forest sites, countries and regions suggests that not only the total valuation of ecosystem services varies widely across studies but also the valuation of individual services. This variation suggests that policies to conserve ecosystems and their services should emphasise local contexts and values. This paper concludes by discussing the shortcomings of existing studies, and suggests that, among other things, future research should focus on the neglected

ecosystem services, 'disservices', assess the role of dynamic factors and environmental catastrophes on the provision of ecosystem services, and assess the benefits of keeping forests intact versus converting them to alternative uses.

Economywide impacts of climate change on agriculture in Sub-Saharan Africa

- Ecological Economics---2013---Alvaro Calzadilla,Tingju Zhu,Katrin Rehmanz,Richard Tol,Claudia Ringler

Two possible adaptation scenarios to climate change for Sub-Saharan Africa are analyzed under the SRES B2 scenario. The first scenario doubles the irrigated area in Sub-Saharan Africa by 2050, compared to the baseline, but keeps total crop area constant. The second scenario increases both rainfed and irrigated crop yields by 25% for all Sub-Saharan African countries. The two adaptation scenarios are analyzed with IMPACT, a partial equilibrium agricultural sector model combined with a water simulation module, and with GTAP-W, a general equilibrium model including water resources. The methodology combines the advantages of a partial equilibrium approach, which considers detailed water-agriculture linkages, with a general equilibrium approach, which takes into account linkages between agriculture and nonagricultural sectors and includes a full treatment of factor markets. The efficacy of the two scenarios as adaptation measures to cope with climate change is discussed. Due to the limited initial irrigated area in the region, an increase in agricultural productivity achieves better outcomes than an expansion of irrigated area. Even though Sub-Saharan Africa is not a key contributor to global food production (rainfed, irrigated or total), both scenarios help lower world food prices, stimulating national and international food markets.

Environmental variability and collective action: Experimental insights from an irrigation game

- Ecological Economics---2013---John M. Anderies,Marco A. Janssen,Allen Lee,Hannah Wasserman

Studies of collective action in commons dilemmas in social–ecological systems typically focus on scenarios in which actors all share symmetric (or similar) positions in relation to the common-pool resource. Many common social–ecological systems do not meet these criteria, most notably, irrigation systems. Participants in irrigation systems must solve two related collective action problems: 1) the provisioning of physical infrastructure necessary to utilize the resource (water), and 2) the asymmetric common-pool resource dilemma where the relative positions of “head-enders” and “tail-enders” generate asymmetric access to the resource itself (water). In times of scarcity, head-enders have an incentive to not share water with tail-enders. Likewise, tail-enders have an incentive to not provide labor to maintain the system if they do not receive water. These interdependent incentives may induce a cooperative outcome under favorable conditions. However, how robust is this system of interdependent incentives in the presence of environmental variability that generates uncertainty about water availability either through variation in the water supply itself or through shocks to infrastructure? This paper reports on results from laboratory experiments designed to address this question.

Can uncertainty justify overlapping policy instruments to mitigate emissions?

- Ecological Economics---2013---Oskar Lecuyer,Philippe Quirion

This article constitutes a new contribution to the analysis of overlapping instruments to cover the same emission sources. Using both an analytical and a numerical model, we find that if there is a risk that the carbon price drops to zero and if the political unavailability of a CO2 tax (at least in the European Union) is taken into account, it can be socially beneficial to implement an additional instrument encouraging the reduction of emissions, for instance a renewable energy subsidy. Our analysis has both a practical and a theoretical purpose. It aims at giving economic insight to policymakers in a context of increased uncertainty concerning the future stringency of the European Emission Trading Scheme.

It also gives another rationale for the use of several instruments to cover the same emission sources, and shows the importance of accounting for corner solutions in the definition of the optimal policy mix.

Managing interacting species in unassessed fisheries

- Ecological Economics---2013---Nicolas Querou,Agnes Tomini

This paper addresses the management of multispecies fisheries, and suggests the use of restricted fishing policies as an interesting option for unassessed fisheries (as is the case within developing countries). Specifically, we consider a predator–prey system under two potential management policies: an unrestricted regime where agents can compete to harvest from both species, and a second one where they are allowed to harvest only predators. The performance of both policies is compared from an ecological and an economic point of view. For a sufficiently large number of agents (or for strong biological interaction parameters) the assumed restricted fishing policy yields both higher long run stock levels and profits. Thus, this contribution suggests that such a policy, while requiring weaker monitoring/governance than instruments based on outputs (such as quotas or taxes), would meet environmental and economic objectives. Finally, several features of the analysis are discussed, including targeting prey instead of predator and the issue of compliance.

The transmission of sustainable harvesting norms when agents are conditionally cooperative

- Ecological Economics---2013---Andries Richter,Johan Grasman

Experimental and observational studies have highlighted the importance of agents being conditionally cooperative when facing a social dilemma. We formalize this mechanism in a theoretical model that portrays a small community having joint access to a common pool resource. The diffusion of norms of cooperation takes place via interpersonal relations, while individual

agents face the temptation of higher profits by over-exploiting the resource. Agents remain conditionally cooperative, unless other individuals are misbehaving already. We can observe a bubble of conditional cooperators slowly building up followed by a sudden burst, which means that a transition from a cooperative social norm to non-cooperation occurs. Interestingly, in some parameter regions alternative stable states and limit cycles arise. The latter implies that the same community goes through such a transition repeatedly over long time spans — history thus repeats itself in the form of the creation and erosion of social capital.

Inter-district rice water productivity differences in Bangladesh: An empirical exploration and implications

- Ecological Economics---2013---Mohammad Alaudin,Bharat R. Sharma

While the bulk of research on crop water productivity (WP) focuses on static cross-section analysis, this research provides a spatio-temporal perspective. It estimates rice crop WP for 21 Bangladesh districts for 37years; explores WP variations among districts; and investigates causality involving WP, intensification and technological variables; and groundwater irrigation and depth. It breaks new grounds by probing these significant but unexplored issues.

Assessing the total economic value of threatened livestock breeds in Italy: Implications for conservation policy

- Ecological Economics---2013---Kerstin K. Zander,Giovanni Signorello,Maria De Salvo,Gustavo Gandini,Adam G. Drucker

The total economic value (TEV) of two threatened Italian cattle breeds (Modicana and Maremmana) was investigated using a choice experiment survey. Most respondents (85%) support breed conservation, their stated willingness-to-pay easily justifying EU support. The high landscape maintenance, existence and future option values of both breeds (around 80% of their TEVs) suggest that incentives mechanisms are indeed

needed in order to allow farmers to capture some of these public good values and hence motivate them to undertake conservation-related activities. The positive direct use values of both breeds (around 20% of their TEVs) imply that niche product markets aimed at enhancing the private good values associated with conservation could also form elements of a conservation and use strategy for these breeds.

Input–output analysis of virtual water transfers: Case study of California and Illinois

- Ecological Economics---2013---Stanley Mubako,Sajal Lahiri,Christopher Lant

Increasing pressures on water resources in the two economically important states of California (CA) and Illinois (IL) have created a need for critical information related to sustainable water use and management. This paper applies input–output (IO) analysis to evaluate water use and quantify virtual water transfers involving the two states. Results show that aquaculture requires the largest input of direct water per unit of economic output, followed by crops, power generation, livestock, mining, services, domestic, and industry. Low water use intensity industry and services sectors contributed the largest proportions of value added and employee compensation. In 2008, the two states were net virtual exporters, with CA exporting 1.3 times the net export volume of IL. More than 72% of virtual water exports for each state originated from the high total water use intensity but low value added crops sector, with irrigation and rainfall contributing 99% and 97% of the crop-related exports for CA and IL, respectively. Virtual water export volumes were 59% for CA and 71% for IL when compared to actual water use. These results highlight the need to consider water use efficiency and opportunity cost when managing water under scarcity conditions.

Livestock management at northern latitudes

- Ecological Economics---2013---Anne B. Johannesen,Anders Nielsen,Anders Skonhoft

We study the economy and ecology of sheep farming

under future climate change scenarios. The analysis is at the farm level and includes two different categories of the animals, ewes (adult females) and lambs with a crucial distinction between the outdoor grazing season and the winter indoor season. The model is formulated in a Nordic economic and biological setting. During the outdoor grazing season, animals may experience growth constraints as a result of limited grazing resources. The available grazing resources are determined by animal density (stocking rate) and weather conditions potentially affecting the weight, and hence, the value of lambs. Because empirical evidence suggests that climate changes, e.g., increased temperature, have contrasting effects on lamb weights depending on the location of the farm, the spatial effects of such changes are analyzed.

Local exposure to toxic releases: Examining the role of ethnic fractionalization and polarisation

- Ecological Economics---2013---Matthew Cole,Robert Elliott,Khemrutai Khemmarat

This paper examines the role played by community characteristics in influencing local exposure to toxic releases, focusing specifically on ethnic fractionalization and polarisation. In contrast to the previous literature, this study argues that it is the fractionalization and/or polarisation of ethnic groups that is the relevant consideration, rather than the population share of ethnic minorities, since such ethnic divisions may significantly increase the difficulty of coordinating community action. Using toxic release data for the periods 1990 to 1995 and 2000 to 2005 we find that measures of ethnic divisions have a positive relationship with toxic releases. This finding persists across a range of robustness exercises.

Ecosystem services and ethics

- Ecological Economics---2013---Kurt Jax,David N. Barton,Kai M.A. Chan,Rudolf de Groot,Ulrike Doyle,Uta Eser,Christoph Görg,Erik Gómez-Baggethun,Yuliana Griewald,Wolfgang Haber,Roy Haines-Young,Ulrich Heink,Thomas Jahn,Hans

Joosten,Lilin Kerschbaumer,Horst Korn,Gary W. Luck,Bettina Matzdorf,Barbara Muraca,Carsten Neßhöver,Bryan Norton,Konrad Ott,Marion Potschin,Felix Rauschmayer,Christina von Haaren,Sabine Wichmann

A major strength of the ecosystem services (ESS) concept is that it allows a succinct description of how human well-being depends on nature, showing that the neglect of such dependencies has negative consequences on human well-being and the economy. As ESS refer to human needs and interests, values are to be considered when dealing with the concept in practice. As a result we argue that in using the concept there is a need to be clear about what different dimensions of value are involved, and be aware of ethical issues that might be associated with the concept. A systematic analysis of the ethical implications associated to the ESS concept is still lacking. We address this deficiency by scrutinising value dimensions associated with the concept, and use this to explore the associated ethical implications. We then highlight how improved transparency in the use of the ESS concept can contribute to using its strengths without succumbing to possible drawbacks arising from ethical problems. These problems concern the dangers that some uses of the concept have in obscuring certain types of value, and in masking unevenness in the distribution of costs and benefits that can arise in the management of ESS.

Galtung meets Daly: A framework for addressing inequity in ecological economics

- Ecological Economics---2013---Crelis F. Ram-melt,Jan Boes

Since World War II, economic growth has been the leading policy goal in efforts to eradicate poverty. There is strong evidence that this strategy has gone hand in hand with increasing inequity and environmental degradation. We need concepts that will help us understand the inadequacies of the current economic system. We propose drawing from the ideas of sociologist Johan Galtung on social power structures, and those of economist Herman Daly on the physical features of

the economy. A fusion of these perspectives creates a novel framework for analysis and a basis to formulate alternatives to the current growth strategy.

Effects of consumer preferences for rarity on the harvest of wild populations within a species

- Ecological Economics---2013---Jessica A. Lyons, Daniel J.D. Natusch

Economic theory predicts that exploitation of a species alone is unlikely to result in extinction because of escalating costs involved in finding increasingly rare individuals of a declining species. However, a recently proposed hypothesis, the Anthropogenic Allee Effect (AAE), proposes that if people place disproportionate value on rare species, this may result in a cycle whereby increased exploitation reduces the population size, thus increasing its value and ultimately leading to its extinction in the wild. We tested this hypothesis using data collected on wild harvests, preferences of pet keepers and sale prices of different populations of green pythons (*Morelia viridis*) and hypothesized that the AAE could occur among population within species, not just between them. The rarity of populations of green pythons was strongly positively correlated with price and negatively correlated with harvest levels. The two populations that were deemed most desirable by pet collectors exhibited abnormal coloration and were found to be suffering from the effects of over-exploitation for the pet trade. Adequate regulation and enforcement are needed to reduce the effects of demand on illegal harvesting and conservationists and government bodies should be aware of the effects of disclosing the rarity of a species and its populations.

Media attention and the Toxics Release Inventory

- Ecological Economics---2013---Shrawantee Saha, Robert D. Mohr

This paper explores the relationship between the print media and toxic releases in the first wave of Toxics Release Inventory (TRI) filings. It first studies the degree to which neighborhood characteristics like racial composition and income status associate with the number of

newspaper articles written about a TRI establishment, controlling for the volume of toxic releases, industry and observable establishment characteristics. It follows up to study whether establishments that receive media attention reduce toxics releases more than those that do not. Neither a qualitative review of the articles nor regression results show any significant correlation between race or income and the likelihood of being included in media reports. A difference-in-difference approach shows a statistically significant decrease in the toxic releases of establishments that received media attention compared to those that did not.

Toxicity and profitability of rice cultivation under wastewater irrigation: the case of the East Calcutta Wetlands

- Ecological Economics---2013---Vivekananda Mukherjee, Abhishek Das, Anirban Akhand, Gautam Gupta

The paper reports the results of an empirical study on profitability of rice cultivation in the East Calcutta Wetlands (ECW) region where untreated sewage from the city of Kolkata (earlier Calcutta), India, is used for the purpose of irrigation during the winter/summer crop. The results show that plots using wastewater containing organic nutrients earn lower profits than those using groundwater. We also find that the profitability of plots using wastewater is negatively affected by the presence of heavy metals such as Lead and Mercury that are carried through untreated sewage-water canals and deposited in the soil. Of the two opposing effects of wastewater irrigation, the negative effect of heavy metal toxicity outweighs the positive effects of organic nutrients. The results support regulation of the discharge of the heavy metals like Lead and Mercury into the wastewater from households and industries. This would lead to conservation of the Wetlands generating a number of ecological and environmental benefits to the society.

Improving stove evaluation using survey data: Who received which intervention matters

- Ecological Economics---2013---Valerie Mueller,Alexander Pfaff,John Peabody,Yaping Liu,Kirk R. Smith

As biomass fuel use in developing countries causes substantial harm to health and the environment, efficient stoves are candidates for subsidies to reduce emissions. In evaluating improved stoves' relative benefits, little attention has been given to who received which stove intervention due to choices that are made by agencies and households. Using Chinese household data, we find that the owners of more efficient stoves (i.e., clean-fuel and improved-biomass stoves, as compared with traditional-biomass and coal stoves) live in less healthy counties and differ, across and within counties, in terms of household characteristics such as various assets. On net, that caused efficient stoves to look worse for health than they actually are. We control for counties and household characteristics in testing stove impacts. Unlike tests that lack controls, our preferred tests with controls suggest health benefits from clean-fuel versus traditional-biomass stoves. Also, they eliminate surprising estimates of health benefits from coal, found without using controls. Our results show the value, for learning, of tracking who gets which intervention.

Index decomposition analysis applied to CO2 emission studies

- Ecological Economics---2013---X.Y. Xu,B.W. Ang

Index decomposition analysis (IDA) was first extended from energy consumption to energy-related CO2 emission studies in 1991. Since then many studies have been reported covering various countries and emission sectors. However, unlike the case of energy consumption studies, a comprehensive literature survey that focuses specifically on emission studies has so far not been reported. In this paper, we attempt to fill this gap by reviewing 80 papers appearing in peer-reviewed journals from 1991 to 2012 in this application area. The first part of this paper deals with the developments

with regard to the IDA approaches used by researchers, and the scope and focus of their studies. In the second part, the empirical results reported in the surveyed studies are analyzed, consolidated, and presented by emission sector. The objective is to reveal the relative contributions of key effects on changes in the aggregate carbon intensity, and this is done by emission sector and by country. The findings of both parts are useful in understanding the development of IDA in the application area of emission study, as well as the key drivers of aggregate carbon intensities in the past and their possible future developments.

Organic certification, agro-ecological practices and return on investment: Evidence from pineapple producers in Ghana

- Ecological Economics---2013---Linda Klee-mann,Awudu Abdulai

The recent empirical literature on economic sustainability of certified export crops shows that certification standards that enhance yields are important for improving farm revenues and household welfare. However, limited evidence exists on the impact of organic certification on the adoption of agro-ecological practices. In this study, we use unique farm-level data from pineapple producers in Ghana to examine the impact of organic certification on the use of agro-ecological practices such as organic fertilizers, organic pest and weed control, crop rotation, and soil and water conservation, as well as how using these measures affect farm outcomes such as return on investment. Our empirical results reveal that organic certification increases agro-ecological practice use, although from a very low starting point. Using a generalized propensity score approach, we show that there is a positive, but nonlinear relationship between the intensity of agro-ecological practice use and return on investment.

The Spanish livestock model: A coevolutionary analysis

- Ecological Economics---2013---Sandra M. Ríos-Núñez,Daniel Coq-Huelva,Roberto García-Trujillo

Coevolution is a wide theoretical framework that enables the study of socio-ecological transformations in different contexts and, specifically, in agrarian systems. This article analyses coevolutionary changes in Spanish livestock over the last 50 years, from the so-called “traditional” livestock model, in which ecological, social and economic elements co-evolve in closely interconnected relationships, to the currently dominant industrial livestock model, governed by “ecologies at a distance”. Not only meat consumption grew significantly as a consequence of the change in the prevailing livestock production model, Spain also became one of the most important meat producers in the European Union. Simultaneously, dependence on imported cereals and soya increased dramatically. Nevertheless, in spite of the prevalence of industrial logics, extensive livestock farming, that follows hybrid logics incorporating features from both models, still exists in Spain and, particularly, in Andalusia (Southern Spain). This locally based model is characterised by higher environmental standards, as well as its contribution to the preservation of a singular agro-ecosystem (*dehesa*). However, its long-term transformation and, therefore, the social construction of more sustainable local livestock systems, must be understood as a co-evolutionary process in which agency and social selection of innovations are essential elements.

The shallow or the deep ecological economics movement?

- Ecological Economics---2013---Clive Spash

Ecological economics and its policy recommendations have become overwhelmed by economic valuation, shadow pricing, sustainability measures, and squeezing Nature into the commodity boxes of goods, services and capital in order to make it part of mainstream economic, financial and banking discourses. There are deeper concerns which touch upon the understanding of humanity in its various social, psychological, political and ethical facets. The relationship with Nature proposed by the ecological economics movement has the potential to be far reaching. However, this is not the picture portrayed by surveying the amassed body of

articles from this journal or by many of those claiming affiliation. A shallow movement, allied to a business as usual politics and economy, has become dominant and imposes its preoccupation with mainstream economic concepts and values. If, instead, ecological economists choose a path deep into the world of interdisciplinary endeavour they will need to be prepared to transform themselves and society. The implications go far beyond the pragmatic use of magic numbers to convince politicians and the public that ecology still has something relevant to say in the 21st century.

Property rights regimes in complex fishery management systems: A choice experiment application

- Ecological Economics---2013---Yingluk Kanchanaroek, Mette Termansen, Claire Quinn

The Tonle Sap wetland fishery was previously divided into 3 different management zones for conservation, open access fishing and private fishing. Rights to the private fishing zone involved auctions for exclusive rights to temporarily designated plots. This paper aims to explore the auction-based system by investigating how this fishery management system affects different groups of small scale fishermen and how different characteristics of the fishing lots affect the bidding. A choice experiment approach was used to model fishermen's choices in a hypothetical auction market by offering fishermen the choice between purchasing different potential fishing lots and a no purchase option, implying fishing only in the communal fishing grounds. The preferred latent class model with two segments of fishermen showed that the bidding behavior of the more privileged group out-competes the other group irrespective of the lot characteristics. This result suggests that it is unlikely that the redesign of the auction system itself would be an effective way of securing access to fishing resources for the two observed groups of fishermen. This implies that open access fishing grounds and/or other regulations may also be needed in future management as they serve an important role for the poorer segments.

Ecological threshold and ecological economic threshold: Implications from an ecological economic model with adaptation

- Ecological Economics---2013---Takuro Uehara

This paper investigates ecological threshold and ecological economic threshold by developing an ecological economic model—an extension of a population–resource dynamics model developed by Brander and Taylor (1998). The model reflects three critical issues regarding an ecological economic system: system boundary, non-convexity, and adaptation. The paper elucidates six main findings: ecological economic threshold may come before ecological threshold; the ecological economic threshold may exhibit a highly context-dependent and dynamic nature, which suggests the precautionary principle; markets do not respond sufficiently to maintain resiliency under an external shock as prices do not reflect thresholds; the system can be restored by intervention, even after crossing the ecological economic threshold; various transitional paths are possible in restoring the system; and adaptation affects resilience to a somewhat significant effect which suggests the importance of better information and education. Because of the complexity of the model, I adopt a system dynamics approach for the development and analysis of the model.

Integrated scenarios of energy-related CO2 emissions in Ireland: A multi-sectoral analysis to 2020

- Ecological Economics---2013---Mahony, Tadhg O',Peng Zhou,John Sweeney,Tadhg O' Mahony

This paper presents future scenarios of Irish energy-related CO2 emissions to 2020, using a combination of multi-sectoral decomposition analysis with scenario analysis. Alternative development paths, driving forces and sectoral contributions in different scenarios have been explored. The scenarios are quantified by using decomposition analysis as a Divisia Index Scenario Generator (DISCEN). The driving forces of population, economic and social development, energy resources and technology and governance and policies are discussed.

A set of four integrated or 'hybrid' qualitative and quantitative baseline emission scenarios are developed. It is found that sectoral contributions and emissions in each scenario vary significantly. The inclusion of governance, social and cultural driving forces are important in determining alternative development paths and sustainability is crucial. Our empirical results show that decomposition analysis is a useful technique to generate the alternative scenarios.

A review of transdisciplinary research in sustainability science

- Ecological Economics---2013---Patric Brandt,Anna Ernst,Fabienne Gralla,Christopher Luederitz,Daniel J. Lang,Jens Newig,Florian Reinert,David J. Abson,Henrik von Wehrden

Achieving the goal of sustainability requires understanding and management of unprecedented and interconnected challenges. A transdisciplinary approach is a key component of sustainability science. However, there are considerable barriers to implementing transdisciplinary projects. We undertake a mixed quantitative and qualitative analysis of peer-reviewed sustainability science studies where the transdisciplinary approach has been applied. We assess the growth and scientific impact of transdisciplinary sustainability research, the methods used and how three key characteristics of transdisciplinarity research—process phases, knowledge types and the intensity of involvement of practitioners—are implemented. While transdisciplinary research is growing there is no common glossary, no focused communication platform and no commonly shared research framework. Transdisciplinary research utilizes a broad, but not clearly defined, set of methods for knowledge production. While the intensity of practitioner involvement varied within the case studies analyzed, very few realized empowerment. Based on our review of transdisciplinary case study papers we conclude that transdisciplinary research must be clearly framed, including the use of a common terminology and the development of a broad suite of appropriate methods. Despite the challenges highlighted here, science needs to move beyond classical disciplinary approaches

and should consider interdisciplinary work that engages with practitioners to achieve sustainable transitions.

Capturing the least costly way of reducing pollution: A shadow price approach

- Ecological Economics---2013---Kenneth Løvold Rødseth

The production analysis literature is increasingly concerned with estimating marginal abatement costs. Yet, most studies do not emphasize the ways in which pollutants may be reduced and their costs, which makes them unable to identify the least costly compliance strategy. This paper utilizes the materials balance principle to relate pollution to the employment of material inputs. A production model which allows input and output substitution, downscaling of operations, pollution control, and emission permits purchases as compliance strategies is proposed, and the implications of joint and non-joint pollution controls for the trade-off between pollutants and desirable outputs are considered. Marginal abatement costs, reflecting the least costly way of compliance, are derived by exploiting the duality between the directional distance function and the profit function.

Drivers of different types of eco-innovation in European SMEs

- Ecological Economics---2013---Angela Triguero Cano,Lourdes Moreno-Mondéjar,María A. Davia

In this paper we explore the drivers of different types of eco-innovation in European SMEs. Drawing upon a database of 27 European countries, empirical evidence is found for the different roles of supply-side, demand-side and regulatory factors in encouraging the adoption of different types of eco-innovation. Our empirical strategy consists of the estimation of a trivariate probit model. Our results show that those entrepreneurs who give importance to collaboration with research institutes, agencies and universities, and to the increase of market demand for green products are more active in all types of eco-innovations. Supply-side factors

seem to be a more important driver for environmental processes and organizational innovations than for environmental product innovations. The results also show that market share only has a significant positive influence on eco-product and eco-organizational innovations, while cost-savings are solely significant for eco-process innovations. Finally, prioritizing existing regulations shapes eco-product and eco-organizational innovations while expected regulations and access to subsidies and fiscal incentives do not have any significant effect on the decision to eco-innovate in Europe at the firm-level.

Real-payment choice experiments: Valuing forested wetlands and spatial attributes within a landscape context

- Ecological Economics---2013---Laurie W. Newell,Stephen Swallow

We consider the choice experiment approach to valuation, due to its focus on tradeoffs between alternatives. Our study is not hypothetical, but implements a real-payment choice experiment (CE) for a multi-attribute good. We use two real wetland parcels to create over 18 descriptions of parcels for conservation under a 10-year development-rights contract. Our payment protocol mitigates incentives to understate willingness to pay through a provision point with a rebate of excess funds. Real choice questions captured significant values for spatial attributes of wetland conservation. Average respondents positively valued 73-acre parcels surrounded by woodland, but required 100acres for parcels surrounded by residential or farm land, and accepted a 19-acre smaller parcel in exchange for full public access.

Modelling and mapping spatial heterogeneity in forest recreation services

- Ecological Economics---2013---Mette Tormansén,Colin J. McClean,Frank Søndergaard Jensen

Modelling and spatial mapping of recreation services require attention to both demand and supply factors. This paper combines recreational choice modelling and

economic valuation with GIS based techniques to allow an assessment of the spatial diversity of the value of forest recreation services. The data for the analysis is a national study of the car borne recreational use of Danish forest sites. A random utility framework is used and a comparison between the standard fixed coefficient model and a mixed logit model is made. The results show that the different specifications of the random utility models reveal similar preferences for the measured forest attributes in terms of sign and magnitude. The spatial predictions, however, reveal a considerable difference in the spatial pattern of economic benefits from recreation between the two models. These results have implications for current ecosystem service mapping initiatives as they emphasise the need to account for spatial heterogeneity in preferences, and aggregate demand and environmental attributes and infrastructure.

Spatially induced disparities in users' and non-users' WTP for water quality improvements —Testing the effect of multiple substitutes and distance decay

- Ecological Economics---2013---Sisse Liv Jørgensen,Søren Olsen,Jacob Ladenburg,Louise Martinsen,Stig Roar Svenningsen,Berit Hasler

Costs and benefits of water restoration projects are not necessarily evenly spread out over the entire area affected by the project. The physical distribution of benefits is, therefore, an important parameter when conducting economic analyses of water restoration projects. Two particularly relevant spatial issues relate to 1) the location of the population relative to the location of the waterbody, and 2) the availability and characteristics of substitute water bodies.

Spatial preference heterogeneity in forest recreation

- Ecological Economics---2013---Jens Abildtrup,Serge Garcia,Søren Olsen,Anne Stenger

In this study, we analyze the preferences for recreational use of forests in Lorraine (Northeastern France), applying stated preference data. Our approach allows us to estimate individual-specific preferences for recreational use of different forest types. These estimates are used in a second stage of the analysis where we test whether preferences depend on access to recreation sites. We find that there is significant preference heterogeneity with respect to most forest attributes. The spatial analysis shows that preferences for forests with parking and picnic facilities are correlated with having access to such forests while for the other attributes considered (dominant tree species, trekking paths and presence of lake and rivers) we find no correlation between stated preferences and accessibility.

Farmers' willingness to provide ecosystem services and effects of their spatial distribution

- Ecological Economics---2013---Stine Wamberg Broch,Niels Strange,Jette B. Jacobsen,Kerrie A. Wilson

The supply of ecosystem goods and services is spatially heterogeneous and the provision of such goods and services is also influenced by landowners' willingness to provide. This is particularly the case in countries such as Denmark where many properties are privately owned. However, little attention has previously been given to the relationship between farmers' willingness to provide a good or service and the spatial heterogeneity associated with their demand. In this study farmers' willingness to participate in afforestation contracts are investigated using a choice experiment of various contracts with the purpose to provide: ground-water protection, biodiversity conservation or recreation. We employ a random parameter logit model to analyse the relationship between farmers' preferences for afforestation purposes and the spatial variables; groundwater interests, species richness, human population density, forest cover and hunting. The results show that increasing human population density significantly increases farmers' required compensation with respect to recreational activities. Furthermore, there is a significant effect of hunting which decreases compen-

sation required by the farmers to enter an afforestation project. The share of groundwater and forest cover does not significantly influence preferences. We conclude that spatial variations should be considered when designing conservation policies

A review of the spatial economics of non-timber forest product extraction: Implications for policy

- Ecological Economics---2013---Heidi Albers,Elizabeth Robinson

Patterns of forest cover and forest degradation determine the size and types of ecosystem services forests provide. Particularly in low-income countries, nontimber forest product (NTFP) extraction by rural people, which provides important resources and income to the rural poor, contributes to the level and pattern of forest degradation. Although recent policy, particularly in Africa, emphasizes forest degradation, relatively little research describes the spatial aspects of NTFP collection that lead to spatial degradation patterns. This paper reviews both the spatial empirical work on NTFP extraction and related forest degradation patterns, and spatial models of behavior of rural people who extract NTFPs from forest. Despite the impact of rural people's behavior on resulting quantities and patterns of forest resources, spatial-temporal models/patterns rarely inform park siting and sizing decisions, economic assessments of park effectiveness, development projects to support conservation, or REDD protocols. Using the literature review as a lens, we discuss the models' implications for these policies with particular emphasis on effective conservation spending and leakage.

The impact of buffer zone size and management on illegal extraction, park protection, and enforcement

- Ecological Economics---2013---Elizabeth Robinson,Heidi Albers,Gwenlyn M. Busby

Many protected areas or parks in developing countries have buffer zones at their boundaries to achieve the dual goals of protecting park resources and providing

resource benefits to neighbouring people. Despite the prevalence of these zoning policies, few behavioural models of people's buffer zone use inform the sizing and management of those zones. This paper uses a spatially explicit resource extraction model to examine the impact of buffer zone size and management on extraction by local people, both legal and illegal, and the impact of that extraction on forest quality in the park's core and buffer zone. The results demonstrate trade-offs between the level of enforcement, the size of a buffer zone, and the amount of illegal extraction in the park; and describe implications for "enrichment" of buffer zones and evaluating patterns of forest degradation.

The social costs of homeowner decisions in fire-prone communities: Information, insurance, and amenities

- Ecological Economics---2013---Gwenlyn Busby,Gregory S. Amacher,Robert G. Haight

In this article, we consider wildfire risk management decisions using a dynamic stochastic model of homeowner interaction in a setting where spatial externalities arise. Our central objective is to apply observations from the social science literature about homeowner preferences to this economic externality problem and determine how assumptions about insurance, information and starting fuel loads affect outcomes and the effectiveness of policy. Three new features of our approach are, first, to assess fuel treatment behavior under potential misinformation scenarios, second, to allow for heterogeneous starting fuel loads across ownerships, and, finally, to evaluate the effectiveness of insurance and direct regulation at improving outcomes. Among other results, we find that risk-adjusted insurance may not create incentives for fuel treatment when government suppression exists, and in games with heterogeneous starting fuel loads, the social costs from misinformation can persist over a greater range of fire probability and damage function parameter values. These results suggest that, even as information about wildfire improves, the social costs inherent in private decisions will be more persistent than previously thought on landscapes

where fuel stock differs across ownerships.

Predicting land use allocation in France: A spatial panel data analysis

- Ecological Economics---2013---Raja Chakir,Julie Le Gallo

Predictions of future land use areas are an important issue as land use patterns significantly impact environmental conditions (biodiversity, water pollution, soil erosion, and climate change) as well as economic and social welfare. In order to improve the prediction accuracy of aggregated land use share models, we propose in this paper a methodological contribution by controlling for both unobserved individual heterogeneity and spatial autocorrelation. Our model is a land use shares model applied to aggregated data in France. Our dataset is a panel which covers both time series observations from 1992 to 2003 and cross-sectional observations by Département (equivalent to NUTS3 regions). We consider four land use classes: (1) agriculture, (2) forest, (3) urban and (4) other use. We investigate the relation between the areas in land in different alternative uses and economic and demographic factors influencing land use decisions. Based on the comparison of prediction accuracy of different model specifications, our findings are threefold: First, controlling for both unobserved individual heterogeneity and spatial autocorrelation outperforms any other specification in which spatial autocorrelation and/or individual heterogeneity are ignored. Second, accounting for cross-equation correlations does not seem to improve the prediction performances and finally, ignoring individual heterogeneity introduces substantial loss in prediction accuracy.

The effect of forest land use on the cost of drinking water supply: A spatial econometric analysis

- Ecological Economics---2013---Jens Abildtrup,Serge Garcia,Anne Stenger

Forest land use is often associated with the protection of water resources from contamination and the

reduced cost of drinking water supply. This study attempted to measure the value of the forest on the quality of water resources from a contingent market, namely drinking water supply, by estimating variations in drinking water costs as a function of variations in land uses. Spatial correlations were taken into account because of the use of different geographical scales (i.e., water service area and land uses) and the potential existence of organizational and technological spillovers between water services. We found a significant negative effect of forest land use on water costs. We found no evidence of spatial spillovers concerning the management regime but did find that factors related to the scarcity of resources in neighboring water services have an impact on water costs.

Prices, poaching, and protein alternatives: An analysis of bushmeat consumption around Serengeti National Park, Tanzania

- Ecological Economics---2013---Dennis Rentsch,Amy Damon

The consumption of meat from wild animals (or bushmeat) occurs throughout Africa and highlights the conflict between two distinct development goals: food security and biodiversity conservation. Growing human populations throughout the greater Serengeti ecosystem rely heavily on bushmeat as a source of protein, which places pressure on migratory wildlife populations. This paper uses unique data from protein consumption surveys from 131 households over 34 months in a generalizable empirical framework to estimate price, cross-price, and expenditure elasticities of protein sources, and analyze the potential economic effects of policies to mitigate bushmeat hunting and consumption. Results suggest that: (1) directly increasing the price of bushmeat through enforcement or other policies to reduce supply will have the most direct and largest effect of bushmeat consumption; (2) increasing income increases bushmeat consumption as well as consumption of other meat sources; (3) if surrounding fisheries experience a negative shock, or collapse, this will lead to a dramatic increase in bushmeat consumption. Overall, these results strongly indicate that policies to reduce bushmeat

hunting while maintaining food security must be considered in a broad and comprehensive framework.

A Kantian approach to sustainable development indicators for climate change

- Ecological Economics---2013---Mads Greaker, Per Espen Stoknes, Knut Alfsen, Torgeir Ericson

Agenda 21 required countries to develop and regularly update a national set of indicators for sustainable development. Several countries now have such sets also including separate indicators for climate change. Some of these indicators typically report global concentration of green house gasses in the atmosphere or time series for global temperatures. While such indicators may give the public information about the state of the global climate, they do not provide a benchmark which makes it possible for the public to evaluate the climate policy of their government.

An ecosystem services approach to estimating economic losses associated with drought

- Ecological Economics---2013---Onil Banerjee, Rosalind Bark, Jeff Connor, Neville D. Crossman

A consistent methodology enabling the estimation of the economic losses associated with drought and the comparison of estimates between sites and across time has been elusive. In this paper, we develop an ecosystem service approach to fill this research gap. We apply this approach to analysis of the Millennium Drought in the South Australian portion of the Murray–Darling Basin which provided a natural experiment for the economic estimation of hydrological ecosystem service losses. Cataloguing estimates of expenditures incurred by Commonwealth and State governments, communities and individuals, we find that nearly \$810million was spent during the drought to mitigate losses, replace ecosystem services and adapt to new ecosystem equilibria. The approach developed here is transferable to other drought prone regions, providing insights into the potentially unexpected consequences of drought

and ecosystem thresholds and socioeconomic and political tipping points after which ecosystem restoration may become very costly. Our application to the South Australian Murray–Darling Basin demonstrates the potential of this approach for informing water, drought preparedness and mitigation policy, and to contribute to more robust decision-making.

Adoption and continued use of contour cultivation in the highlands of southwest China

- Ecological Economics---2013---Hongmei Liu, Qiuqiong Huang

This paper examines the use and continued use of contour cultivation in Yunnan Province. Descriptive analysis shows that even with easy-to-adopt conservation practices such as contour cultivation, we do not observe high rates of adoption without subsidy or monetary incentives. Multivariate analysis shows that households with larger plots, more fertile land and male and younger decision makers are more likely to use contour cultivation. Households relying more heavily on agricultural income tend to continue to use contour cultivation. The findings suggest that the trends in China's agriculture sector (increasing off-farm employment, aging and more female farmers on farm) are not conducive to the use of soil conservation practices. To alleviate soil erosion problems, the government should increase investment in agricultural extension and provide farmers with monetary incentives to encourage the adoption of environmental conservation measures. Policies should also target marginal land where conservation efforts may be lacking.

Carbon footprint accounting and dynamics and the driving forces of agricultural production in Zhejiang Province, China

- Ecological Economics---2013---Gang Dong, Xianqiang Mao, Ji Zhou, An Zeng

In recent decades, Chinese agriculture has moved towards higher-energy and higher carbon-input systems to increase food production in the country's limited area of croplands. To investigate the environmental

impacts of this trend, this study aimed to develop an “Integrated Life Cycle Assessment and Environmental Input–Output Model” (LCA–EIO Model). Using the tri-scope carbon footprint (CF) accounting method, the agricultural carbon footprint of Zhejiang Province, China was calculated for the years from 1997 to 2007, and the categories and structure of carbon emissions sources were analyzed, including patterns of change. In addition, the carbon intensity of crop farming in Zhejiang Province was examined. While an overall reduction in cropland areas has resulted in a substantial decline in direct greenhouse gas emissions from agricultural production, the proportion of carbon emissions caused by energy and chemical consumption has increased dramatically, and this consumption has become the primary source of carbon emissions. A decomposition analysis also identified the key driving forces of energy-related CF dynamics, such as the machinery–labor substitution effect. The results of the decomposition analysis can support decision makers in understanding and promoting low-carbon output agriculture.

The effect of government expenditure on the environment: An empirical investigation

- Ecological Economics---2013---George Halkos, Epameinondas A. Paizanos

This paper examines the impact of government spending on the environment using a panel of 77 countries for the time period 1980–2000. We estimate both the direct and indirect effects of government spending on pollution. The indirect effect in particular operates through the impact of government spending on income and the subsequent effect of the income level on pollution. To take into account the dynamic nature and the potential endogeneity in the relationships examined, appropriate econometric methods are used. For SO₂, government spending is estimated to have a negative direct impact on per capita emissions, while the direct effect is insignificant on CO₂ pollution. The indirect effect on SO₂ is negative for low income levels and becomes positive as income increases, while it remains negative for CO₂ for the most part of the sample range.

The resultant total effects follow the patterns of the indirect effects, which dominate their respective direct ones for each pollutant. Policy implications from the results vary depending on the income level of the considered countries.

The value of agricultural water rights in agricultural properties in the path of development

- Ecological Economics---2013---James Yoo, Silvio Simonit, John P. Connors, Paul J. Maliszewski, Ann P. Kinzig, Charles Perrings

This paper estimates the value of water rights in a rapidly urbanizing semi-arid area: Phoenix, Arizona. To do this we use hedonic pricing to explore the impact of water rights on property values in 151 agricultural land transactions that occurred between 2001 and 2005. We test two main hypotheses: (1) that the marginal willingness to pay for water rights is higher in more developed urbanizing areas than in less developed rural areas, and (2) that the marginal willingness to pay for water rights in urban areas is increasing in the value of developed land. We find that the marginal willingness to pay for water rights is highest among properties in urbanized or urbanizing areas where a significant proportion of the land has already been developed. Additionally, we find that the marginal willingness to pay for agricultural water rights is greatest in cities where developed land is most valuable.

An optimization framework for addressing aquatic invasive species

- Ecological Economics---2013---Kari Hyytiäinen, Maiju Lehtiniemi, Jarkko K. Niemi, Kimmo Tikka

This study develops a bio-economic model framework to optimize the management of aquatic invasive species. Stochastic dynamic programming is applied to investigate when and to what extent a society should engage in efforts to reduce the likelihood of an invasion, to control and eradicate a newly established population,

and to adapt to damages. The framework is parameterized for a potential Asian clam (*Corbicula fluminea*) invasion in the warm water discharge area of a nuclear power plant planned on the northern shores of the Baltic Sea. The sensitivity analysis reveals three distinct strategies: an adaptive strategy, which reduces the damage that an existing invasive species population causes to the private sector; a preventive strategy, which delays the invasion and the resulting damage; and a mitigative strategy, which puts effort into timely detection, control and eradication of the newly established population. Choice of the optimal strategy is sensitive to the unit costs and effectiveness of the measures required, to the level of externalities and to the size of the clam population after the invasion has been detected. The results emphasize the need for the energy sector to identify and internalize the external costs of potential invasions when making any large-scale investment plans.

Using stochastic frontier models to mitigate omitted variable bias in hedonic pricing models: A case study for air quality in Bogotá, Colombia

- Ecological Economics---2013---Fernando Carriazo, Richard Ready, James Shortle

Hedonic pricing models use property value differentials to value changes in environmental quality. If unmeasured quality attributes of residential properties are correlated with an environmental quality measure of interest, conventional methods for estimating implicit prices will be biased. Because many unmeasured quality measures tend to be asymmetrically distributed across properties, it may be possible to mitigate this bias by estimating a heteroskedastic frontier regression model. This approach is demonstrated for a hedonic price function that values air quality in Bogotá, Colombia.

Tradable pollution permits in dynamic general equilibrium: Can optimality and acceptability be reconciled?

- Ecological Economics---2013---Thierry Bréchet, Pierre-André Jouvét, Gilles Rotillon

In this paper we study the dynamic general equilibrium path of an economy and the associated optimal growth path in a two-sector overlapping generation model with a stock pollutant. A sector (power generation) is polluting, and the other (final good) is not. Pollution is regulated by tradable emission permits. The issue is to see whether the optimal growth path can be replicated in equilibrium with pollution permits, given that some permits must be issued free of charge for the sake of political acceptability. We first analyze the many adverse impacts of free allowances, and then we propose a policy rule that allows optimality and acceptability to be reconciled.

Disaggregated economic impact analysis incorporating ecological and social trade-offs and techno-institutional context: A case from the Western Ghats of India

- Ecological Economics---2013---Sharachandra Lele, Veena Srinivasan

Economic valuation of ecosystem benefits and their aggregation in a benefit–cost analysis (BCA) framework is the norm in mainstream environmental economics. But valuation and BCA have also attracted criticisms. ‘Internal’ criticisms point to the absence of alternative scenarios in valuation, overlooking of ecological trade-offs and dis-services, and inattention to context. Others criticize aggregation across diverse stakeholders and the problem of non-monetizable benefits, and dismiss BCA as fatally flawed. They suggest approaches such as deliberative decision-making and multi-criteria analysis. We propose a middle path that uses the strengths of economic analysis for decision support while avoiding the pitfalls. We disaggregate economic impacts by stakeholder groups, link ecosystem changes to benefits as well as dis-benefits, and examine how socio-technological context shapes the magnitude of economic impact. We illustrate this approach by studying the impact of creating the Biligiri Rangaswamy Temple wildlife sanctuary in the Western Ghats forests of southern India. Our analysis shows that while some stakeholders are net beneficiaries, others are net losers. Changes in forest rights, irrigation technologies, and

ecosystem dynamics influence the magnitude of benefits and sometimes convert gainers into losers. Such disaggregated analysis can provide useful information for deliberative decision-making and important academic insights on how economic value is generated.

The evolution and empirical estimation of ecological-economic production possibilities frontiers

- Ecological Economics---2013---Elias G. Bekele,Christopher L. Lant,Sethuram So-man,Girmay Misgna

This paper presents a graphical model of an ecological-economic production possibilities frontier (EEPPF) that explicitly considers the roles of market failure and technological asymmetry in the provision of ecosystem goods and services. An empirical example of a 6-dimensional EEPPF is provided using a watershed in Illinois where three provisioning ecosystem services (corn, soybeans, hay) and three regulating services (flood control, water quality, and carbon retention) are the objectives. When aggregated, provisioning and regulatory services form a linear-to-convex EEPPF, but regulatory services can be increased from 10 to over 90% of optimal with a reduction in provisioning services (crops) from 100 to 78% of optimal. While corn and soybeans are shown to form a trade-off with all other ecosystem services, hay is complementary with flood control, water quality and carbon retention. These three regulating services are complementary with one another, with water quality and carbon correlated at 0.80. These results demonstrate the use of GIS, distributed watershed models such as SWAT, and genetic algorithms as a valuable method to estimate empirical EEPPFs.

Recycling: Social norms and warm-glow revisited

- Ecological Economics---2013---Andrew Abbott,Shasikanta Nandeibam,Lucy O'Shea

We examine the role of social norms and warm-glow in a theoretical framework and establish that improving

the quality of recycling facilities, for example through kerbside collection, will elicit more recycling effort if warm-glow is present. Drawing on the literature, we model the role of social norms with reference to age profile, ethnicity and geographical location of the reference group. Using English local authority data, we show that a social norm for recycling does exist. We find the expected relationship between the quality of kerbside provision and recycling activity, if the household derives warm-glow from the activity; however, it is insignificant. Amongst the control variables, we find evidence that multifamily dwellings recycle less.

Is the Environmental Kuznets Curve for deforestation a threatened theory? A meta-analysis of the literature

- Ecological Economics---2013---Johanna Choumert Nkolo,Pascale Combes Motel,K Dakpo,Pascale Combes Motel

Although widely studied, deforestation remains a common research topic. The relationship between economic development and deforestation is still in question. This paper presents a meta-analysis of Environmental Kuznets Curve (EKC) studies for deforestation. Using 69 studies, offering 547 estimations, we shed light on why EKC results differ. We investigate the incidence of choices made by authors (such as econometric strategy, measure of deforestation, geographical area, and presence of control variables) on the probability of finding an EKC. After a phase of work corroborating the EKC, we find a turning point after the year 2001. Building on our results, we conclude that the EKC story will not fade until theoretical alternatives are provided.

Insiders, outsiders, and the adaptability of informal rules to ecological shocks

- Ecological Economics---2013---Erik Kimbrough,Bart Wilson

The history of the world is strewn with the remains of societies whose institutions failed to adapt to ecological change, but the determinants of institutional fragility are difficult to identify in the historical record. We

report a laboratory experiment exploring the impact of an exogenous ecological shock on the informal rules of property and exchange. We find that geographically-induced tribal sentiments, which are unobservable in the historical record, impede adaptation post shock and that inequality declines as wealth and sociableness increase. Quantitative measures of individual and group sociality account for some of the differences in successful or failed adaptation.

Towards a consistent approach for ecosystem accounting

- Ecological Economics---2013---Bram Edens,Lars Hein

In spite of an increasing interest in environmental economic accounting, there is still very limited experience with the integration of ecosystem services and ecosystem capital in national accounts. This paper identifies four key methodological challenges in developing ecosystem accounts: the definition of ecosystem services in the context of accounting, their allocation to institutional sectors; the treatment of degradation and rehabilitation, and valuing ecosystem services consistent with SNA principles. We analyze the different perspectives taken on these challenges and present a number of proposals to deal with the challenges in developing ecosystem accounts. These proposals comprise several novel aspects, including (i) presenting an accounting approach that recognizes that most ecosystems are strongly influenced by people and that ecosystem services depend on natural processes as well as human ecosystem management; and, (ii) recording ecosystem services as either contributions of a private land owner or as generated by a sector 'Ecosystems' depending on the type of ecosystem service. We also present a consistent approach for recording degradation, and for applying monetary valuation approaches in the context of accounting.

Development without energy? Assessing future scenarios of energy consumption in developing countries

- Ecological Economics---2013---Jan Christoph Steckel,Robert J. Brecha,Michael Jakob,Jessica Streffler,Gunnar Luderer

We analyze the relationship between economic development and energy consumption in the context of greenhouse gas mitigation. The main contribution of this work is to compare estimates of energy thresholds in the form of minimum energy requirements to reach high levels of development with output projections of per capita final energy supply from a group of integrated assessment models (IAMs). Scenarios project that reductions of carbon emissions in developing countries will be achieved not only by means of decreasing the carbon intensity, but also by making a significant break with the historically observed relationship between energy use and economic growth. We discuss the feasibility of achieving, on time scales acceptable for developing countries, both decarbonization and the needed structural changes or efficiency improvements, concluding that the decreases in energy consumption implied in numerous mitigation scenarios are unlikely to be achieved without endangering sustainable development objectives. To underscore the importance of basic energy needs also in the future, the role of infrastructure is highlighted, using steel and cement as examples.

On market-mediated emissions and regulations on life cycle emissions

- Ecological Economics---2013---Deepak Rajagopal,David Zilberman

We analyze the use of life cycle assessment (LCA) as a regulatory tool using biofuel regulations as an illustrative example. A regulatory context calls for a consequential LCA (CLCA) of a policy as opposed to an attributional LCA (ALCA) of a product. In performing CLCA, issues of scale, price effects, technology and policy in the counterfactual state of the world, strategic behavior, policy horizon etc. need consideration. This

appears to increase both uncertainty in estimates and the cost of performing LCA. We suggest heuristics for determining vulnerability to harmful indirect effects at an early stage in the policy process and discuss alternative policies to limit harmful indirect effects without engaging in the full effort of computation and selection of a central estimate for uncertain outcomes.

Managing excessive predation in a predator-endangered prey setting

- Ecological Economics---2013---Richard Melstrom,Richard Horan

Bioeconomic analyses of predator–prey systems examine how to adjust species management in response to predation spillovers to avoid inefficiencies. Predation spillovers refer to the net economic value of predation, taking into account the impacts on prey. Inefficiencies arise when the species interactions that generate this value are not managed to maximize the net economic surplus generated by the system. Consumptive values for predator and/or prey harvests factor into the value of predation spillovers in prior work. In contrast, we examine the optimal management of a predator–prey system where the only values are non-market values associated with the species’ abundances. We find that adverse predation spillovers may alone create social incentives for harvests or other interventions. Moreover, optimally reducing adverse predation spillovers may increase both species’ abundances — an ecological “win–win” outcome that increases economic surplus, although the result depends on the controls used. We examine predator removal and predator exclosures that shelter prey from predation. Using a numerical example of the Great Lakes Piping Plover, an endangered prey bird, and Merlins, a falcon predator, we find predator exclosures can reduce inefficiencies and produce a win–win outcome.

Social influence and collective action effects on farm level soil conservation effort in rural Kenya

- Ecological Economics---2013---Daniel Kyalo Willy,Karin Holm-Müller

This paper analyzes the effects of social influence and participation in collective action initiatives on soil conservation effort among smallholder farmers in Lake Naivasha basin, Kenya. We apply binary and ordered probit models in a two stage regression procedure to cross-sectional data collected through a household survey among randomly selected smallholder farmers. Smallholder farming systems in the research area are associated with practices that render farmlands susceptible to soil erosion causing negative impacts on land and the environment. Therefore, strategies that encourage soil conservation are likely to also offer solutions for dealing with agri-environmental challenges and poverty alleviation. Results indicate that social capital facilitates participation in collective action initiatives which then influence individual soil conservation efforts. Neighborhood social influences, subjective norms, gender, education level, farm size, access to credit and livestock ownership also emerge as key determinants of soil conservation effort. Policy implications drawn by this study encourage strategies to increase participation and effectiveness in collective action initiatives as a boost to soil conservation. Implementation of soil conservation practices could also be encouraged through awareness increasing instruments, facilitating access to agricultural micro-credit and paying attention to gender related challenges on knowledge access and rights over land and other natural resources.

Clean energy policy: Taxing carbon and the illusion of the equity objective

- Ecological Economics---2013---Neil Perry,Stuart Rosewarne,Graham White

The Australian government has passed legislation, the Clean Energy Future Policy, establishing a carbon-emission pricing scheme. While the scheme is represented as the most efficient and cost effective means of reducing emissions, the government has also committed to ensuring equity in burden sharing, particularly through the use of household compensation methods and by minimising the disadvantages faced by energy-intensive trade-exposed industries thereby committing to these industries’ continued developments. Treasury

modelling used to determine the required level of household compensation has remained relatively uncontested. We question the conclusion of equity in burden sharing on the basis of this modelling. The modelling reflects fairly standard conventional economic theory in terms of market structures, the determination of prices and outputs, and the characterisation of factor markets. The behavioural assumptions overstate the consumer and producer substitution possibilities, failing to consider the possibility of technical reswitching, and ignore the impact that oligopolistic market structures would have on price increases and infrastructure investment. The full ramifications of compensation for overall government expenditure and therefore the capacity of the government to continue to fund a range of elements of the social wage, the potential for unemployment and transitioning workers to less carbon-intensive industries, are also overlooked.

Who emits most? Associations between socio-economic factors and UK households' home energy, transport, indirect and total CO2 emissions

- Ecological Economics---2013---Milena Büchs,Sylke Schnepf

Does the association between household characteristics and household CO2 emissions differ for areas such as home energy, transport and indirect emissions? This question is policy relevant because distributional implications of mitigation policies may vary depending on the area of emissions that is targeted if specific types of households are likely to have higher emissions in some areas than in others. So far, this issue has not been examined in depth in the literature on household CO2 emissions. Using a representative UK expenditure survey, this paper compares how household characteristics like income, household size, education, gender, worklessness and rural or urban location differ in their association with all three areas as well as total emissions. We find that these associations vary considerably across emission domains. In particular, whilst all types of emissions rise with income, low income, workless and elderly households are more likely to have high

emissions from home energy than from other domains, suggesting that they may be less affected by carbon taxes on transport or total emissions. This demonstrates that fairness implications related to mitigation policies need to be examined for separate emission domains.

A complex system perspective on the emergence and spread of infectious diseases: Integrating economic and ecological aspects

- Ecological Economics---2013---Michele Graziano Ceddia,Nicholas Bardsley,R. Goodwin,G.J. Holloway,Giuseppe Nocella,Antonio Stasi

The emergence and spread of infectious diseases reflect the interaction of ecological and economic factors within an adaptive complex system. We review studies that address the role of economic factors in the emergence/spread of infectious diseases and identify three broad themes. First, the process of macro-economic growth leads to environmental encroaching, which is related to the emergence of infectious diseases. Second, there are mutually reinforcing processes associated with the emergence/spread of infectious diseases. For example, diseases can cause significant economic damages, which in turn may create the conditions for further spread. In addition, the existence of a mutually reinforcing relationship between global trade and macro-economic growth amplifies the emergence/spread of infectious diseases. Third, microeconomic approaches to infectious disease point to the adaptivity of human behaviour, which simultaneously shapes the course of epidemics and responds to it. Most of the applied research has focused on the first two aspects, and to a lesser extent on the third aspect. In this respect, there is a lack of empirical research aimed at characterising the behavioural component following a disease outbreak. Future research should seek to fill this gap and develop hierarchical econometric models capable of integrating both macro and micro-economic processes into disease ecology.

Breaking the elected rules in a field experiment on forestry resources

- Ecological Economics---2013---Marco A. Janssen,François Bousquet,Juan-Camilo Cardenas,Daniel Castillo,Kobchai Worrapimphong

Harvesting from common resources has been studied through experimental work in the laboratory and in the field. In this paper we report on a dynamic commons experiment, representing a forest, performed with different types of communities of resource users in Thailand and Colombia, as well as student participants. We find that all groups overharvest the resource in the first part of the experiment and that there is no statistical difference between the various types of groups. In the second part of the experiment, participants appropriate the common resource after one of three possible regulations is elected and implemented. There is less overharvesting after the rules are implemented, but there is a significant amount of rule breaking. The surprising finding is that Colombian villagers break the rules of the games more often than other groups, and even more so when they have more trust in members of the community. This observation can be explained by the distrust in externally proposed regulations due to the institutional and cultural context.

FDI and pollution havens: Evidence from the Norwegian manufacturing sector

- Ecological Economics---2013---Alief A. Rezza

This is an empirical study of the firm and country determinants of foreign direct investment (FDI) and how it is affected by the stringency of environmental regulations in host countries. We employ disaggregated data on sales by Norwegian multinationals' affiliates from 1999 to 2005 that allow such affiliates to be categorized as either efficiency-seeking (vertical) or market-seeking (horizontal) FDI. While the environmental stringency of a host country and its enforcement are found to have no effect on the average investment, we find a significant negative effect on multinationals with vertical motives. Compared to those located in lenient

countries, the efficiency-seeking affiliates in more environmentally regulated countries receive less investment from their parent companies in terms of (i) equity capital, (ii) capital stock, and (iii) assets. We further find that the total exports from affiliates to parent companies in Norway decrease with the level of enforced environmental stringency in the host countries.

Linking action situations: Coordination, conflicts, and evolution in electricity provision for irrigation in Andhra Pradesh, India

- Ecological Economics---2013---Christian Kimmich

Actor-centred institutional analysis can gain through an expanded focus from a focal action situation to the adjacent situations that make up its structure. Equilibrium outcomes in game models of a focal action situation may not be explainable without considering linked games. The concepts of an 'ecology of games', 'nested games' or economic network analysis indicate the relevance of this move, but a structured approach to heterogeneous networks of adjacent action situations encountered in resource and infrastructure governance has only recently been developed. This paper draws on the adjacency concept and proposes four types of links, a potential boundary for adjacency networks, and a condition for bidirectional causation between linked action situations. The relevance of the theoretical propositions laid out is empirically supported for the analysis of electricity governance of irrigation in Andhra Pradesh. The actual and empirically observed outcomes, as well as the potential capacity of an adjacent action situation to influence focal outcomes, are analysed through a set of stylised game theory models and their links.

Modeling Cumulative Effects of Nutrient Surpluses in Agriculture: A Dynamic Approach to Material Balance Accounting

- Ecological Economics---2013---Natalia Kuosmanen,Timo Kuosmanen

Nutrients such as nitrogen and phosphorus have a dual role as inputs to crop production and as pollutants

to water, air, and soil. The nutrient surplus measures are frequently used as indicators of environmental performance or eco-efficiency at micro level of individual farms and at macro levels of regions and countries. However, the static material balance accounting ignores an important dimension of the nutrient cycle: the time. Nutrients accumulate in soil, causing delayed effects and persistent harm to the environment. In this paper we propose a dynamic model of material balance, following the standard model of capital accumulation used in production economics. Using data of agricultural production in Finland in the years 1961–2009, we show that it is possible to estimate the stocks of nitrogen and phosphorus accumulated in the soil using information and data that are readily available. The dynamic model allows us to estimate not only the stocks of nutrients, but also the outflow of nutrients to water and air. Better understanding of flows and stocks of nutrients can provide insights to support managerial and policy decisions.

Re-framing the urban blight problem with trans-disciplinary insights from ecological economics

- Ecological Economics---2013---R.C. Weaver

Similar to circumstances in the field of economics, market fundamentalism dominates urban blight policy spaces in the U.S. despite criticisms of the paradigm. Unlike the unified alternative that ecological economics (EE) provides to conventional economic theory, however, disagreement over the meaning of “blight” has prevented a commonly held pre-analytic vision and policy agenda from forming in critical blight scholarship. This paper asserts that “applied EE” offers a framework in which to develop such a vision, and to strengthen the inchoate critical blight policy stream. We draw on the EE theory and concepts to argue that blight can be understood as a stock that accumulates in an urban system as a result of underinvestment into real property. Our conceptualization of the problem has several important implications for public policy. A brief illustration compares the relative efficacy of one city’s characteristically neoliberal blight policies

with more “EE-consistent” policies in a second city to show that the latter might in fact outperform the former.

Quantifying the sustainability of economic resource networks: An ecological information-based approach

- Ecological Economics---2013---Ali Kharrazi,Elena Rovenskaya,Brian D. Fath,Masaru Yarime,Steven Kraines

Sustainability as a concept has multiple disparate perspectives stemming from different related disciplines which either maintain ambiguous interpretations or concentrate on metrics pertaining to single aspects of a system. Given the embedded multi-dimensionality of sustainability, systemic approaches are needed that can cope with interactions of different dimensions. Past efforts for measuring sustainability holistically have taken an accounting approach based on the availability and efficiency of resource flows. However, an accounting approach fails to fully incorporate the intensive parameters pertaining to sustainability. An ecological information-based approach is a promising holistic measurement which incorporates both intensive and extensive dimensions of sustainability. This paper evaluates this approach by applying it to six economic resource trade flow networks: virtual water, oil, world commodity, OECD+BRIC commodity, OECD+BRIC foreign direct investment, and iron and steel. From the perspective of biomimicry, it appears that these networks can achieve higher levels of efficiency without weakening their robustness to resource delivery. The trends of measured efficiency and redundancy of the studied networks are demonstrated to be useful in reflecting long term changes while the trend in robustness levels were found to exhibit similar behavior to an ecosystem in its early phase of development.

Evolutionary-economic policies for sustainable consumption

- Ecological Economics---2013---Karolina Safarzynska

Policy prescriptions for sustainable consumption have been dominated by neoclassical economics, which is built around the notions of market equilibrium, utility maximization, and exogenous preferences. There are concerns that neoclassical economics is inadequate to guide policy prescriptions in the presence of evolving preferences and complex dynamics. Evolutionary economics provides a more realistic account of individual behavior underlying economic processes. It offers a framework for studying complex socio-economic interactions and exploring their properties. As a consequence, it may offer a better approach for the analysis of policies aimed at inducing fundamental changes in behaviors, technologies and institutions in the direction of increased sustainability. However, a coherent evolutionary-economic approach to economic policies has been missing so far. In particular, policy criteria for evaluating evolutionary outcomes and processes are ambiguous. The paper discusses the implications of employing the evolutionary-economic approaches to study sustainable consumption and policy from different ethical standpoints.

Examining the Demand for Ecosystem Services: The Value of Stream Restoration for Drinking Water Treatment Managers in the Llobregat River, Spain

- Ecological Economics---2013---Jordi Honey-Rosés,Vicenç Acuña,Mònica Bardina,Nicholas Brozović,Rafael Marcé,Antoni Munné,Sergi Sabater,Montserrat Termes-Rifé,Fernando Valero,Àlex Vega,Daniel W. Schneider

Ecosystem services would be incorporated into decision making more often if researchers were to focus more on the demand for these services rather than the supply. This implies examining the economic, decision making and technological context of the end-user before trying to attribute economic values to well known biological processes. This paper provides an example of how this research approach for ecosystems services could unfold. In the Llobregat River in northeastern Spain, higher stream temperatures require water treatment managers to switch on costly water treatment

equipment especially during warm months. This creates an opportunity to align the economic interests of downstream water users with the environmental goals of river managers. A restored riparian forest or an increase in stream flow could reduce the need for this expensive equipment by reducing stream temperatures below critical thresholds. We used the Stream Network Temperature Model (SNTMP) to test the impact of increasing shading and discharge on stream temperature at the intake of the drinking water treatment plant. The value of the stream temperature ecosystem services provided by existing forests is €79,000 per year for the water treatment facility, while additional riparian forest restoration along the Llobregat River could generate economic savings for water treatment managers in the range of €57,000–€156,000 per year. Stream restoration at higher elevations would yield greater benefits than restoration in the lower reaches. Moderate increases in stream discharge (25%) could generate savings of €40,000 per year.

Escalation of commitment to fossil fuels

- Ecological Economics---2013---Katherine D. Arbuthnott,Brett Dolter

The use of fossil fuels has been a great boon to human civilization. However, given the issue of climate change, it has become clear that this is a time-limited strategy and that we will at some point need to severely curtail, and perhaps ultimately eliminate, this strategy of meeting our energy needs. Given this long-term perspective, the authors argue that continued public investment in fossil fuel industries and infrastructures reflects escalation of commitment, continued investment in a failing strategy. In this context, this paper reviews the research on escalation of commitment and factors that encourage de-escalation, highlighting strategies that citizens can use to encourage politicians and public administrators to protect long-term civic well-being by shifting investments away from fossil fuel industries.

The biodiversity conservation game with heterogeneous countries

- Ecological Economics---2013---Sarah Winands,Karin Holm-Müller,Hans-Peter Weikard

Biodiversity is an essential resource, which we classify as conditionally-renewable. In order to achieve conservation and sustainable use of biodiversity virtually all nation states signed the United Nations Convention on Biological Diversity. In this paper we investigate how the heterogeneity of countries in regard to ecosystems and wealth influences the stability of international biodiversity conservation agreements both without and with transfers. We further examine the effect of different degrees of ecosystem substitutability. We model a coalition formation game with players that have a continuous conservation choice. The conservation benefit is dependent on wealth and ecosystem quality. Aggregation of global benefits respects differences in ecosystem substitutability. In case of transfers, a fund redistributes coalition benefits according to a sharing rule. The main finding is that in the absence of transfers, compared to the homogeneous situation, heterogeneity in ecosystems and wealth reduces the size of a stable coalition. The destabilising effect is stronger the higher the ecosystem substitutability. Optimal transfers facilitate a large stable coalition.

Environmental attitudes as WTP predictors: A case study involving endangered species

- Ecological Economics---2013---Andy Choi,Kelly S. Fielding

This paper investigates environmental attitudes as significant motives for the behavioral intention of willingness to pay (WTP) involving endangered species in a choice modeling context, and examines the underlying causal mechanism. Pro-environmental attitudes are measured using the New Ecological Paradigm (NEP) scale. Although the empirical evidence of this paper supports a significant attitude–WTP association, the causal mechanism is different from previous theorizing. When observed at the parameter level using random parameter logit models, the significant causal linkages

are evident with both the target good and the payment variable. The findings of this paper not only support direct and indirect impacts of general attitudes on WTP, but also provide novel findings about the causal mechanism for a significant attitude–WTP relationship at the parameter level in a non-Western case study. The impact of past visiting experience was also significant on the relationship, undermining the impact of attitudes on WTP.

The incentives for supply chain collaboration to improve material efficiency in the use of steel: An analysis using input output techniques

- Ecological Economics---2013---Alexandra C.H. Skelton,Julian M. Allwood

In the face of increasing demand and limited emission reduction opportunities, the steel industry will have to look beyond its process emissions to bear its share of emission reduction targets. One option is to improve material efficiency — reducing the amount of metal required to meet services. In this context, the purpose of this paper is to explore why opportunities to improve material efficiency through upstream measures such as yield improvement and lightweighting might remain underexploited by industry. Established input–output techniques are applied to the GTAP 7 multi-regional input–output model to quantify the incentives for companies in key steel-using sectors (such as property developers and automotive companies) to seek opportunities to improve material efficiency in their upstream supply chains under different short-run carbon price scenarios. Because of the underlying assumptions, the incentives are interpreted as overestimates. The principal result of the paper is that these generous estimates of the incentives for material efficiency caused by a carbon price are offset by the disincentives to material efficiency caused by labour taxes. Reliance on a carbon price alone to deliver material efficiency would therefore be misguided and additional policy interventions to support material efficiency should be considered.

An agent-based spatial simulation to evaluate the promotion of electricity from agricultural biogas plants in Germany

- Ecological Economics---2013---G. Sorda,Y. Sunak,Reinhard Madlener

In this paper we investigate how changes in the support scheme may affect electricity generation from agricultural Combined Heat and Power (CHP) biogas plants in Germany. An agent-based simulation model for investment decision-making is coupled with GIS data. The spatial-temporal diffusion model accounts for the limited availability of substrate resources, alternative plant sizes and different heat use combinations. For illustration, we apply the model to the German federal states of North Rhine-Westphalia and Bavaria, for which we estimate an additional economical capacity potential of 409MWel. Overall, we conclude that current feed-in payments per unit of electric power provided are probably not too far off the optimum level, if one considers the maximum diffusion of CHP units possible. However, the current feed-in system may overtly favor small generating units, thereby failing to incentivize coordination among farmers for joint resource utilization in larger and more efficient plants. In addition, optimization of the biogas conversion process and feedstock use would also be highly beneficial.

Comprehensive carbon stock and flow accounting: A national framework to support climate change mitigation policy

- Ecological Economics---2013---Judith I. Ajani,Heather Keith,Margaret Blakers,Brendan G. Mackey,Helen P. King

Greenhouse gas (GHG) inventories underpinning the United Nations Framework Convention on Climate Change (UNFCCC) and Kyoto Protocol report each country's net annual emissions, that is GHG flows. Yet the UNFCCC's goal is defined as a stock (atmospheric GHG concentration). Flow inventories are apt for the fossil fuel sector where flows are effectively one way, stock changes are almost entirely anthropogenic, and

stocks are stable in the absence of human perturbation. For the land sector, flow-based GHG inventories obscure fundamental differences between ecosystems: in their carbon stock stability, restoration capacity, and density. This paper presents a national carbon accounting framework that is comprehensive and includes stocks as well as flows for reservoirs, lands and activities continuously over time. It complements current flow-based inventories under the UNFCCC and Kyoto Protocol. The framework differentiates reservoirs by their role in the global carbon cycle, distinguishing between geocarbon (carbon in the geosphere), biocarbon (carbon in the biosphere) and anthropogenic carbon (stockpiles, products and waste). A reservoir ranking system is proposed based on longevity, reversibility of carbon loss, and carbon density. This framework will support policy makers and researchers grappling with mitigation strategies and competing demands on agricultural land and natural ecosystems.

Under- and over-use of pesticides: An international analysis

- Ecological Economics---2013---Narishwar Ghimire,Richard Woodward

This paper analyzes the economic, political and environmental factors that contribute to the consumption and under- or over-use of pesticides. Using unbalanced panel data analysis, we study how pesticide over- or under-use varies for countries with different per capita Gross Domestic Product (GDP) and foreign direct investment (FDI) stock. We begin by controlling for climatic and agricultural variables that should lead to variation in pesticide application rates. The residual from the regression provides an indication of a nation's deviation in pesticide use relative to the mean. The more negative the residual, the more likely it is that that nation is under-using pesticides. The more positive it is, the more likely it is that pesticides are being over-used. We study the correlation of this residual with important economic and political variables. We find that at low levels of per capita GDP, there is evidence of pesticide under-use and that at the highest income levels, there may be increasing over-use.

We also look at the correlation of pesticide use with foreign direct investment stock, farm size, mechanization and democracy and, in most cases find significant correlation with these variables.

Legal exclusions, private wealth and livelihoods: An analysis of work time allocation in protected areas

- Ecological Economics---2013---Sirisha Naidu

Do exclusionary forest access regimes have an unequal impact on livelihood activities? This paper analyzes primary data on time allocation to livelihood activities by forest communities in the Indian Himalayas to investigate this question. Estimation results are consistent with the hypothesis that forest access regimes affect both forest extraction behavior and other livelihood strategies. Residents of sanctuary forests, experiencing higher restrictions on forest use, decrease the proportion of time allocated to forest extraction and livestock activities, but compensate by increasing their time allocation to agriculture in comparison to residents of state-controlled protected forests. However, wealthy residents of the wildlife sanctuary expend a higher proportion of their time in managing livestock and extracting forest resources in comparison to its less affluent residents. Thus wealth enables circumvention of access restrictions despite legalization of exclusion. Findings of this study have implications for design of biodiversity conservation and carbon sequestration policies.

Motivation for conservation: Assessing integrated conservation and development projects and payments for environmental services in La Sepultura Biosphere Reserve, Chiapas, Mexico

- Ecological Economics---2013---Luis Rico García-Amado,Manuel Ruiz Pérez,Sara Barrasa García

In order to achieve conservation and development, direct strategies, such as Payments for Environmental Services (PES), have been claimed to be potentially more effective than indirect strategies, like

Integrated Conservation and Development Projects (ICDPs). However, PES have raised some concerns on the commodification of nature and the potential replacement of non-chrematistic forms of valuing ecosystems. This article evaluates PES and ICDPs in La Sepultura Biosphere Reserve, Mexico, by analyzing the programs' fund allocation, examining conservation perceptions based on 731 structured interviews and presenting a detailed assessment of ICDP/PES preferences in a community with the longest participation in both schemes. People receiving PES tend to make the future of conservation contingent on monetary and utilitarian reasons, this preference increasing with the number of years receiving PES. These are preferred for their directness and short-term results, although raising concerns about the little social capital they generate. ICDPs are appreciated for arising environmental awareness, being linked with long term conservation, productive capacity and social capital building. Negative perceptions of ICDPs are related to past economic failures. Our results suggest that the real issue is not PES vs. ICDPs but how to combine them to find the proper sequence while reinforcing intrinsic value-based attitudes.

Environmental performance, innovation and spillovers. Evidence from a regional NAMEA

- Ecological Economics---2013---Valeria Costantini,Massimiliano Mazzanti,Anna Montini

The achievement of positive Environmental Performance (EP) at national level could strongly depend on differences in regional features, namely productive specialization, regulation stringency and innovation capabilities of both public institutions and the private business sector. We present empirical evidence for a newly released NAMEA available for the 20 Italian regions in order to demonstrate the role played by sector innovation, regional spillovers and environmental policies. The Italian North-south divide regarding industrial development and productive specialization patterns seems to affect regional EP. Nonetheless, such a pattern presents some interesting differences, revealing a more heterogeneous distribution of emissions

which may reflect the role of other driving forces. In particular, agglomerative effects seem to play a major role and the EP of neighboring regions influences the regional internal EP. This means that together with the spatial concentration of specific sectors into restricted areas, there is also some convergence in the adoption of cleaner or dirtier production process techniques. Finally, interregional technological spillovers are more important than sector internal innovation for improving EP, revealing that accounting for spatial features and linking ecological economics to regional economics are crucial in understanding the key drivers of EP.

More than total economic value: How to combine economic valuation of biodiversity with ecological resilience

- Ecological Economics---2013---Jeroen F. Admiraal, Ada Wossink, Wouter T. de Groot, Geert R. de Snoo

The assessment of total economic value has become a pragmatic and popular approach in nature valuation, yet criticisms have been raised. One major point of critique is that total economic value bases the monetary value of ecosystems purely on the flow of human benefits of services of ecosystems and consequently ignores questions of sustainable use of natural capital per se. This paper explains why total economic value by itself is in principle an inadequate concept to guide sustainable use of ecosystems and gives an overview of essential ecological theory that needs to be taken into account in addition to total economic value to fully include ecosystem sustainability. The paper concludes with a framework for combining ecological theory with economic valuation. The key elements here are theoretical ecological insights about ecosystem resilience and portfolio theory which offers an economic perspective on investment in biodiversity. Portfolio theory puts total economic value in a framework where investment in biodiversity is expanded to cover functional diversity and mobile link species in order to maintain ecosystem resilience and so fosters sustainable use of ecosystems.

The ‘advancedness’ of knowledge in pollution-saving technological change with a qualitative application to SO₂ cap and trade

- Ecological Economics---2013---David Grover

This paper investigates the extent to which ‘advanced’ knowledge and technology played a role in the SO₂ compliance process in electric power plants under the US SO₂ cap and trade program. It investigates the hypothesis that advanced knowledge and technology dedicated to pollution abatement played a minor role in that process while relatively unadvanced forms of knowledge and technology played the main role. New qualitative evidence in this somewhat well-known case is considered: interviews with electric power plant R&D managers, plant-level compliance data, and the changes undergone by boiler manufacturer, coal mining and railroad companies in the supply chain. Advanced knowledge dedicated to pollution abatement like the type now being emphasised for carbon capture and storage (CCS) played a minor role, while unadvanced knowledge and technology played the main role. While there are clearly limits to how far this unadvanced knowledge and technology finding can be generalised to GHG emission control, the specific aspects of the SO₂ case that might be broadly informative of the response to GHG emissions are elaborated. In any case, the paper shows how ‘innovation’ in pollution control can be inexpensive and effective without involving very much advanced knowledge and technology for pollution control.

Improved cooking stoves and firewood consumption: Quasi-experimental evidence from the Northern Peruvian Andes

- Ecological Economics---2013---Marcos Agurto Adrianzen

Over the past few decades, improved firewood cooking stoves have been massively distributed around the world, mainly with the purpose of decreasing fuelwood consumption among rural households. Surprisingly, rigorous “on the field” evidence on the causal impact of these devices is very limited. This paper estimates

the impact of an improved stove design distributed in the Northern Peruvian Andes on firewood consumption. To identify the causal effect of improved stoves, it exploits a quasi-experiment related to the improved stove intervention. The evidence indicates that a proportion of households that adopted the new device experienced iron frame failures. These failures were not systematically caused by inadequate usage, installation or maintenance, but by faulty iron frame construction. Moreover, faulty iron frames were randomly distributed, and whether an iron frame was faulty or not, was not ex-ante observable to the beneficiaries. Therefore, an iron frame failure indicator is used as an instrumental variable to identify the causal effect of improved stoves. Improved stove usage appears to reduce firewood consumption by approximately 46% in the study area.

The relevance of epistemic analysis to sustainability economics and the capability approach

- Ecological Economics---2013---Frank Birkin,Thomas Polesie

This paper considers how epistemic analyses (Birkin and Polesie, 2011; Foucault, 1970, 1990a, 1990b) may assist with the development of sustainability economics (Bartelmus, 2010; Baumgärtner and Quaas, 2010a, 2010b; and Söderbaum, 2011) and the capability approach (Ballet et al., 2011; Martins, 2011; Rauschmayer and Leßmann, 2011; Scerri, 2012).

The short-run and long-run effects of corruption control and political stability on forest cover

- Ecological Economics---2013---Gregmar Galinato,Suzette Galinato

This article examines how governance, particularly corruption control and political stability, affects deforestation due to agricultural land expansion. We estimate the short-run and long-run effects of corruption control and political stability on deforestation in South American and Asian countries using data from

1990 to 2003 where converting forest land into agricultural land is a significant problem. Political stability has a positive and significant effect on forest cover in the short run but an insignificant effect in the long run. In contrast, corruption control has a negative and significant effect on forest cover in the short run and the long run with a larger magnitude in the former. One possible explanation is that corruption control induces more technological productivity and, if technology and land use are complements, increases in technological development lead to agricultural land expansion.

International trade and the geographical separation between income and enabled carbon emissions

- Ecological Economics---2013---Alexandra Marques,João Rodrigues,Tiago Domingos

In this paper we study how international trade allows the geographical separation between the place where carbon emissions occur and the place where income from those emissions is derived. We do so by studying the carbon emissions enabled by the primary inputs of products downstream along the production chain. We find that 18% of global carbon emissions are enabled abroad and that Developed Economies, Fossil Fuel Exporters and Asia account for 80% of the downstream emissions enabled by international trade. Both Developed Economies and Fossil Fuel Exporters exhibit a positive trade balance of enabled emissions while for Asia the opposite is true. Developed Economies and Fossil Fuel Exporters enable emissions mainly through the export of manufactured products (690Mt) and fossil fuels (684Mt), respectively, while Asia exhibits an outflow of enabled emissions through the import of fossil fuels (209Mt). The measurement of enabled emissions allows the understanding of how a region's income is derived from carbon emissions occurring abroad.

Does ecologically unequal exchange occur?

- Ecological Economics---2013---Daniel D. Moran,Manfred Lenzen,Keiichiro Kanemoto,Arne Geschke

The hypothesis of ecologically unequal exchange posits that low and middle income developing nations maintain an ecological deficit with wealthy developed nations, exporting natural resources and high impact commodities thereby allowing wealthy economies to avoid operating ecologically impactful industries at home. In this survey we assess the footprint of consumption of 187 countries using eight indicators of environmental pressure in order to determine whether or not this phenomenon occurs. We use input–output analysis with a new high resolution global Multi-Region Input–Output table to calculate each trading pair’s balance of trade in biophysical terms of: GHG emissions, embodied water, and scarcity-weighted water content, air pollution, threatened species, Human Appropriated Net Primary Productivity, total material flow, and ecological footprint. We test three hypotheses that should be true if ecologically unequal exchange occurs. One: The inter-regional balance of trade in biophysical terms is disproportional to the balance of trade in financial terms. We find this is true, though not strongly so. Two: Exports from developing nations are more ecologically intensive than those from developed nations. We find this is true. Three: High-income nations disproportionately exert ecological impacts in lower income nations. We find this is false: high income nations are mostly exporters, not importers, of biophysical resources.

Behavioral innovations: The missing capital in sustainable development?

- Ecological Economics---2013---Antoine Beretti, Charles Figuières, Gilles Grolleau

Many scholars argue that environmental issues can be addressed through technological innovation, a proposal which echoes a lasting debate between environmental and ecological economics about the substitution rate between natural and manufactured capital. In addition to these two established types of capital, this paper introduces the idea of ‘behavioral capital’. We define behavioral capital as the latent potential of behavioral change to affect improvement in environmental quality. Our contribution argues that technological and tradi-

tional regulatory innovations serve as insufficient tools for addressing modern environmental issues and ensuring sustainable development. Without discarding these solutions, we contend that because human behavior is a significant contributor to environmental problems, it should be regarded as a key component of continued solutions. We suggest that the dual interest theory can serve as an integrative framework for behavioral innovations related to environmental issues. In suggesting this, we assume that behavioral innovations can both overcome some of the limitations of technological innovations and offer new solutions. Our main insight is to suggest that some depletion of natural capital – but not all – can be offset by behavioral changes without decreasing, or even increasing, subjective well-being.

Life satisfaction and air quality in Europe

- Ecological Economics---2013---Susana Ferreira, Alpaslan Akay, Finbarr Brereton, Juncal Cuñado, Peter Martinsson, Mirko Moro, Tine F. Ningal

Concerns for environmental quality and its impact on people’s welfare are fundamental arguments for the adoption of environmental legislation in most countries. In this paper, we analyze the relationship between air quality and subjective well-being in Europe. We use a unique dataset that merges three waves of the European Social Survey with a new dataset on environmental quality including SO₂ concentrations and climate in Europe at the regional level. We find a robust negative impact of SO₂ concentrations on self-reported life satisfaction.

Understanding the uptake of organic farming: Accounting for heterogeneities among Irish farmers

- Ecological Economics---2013---Doris Läpple, Hugh Kelley

This paper examines the decisions of Irish farmers to convert to organic farming by applying the theory of planned behaviour to control for social influence and technical constraints. Cluster analysis and principal

component analysis are utilised to account for sample heterogeneity and to identify heterogeneities in farmer beliefs regarding adoption of organic methods. The results indicate that the impact of economic incentives and technical barriers varies, while social acceptance of organic farming constrains adoption. These findings suggest that policy incentives mainly based on subsidy payments may be insufficient to increase the organic sector in the presence of social and technical barriers.

Divestment of the English Forestry Estate: An economically sound choice?

- Ecological Economics---2013---Steven King,Iain Fraser

This paper evaluates if the proposed divestment of the English Forestry Commission Estate in 2010 was economically rational. The analysis is composed of two parts. First, an amenity value threshold for continued public access to the Estate was estimated. Based on a stated value of the Estate (i.e. £700million) and assuming a discount rate of 3.5% the Estate should never have been considered for sale. However, assuming a discount rate of 5% then the associated critical amenity value was estimated to be approximately £5million. Second, travel cost methods were employed to value public access to the Forest of Dean as a proxy for the Estate. An on-site survey was conducted that yielded estimates of consumer surplus that exceed the critical amenity value of the Estate by two orders of magnitude even when we employ a discount rate above that typically used in public policy decision making. Therefore, we conclude that the policy to divest the Estate for £700million was not ‘a good deal’ and as such the resulting policy reversal was an economically sensible decision.

Endogenous fiscal policies, environmental quality, and status-seeking behavior

- Ecological Economics---2013---Phu Nguyen-Van,Thi Kim Cuong Pham

This paper analyzes endogenous fiscal policy in an endogenous growth model where agents care about social

status and environmental quality. The quest for a higher status is assimilated to a preference for capital wealth. The government uses income tax to finance infrastructure and environmental protection. We find that accounting for preferences for social status and environmental quality may lead to an allocation of tax revenue in favor of a cleanup effort to the detriment of infrastructure. Economic growth is not necessarily and negatively affected by this allocation as it is partly explained by an excessive accumulation of capital wealth due to the quest of status. Status seeking can however harm economic growth and environmental quality when its motive is important enough. Finally, we show that economic growth may be consistent with environmental preservation but is not necessarily welfare-improving as in the case of absence of status-seeking behavior.

Conscientious vs. ambivalent consumers: Do concerns about energy availability and climate change influence consumer behaviour?

- Ecological Economics---2013---Pamela Wicker,Susanne Becken

Energy availability and climate change are interrelated concerns with economic components. They need to be addressed by policy makers and they require changes in energy consumption. This study examines whether concerns about energy availability and climate change influence consumer behaviour, policy perceptions, and beliefs about future energy consumption. This question is investigated by analysing data from the Eurobarometer 75.4, a comprehensive survey of citizens from all countries of the European Union that was conducted in June 2011 (n=26,840). The regression results show that people concerned about climate change were significantly more likely to take action to mitigate climate change, and to be more favourably disposed towards energy policies and future changes in energy consumption, than people who were not concerned about climate change. On the other hand, people who were concerned about energy availability undertook fewer actions and neither supported energy policies nor believed in future changes in energy consumption. This surprising finding raises questions regarding the adequate communication

of energy availability and policies to the public in the European Union.

Beach ‘lovers’ and ‘greens’ : A worldwide empirical analysis of coastal tourism

- Ecological Economics---2013---Laura Onofri,Paulo Nunes

This paper examines worldwide tourist coastal destination choice using a comprehensive global dataset at the country level, for both domestic and international tourists. This data includes a systematic profile of the countries’ coastline with respect to economic and natural environments, such as marine biodiversity related indicators. Tourist demand is modelled using a system of simultaneous structural equations estimated by a 3SLS routine. We identify two tourist demand segments, denoting different preferences for the worldwide coastal destinations. International tourists choose their coastal destination because they have a strong preference for the cultural and natural environments. This, in turn, depends on the destination of country’s coastal habitat abundance and marine biodiversity. We label this segment of coastal tourism, as “greens”. Alternatively, domestic tourists have a preference for beach characteristics, in particular beach length. This in turn depends on anthropogenic pressure, the built environment and climatic variables. For this reason we interpret this tourism segment as “beach lovers”. This information is, in turn, of high significance for stimulating coastal tourism demand as well as for identifying market based policy instruments with the objective to finance the conservation of environmental and cultural capital hosted at the coastal communities.

The relationship between international financial reporting standards, carbon emissions, and R&D expenditures: Evidence from European manufacturing firms

- Ecological Economics---2013---Nicholas Apergis,Sofia Eleftheriou,James Payne

This study examines the impact of research and development (R&D) expenditures on carbon dioxide (CO₂)

emissions prior to and under the mandatory adoption of International Financial Reporting Standards at the firm level within the manufacturing sectors of three European countries, i.e. Germany, France and the U.K. Estimation of a threshold autoregressive model using quarterly data from 1998 to 2011 reveals that in the post-IFRS mandatory adoption year R&D expenditures show a reduction in CO₂ emissions to firms, i.e. rising CO₂ abatement. This is likely due to the presence of incentives provided by the new accounting disclosure regime. Our results remain robust in terms of a sector analysis, firm size, and the introduction of the European Union Emission Trading Scheme (EU-ETS) across the three countries.

Effect of distance of transportation on willingness to pay for food

- Ecological Economics---2013---Carola Grebitus,Jayson Lusk,Rodolfo Nayga

Consumers’ interest in locally produced foods is increasing. Hence, there is a need to decipher and quantify consumers’ desire for local foods and understand the underlying causes of this demand. More specifically, we examine in this paper the issue of distance of transportation and its’ impact on consumer preferences. We investigate how consumers’ willingness to pay (WTP) for food varies with the distance the food traveled. Results from non-hypothetical second-price auctions indicate that average WTP is falling in distance traveled, indicating a preference for local production. Results also indicate that the marginal value of a mile traveled depends on the type of food studied (apples vs. wine). Socio-demographic characteristics, perceptions of freshness, taste and food safety, as well as support of local economy impact WTP for local foods.

Dealing with preference uncertainty in contingent willingness to pay for a nature protection program: A new approach

- Ecological Economics---2013---Louinord Voltaire,Claudio Pirrone,Denis Bailly

In this paper, we propose an alternative preference uncertainty measurement approach where respondents have the option to indicate their willingness to pay (WTP) for a nature protection program either as exact values or intervals from a payment card, depending on whether they are uncertain about their valuation. On the basis of their responses, we then estimate their degree of uncertainty. New within this study is that the respondent's degree of uncertainty is "revealed", while it is "stated" in those using existing measurement methods. Three statistical models are used to explore the sources of respondent uncertainty. We also present a simple way of calculating the uncertainty adjusted mean WTP, and compare this to the one obtained from an interval regression. Our findings in terms of determinants of preference uncertainty are broadly consistent with a priori expectations. In addition, the uncertainty adjusted mean WTP is quite similar to the one derived from an interval regression. We conclude that our method is promising in accounting for preference uncertainty in WTP answers at little cost to interviewees in terms of time and cognitive effort, on the one hand, and without researcher assumptions regarding the interpretation of degrees of uncertainty reported by respondents, on the other.

Forest management for timber and carbon sequestration in the presence of climate change: The case of *Pinus Sylvestris*

- Ecological Economics---2013---Renan Goetz,Natali Hritonenko,Ruben Mur,Angels Xabadia,Yuri Yatsenko

Climatic changes will affect the dynamics of a forest ecosystem. Consequently, carbon sequestration costs can only be estimated correctly if changes in climatic conditions are considered. This article determines the changes in mitigation costs of an optimal forest management regime in the presence of climatic changes and varying prices, and takes account of substitution processes between timber production and carbon sequestration at the stand level. The study demonstrates that in the presence of climate change the sequestration costs per ton of carbon increase with higher amounts

of carbon sequestered per hectare. This finding can be used to identify a threshold for the amount of sequestered carbon per hectare below which the costs of carbon sequestration are hardly influenced by climate change.

Nonmarket values of major resources in the Korean DMZ areas: A test of distance decay

- Ecological Economics---2013---Andy Choi

The Demilitarised Zone (DMZ) and its adjoining areas serve not only as a geopolitical buffering zone between North and South Korea, but also as rare refuges for various animals and plants. This paper investigates conservation values of major DMZ resources and comparatively tests distance decay between contingent valuation and choice modelling. The overall conservation value for the DMZ resources per person as one-off payments was \$9.06 or \$34.97, respectively from the CVM and CM datasets. Research findings deny distance decay regardless of elicitation methods when the distance variable is parameterised as part of utility functions. Conversely, a segmentation-valuation approach demonstrates conflicting conclusions on distance decay and the WTP anomaly between users and non-users depending on elicitation methods. The CM results demonstrate that protection of the DMZ resources might be less important and attractive to local populations than to those in the distant regions. A direct cross-method transfer of any distance effect might not be granted.

Evolutionary modelling of the macro-economic impacts of catastrophic flood events

- Ecological Economics---2013---Karolina Safarzynska,Roy Brouwer,Marjan Hofkes

This paper examines the possible contribution of evolutionary economics to macro-economic modelling of flood impacts to provide guidance for future economic risk modelling. Most macro-economic models start from a neoclassical economic perspective and focus on equilibrium outcomes, either in a static or dynamic way, and describe economic processes at a high level

of aggregation. As a consequence, they typically fail to account for the complexity of social interactions and other behavioural responses of consumers and producers to disasters, which may affect the macro-economic impacts of floods. Employing evolutionary principles and methods, such as agent-based modelling, may help to address some of the shortcomings of current macro-economic models. We explore and discuss the implications of applying consumer and producer heterogeneity, bounded rationality, network effects, social and technological learning, co-evolution and adaptive policy-making concepts into existing economic frameworks for the assessment of macro-economic impacts of floods.

Input–output analysis of CO2 emissions embodied in trade and the driving forces: Processing and normal exports

- Ecological Economics---2013---Bin Su,B.W. Ang,Melissa Low

In recent years, energy-related CO2 emissions embodied in international trade and the driving forces have been widely studied by researchers using the environmental input–output framework. Most previous studies however, do not differentiate different input structures in manufacturing processing exports and normal exports. Using China as an example, this paper exemplifies how implications of results obtained using different export assumptions differ. The study posits that the utilization of traditional I–O model results in an overestimation of emissions embodied in processing exports and an underestimation in normal exports. The estimate of CO2 emissions embodied in China's exports drops by 32% when the extended I–O model is used. The choice of export assumption has more impact on the decomposition results for processing exports. The study further highlights that for a country with an export structure similar to China, it is meaningful to look into the impact of export assumption in embodied emission studies.

A proactive approach for assessing alternative management programs for an invasive alien pollinator species

- Ecological Economics---2013---Aliza Fleischer,Sharoni Shafir,Yael Mandelik

Most evaluations of the economic impacts of invasive species are done post facto and concentrate on direct production loss caused. However, the effects of invasive species on non-market services such as biodiversity and landscapes can be considerable. A proactive approach of assessing the expected economic impact of invasive species prior to their occurrence may contribute to greater efficiency of policy makers. Here we used a stated preference method for a priori evaluating the willingness of the population to pay for different control programs of a new invasive bee species in Israel, the dwarf honey bee, *Apis florea*. We evaluated possible economic impacts of *A. florea* using two model plant species expected to be adversely affected by its invasion due to decreased pollination. The plants have no market value but they add aesthetic value to the open landscape. Using a mixed logit model we found that the mean willingness to pay (WTP) differed between the model plants, and increased with the extent of plant loss. Respondents differentiated between levels of damage to the plants and between control methods in their preferences for a specific program. Our results provide means for informed proactive decision making in preventing the continued invasion of the bee.

Sustainability of national consumption from a water resources perspective: The case study for France

- Ecological Economics---2013---A. Ertug Ercin,Mesfin M. Mekonnen,Arjen Y. Hoekstra

It has become increasingly evident that local water depletion and pollution are often closely tied to the structure of the global economy. It has been estimated that 20% of the water consumption and pollution in the world relates to the production of export goods. This study analyzes how French water resources are

allocated over various purposes, and examines impacts of French production in local water resources. In addition, it analyzes the water dependency of French consumption and the sustainability of imports. The basins of the Loire, Seine, Garonne, and Escaut have been identified as priority basins where maize and industrial production are the dominant factors for the blue water scarcity. About 47% of the water footprint of French consumption is related to imported agricultural products. Cotton, sugar cane and rice are the three major crops that are identified as critical products in a number of severely water-scarce river basins: The basins of the Aral Sea and the Indus, Ganges, Guadalquivir, Guadiana, Tigris & Euphrates, Ebro, Mississippi and Murray rivers. The study shows that the analysis of the external water footprint of a nation is necessary to get a complete picture of the relation between national consumption and the use of water resources.

An international assessment of energy security performance

- Ecological Economics---2013---Benjamin K. Sovacool

Energy security has in recent years grown as a salient policy and political issue. To better understand energy security and sustainability concerns, this study's main objective is to present an energy security index which measures national performance on energy security over time. Based on three years of research involving interviews, surveys, and an international workshop, this study conceptualizes energy security as consisting of the interconnected factors of availability, affordability, efficiency, sustainability, and governance. It then matches these factors with 20 metrics comprising an energy security index, measuring international performance across 18 countries from 1990 to 2010. It offers three case studies of Japan (top performer), Laos (middle performer), and Myanmar (worst performer) to provide context to the index's results. It then presents four conclusions. First, a majority of countries analyzed have regressed in terms of their energy security. Second, despite the near total deterioration of energy

security, a great disparity exists between countries, with some clear leaders such as Japan. Third, tradeoffs exist within different components of energy security. Fourth, creating energy security is as much a matter of domestic policy from within as it is from foreign policy without.

A critique of the perceived solid conceptual foundations of ISEW & GPI — Irving Fisher's cognisance of human-health capital in 'net psychic income'

- Ecological Economics---2013---Andrew John Brennan

This paper puts forward a political economy critique of the perceived solid conceptual foundations of Sustainable Well-Being Indicators (SWBIs) such as ISEW and GPI. A particular version of 'entropic net psychic income' has been implanted as the main conceptual basis for these aggregated measures of sustainable economic welfare. However, a well-known limitation of SWBIs is that they do not prudently factor-in measures of investment and depreciation of 'human-health capital'—yet this is a critical aspect of sustainable well-being. It is argued that under Fisher's psychic income framework, the heart of the indicator is a theory that specifies accounting for some sort of change in the human psyche, i.e. the stock (or fund) of human-health capital. Advocates of SWBIs cannot adequately account for the degree of human health or knowledge, because this is not their reference point—'personal consumption expenditures' is their reference point. Political economy seeks to avoid abstracting from the whole reality, recognising that endogenous processes of human-health capital formation are overdetermined. This paper thus argues that there is a significant conceptual shortcoming in ISEW and GPI, which, if left unattended will undermine the measure of theoretical legitimacy and empirical efficacy.

The failure of the ISEW and GPI to fully account for changes in human-health capital — A methodological shortcoming not a theoretical weakness

- Ecological Economics---2013---Philip Lawn

Andrew Brennan (Ecological Economics, 2013--this issue) has argued that the Index of Sustainable Economic Welfare (ISEW) and Genuine Progress Indicator (GPI) are theoretically flawed because, as indicators designed to capture the net psychic income generated by economic activity, they fail to incorporate net changes in human-health capital. To a lesser extent, Brennan is also critical of the fact that the ISEW and GPI are unable to reflect both economic welfare and sustainability. Whilst I'm happy to concede that the two indicators fail to fully account for changes in human-health capital, it is my contention that this failure represents, at most, a methodological shortcoming. It does not amount to a theoretical weakness. Despite Brennan's best efforts, the ISEW and GPI remain soundly based on Irving Fisher's distinction between income and capital. Indeed, Brennan's suggested modifications to the ISEW and GPI do nothing but conflate income and capital, which, if taken on board, would lead to misleading indicators of total economic welfare. As for not reflecting both economic welfare and sustainability, I have long argued that the ISEW and GPI merely reflect the former and need to be supplemented by biophysical indicators to determine whether the economic welfare being enjoyed by a nation is sustainable. The fact that the ISEW and GPI only reflect economic welfare is not a weakness, since no indicator can or should attempt to reflect both conditions. The use of strong sustainability approaches to calculate the environment costs incorporated in the ISEW and GPI is not an exercise designed to measure sustainability. It is an exercise in good economic accounting.

Transaction costs, collective action and adaptation in managing complex social-ecological systems

- Ecological Economics---2013---Graham Marshall

With the escalating uncertainties and surprises faced in responding to environmental and natural resource challenges has come growing recognition of the need to manage such issues as social-ecological systems and value the capacities that enable adaptation to these changes. Adaptations in environmental management often involve complex, including wicked, problems of collective action. Institutions introduced to reduce the transaction costs of solving these problems do not come for free.

Understanding the evolution and performance of water markets and allocation policy: A transaction costs analysis framework

- Ecological Economics---2013---Dustin Gerrick, Stuart Whitten, Anthea Coggan

Water markets and associated allocation policy reforms have struggled to achieve their intended goals in many water-stressed rivers, in part due to the institutional friction imposed by transition and transaction costs. This paper elaborates a transaction costs analysis framework to examine the evolution and performance of water markets and allocation policy reforms. This analysis rests on three pillars: i) a synthesis of three theoretical traditions of institutional analysis (Williamson, North, and Ostrom) often considered independently; ii) a framework to examine the types and interactions of transaction costs in market-based water allocation over time; and iii) an illustrative analysis of three large river basins – the Colorado, Columbia and Murray-Darling – with varying levels of success in market-based water policy reforms. The resulting framework accounts for water's complexity as an economic good. This framework and the case studies lead to the identification of several policy implications including the need for: a multiphase sequencing of reform, strategic investment in institutional transition costs, and institutional choices that preserve future flexibility to adjust water rights and diversion limits to manage social and environmental externalities.

Talk is cheap, or is it? The cost of consulting about uncertain reallocation of water in the Murray–Darling Basin, Australia

- Ecological Economics---2013---Lin Crase,Sue O’Keefe,Brian Dollery

In this paper we reflect on the challenge of reallocating water resources from agricultural interests to environmental uses. The area of interest is the Murray–Darling Basin, Australia, although the evidence presented provides salient lessons for a range of settings. We draw on the transaction cost literature where the tasks of redesigning and using institutions can help conceptualise the costs associated with policy change. A framework for improving ex ante assessment of transaction costs and its relationship to transformation or abatement costs is elaborated, especially as it relates to community consultation exercises. Against the background of the water reforms of the past three decades we conclude that policy makers and administrators could limit increases in transformation costs and contain transaction costs by giving greater attention to the form of community consultation, by taking account of the sources of uncertainty that attend policy choices and recognising the potential for consultation fatigue.

Transaction costs of alternative greenhouse gas policies in the Australian transport energy sector

- Ecological Economics---2013---Albert Ofei-Mensah,Jeffrey Bennett

This study employs a comparative analysis of the transaction costs of alternative policy instruments. The institutional approach to the allocation of resources is emerging to supplement traditional analyses of market and government failures. The causes of these failures are many, but often point to high transaction costs that result largely from institutional impediments. Effective institutions can help reduce transaction costs through more effective signals and incentives, including information generation, to help markets function more efficiently and policies to be delivered more successfully. The study, which contributes to transaction costs measurement, finds that the magnitudes and

types of transaction costs associated with setting up and implementing three greenhouse gas reduction policy programs in Australia are substantial and different. The estimated transaction costs of the Tradable Permit and Fee System are relatively high compared to those of the mandatory Fuel Label Program and the voluntary Fuel Efficiency Program, which supports the view that market-based policies can also be costly to deliver. Notwithstanding, transaction costs have frequently been ignored in cost–benefit analyses. It is concluded that transaction costs need to be considered alongside other costs and benefits in the assessment of policies.

Factors that influence transaction costs in development offsets: Who bears what and why?

- Ecological Economics---2013---Anthea Cogan,Edwin Buitelaar,Stuart Whitten,Jeffrey Bennett

Environmental policy instruments generate transaction costs to public and private parties. There is a growing literature reporting on the size of transaction costs produced by environmental policy instruments. This paper extends that literature through an analysis of the factors that influence transaction costs in environmental policy and how this influence occurs. The theory based factors that influence transaction costs are categorised as: 1) transaction characteristics; 2) transactor characteristics; 3) nature of the institutional environment; and 4) nature of the institutional arrangements. We examined how these factors influenced transaction costs through the analysis of two Australian-based development offset schemes with different policy designs. We found evidence of all four theory-based categories of influence in the policy case studies. The degree of influence and how each factor influenced transaction costs varies across the two policies and between parties. Policy design as a component of the institutional environment had a particularly large bearing on transaction costs of offset buyers and the policy administrator. An important contribution to transaction cost theory assumes the institutional environment as given.

Transaction costs of carbon offset projects: A comparative study

- Ecological Economics---2013---Oscar Cacho, Leslie Lipper, Jonathan Moss

The land-use change and forestry sector can be a cost-effective contributor to climate mitigation in at least three ways: providing carbon offsets through carbon sequestration in biomass and soils, reducing emissions of methane and other greenhouse gases, and producing biofuels that replace fossil fuels. The presence of carbon markets should help encourage these activities; however, most carbon trades to date have occurred in the energy sector. A major obstacle to carbon trades from land-use systems is the presence of high transaction costs of converting a carbon offset into a tradable commodity, so the prevailing market carbon prices may not provide enough incentive for adoption. This paper presents a model of the exchange of carbon offsets between a project developer and a group of landholders. The model is solved to derive project feasibility frontiers that show the minimum number of contracts necessary to make a project feasible at any given carbon price. The model is applied to two case studies (smallholder agroforestry in Indonesia and partial reforestation of family farms in Australia) under two types of contract (purchase of carbon flows and rental of carbon stocks). The paper concludes by identifying possible strategies to reduce transaction costs while maintaining project integrity.

Improving environmental decisions: A transaction-costs story

- Ecological Economics---2013---David Pannell, Anna M. Roberts, Geoff Park, Jennifer Alexander

A multidisciplinary team of researchers made efforts to influence the design and implementation of environmental policy in Australia. A focus of these efforts was the development of the Investment Framework for Environmental Resources (INFFER). In addition, the team undertook a range of communication activities, training, user support, and participation in committees

and enquiries. Transaction costs were relevant to these efforts in a variety of ways. Environmental managers perceived INFFER to involve relatively high transaction costs. A balance was struck between the system having simplicity (and low transaction costs) and delivering environmental benefits. Transaction costs were factored into the planning and prioritisation processes developed. For example, public and private transaction costs are accounted for in the calculation of benefit:cost ratios and in the choice of policy mechanisms. There are diverse roles that transaction costs play in the processes of developing, implementing and influencing environmental policy programmes. A key observation is that appropriate strategic investment in transaction costs can improve decisions and increase net benefits from an environmental programme. A well-designed decision process can involve incurring transaction costs at one stage in order to save transaction costs at a later stage.

Transaction costs and environmental policy design

- Ecological Economics---2013---Laura McCann

This article synthesizes the growing empirical literature on transaction costs to identify pragmatic design recommendations for environmental and natural resource policies. The New Institutional Economics literature recognizes that appropriate policy choice and design will be a function of the specific characteristics of the problem. The physical and institutional determinants of both transaction costs and abatement costs should be considered in the policy design process due to potential interactions between them. Analysts also need to incorporate the extent to which the technologies, institutional environment, governance structures, or policy designs can be changed; some factors can only be adjusted to or “designed around” while others can be designed differently. This framework highlights the importance of property rights since transaction costs will be incurred to obtain or retain property rights and since the rights assignment may affect both the magnitudes and distribution of costs. Another implication is that education and extension programs or use

of behavioral economics concepts to affect choices can be cost-effective in some circumstances. Policy design should take advantage of economies of scale and foster technical change. Appropriate sequencing of policy instruments may decrease transaction costs, particularly if there is potential for technical change.

Farm-level Autonomous Adaptation of European Agricultural Supply to Climate Change

- Ecological Economics---2013---David Leclère,Pierre-Alain Jayet,Nathalie de Noblet-Ducoudré

The impact of climate change on European agriculture is subject to a significant uncertainty, which reflects the intertwined nature of agriculture. This issue involves a large number of processes, ranging from field to global scales, which have not been fully integrated yet. In this study, we intend to help bridging this gap by quantifying the effect of farm-scale autonomous adaptations in response to changes in climate. To do so, we use a modelling framework coupling the STICS generic crop model to the AROPAj microeconomic model of European agricultural supply. This study provides a first estimate of the role of such adaptations, consistent at the European scale while detailed across European regions. Farm-scale autonomous adaptations significantly alter the impact of climate change over Europe, by widely alleviating negative impacts on crop yields and gross margins. They significantly increase European production levels. However, they also have an important and heterogeneous impact on irrigation water withdrawals, which exacerbate the differences in ambient atmospheric carbon dioxide concentrations among climate change scenarios.

A methodology for facilitating the feedback between mental models and institutional change in industrial ecosystem governance: A waste management case-study from northern Finland

- Ecological Economics---2013---Jarkko O. Levänen,Janne I. Hukkinen

Deliberative environmental policy links the formal institutional setting within which environmental policy takes place and the informal ways of thinking and doing by those whose daily work the policy influences. Despite an extensive theoretically oriented literature on policy deliberation, little methodological advice exists relating deliberation to the two domains it aims to link, i.e., the formal and informal institutions. In this paper, we develop a methodology for environmental policy deliberation that is grounded in institutional theory and theories explaining the cognitive practices of individuals in action situations. The methodology has three stages. First, we outline the problem setting on the basis of the stakeholders' mental model analysis. Second, more specific research problems and proposed solutions are formulated collaboratively with researchers from different fields. Third, the hypotheses are tested and challenged in a workshop with the interviewed stakeholders and re-formulated into final institutional recommendations. We illustrate the success of the procedure with a case study on a regional industrial complex located in the Bothnian Arc of northern Finland.

A dynamic approach to PES pricing and finance for interlinked ecosystem services: Watershed conservation and groundwater management

- Ecological Economics---2013---James Roumasset,Christopher Wada

A theory of payment for ecosystem services (PES) pricing consistent with dynamic efficiency and sustainable income requires optimized shadow prices. Since ecosystem services are generally interdependent, this requires joint optimization across multiple resource stocks. We develop such a theory in the context of watershed conservation and groundwater extraction. The optimal program can be implemented with a decentralized system of ecosystem payments to private watershed landowners, financed by efficiency prices of groundwater set by a public utility. The theory is extended to cases where land is publicly owned, conservation instruments exhibit non-convexities on private land, or the size of a conservation project is

exogenous. In these cases, conservation investment can be financed from benefit taxation of groundwater consumers. While volumetric conservation surcharges induce inefficient water use, a dynamic lump-sum tax finances investment without distorting incentives. Since the optimal level of conservation is generated as long as payments are correct at the margin, any surplus can be returned to consumers through appropriate block pricing. The present value gain in consumer surplus generated by the conservation-induced reduction in groundwater scarcity serves as a lower bound to the benefits of conservation without explicit measurement of other benefits such as recreation, biodiversity, and cultural values.

Towards systemic and adaptive governance: Exploring the revealing and concealing aspects of contemporary social-learning metaphors

- Ecological Economics---2013---Ray Ison,Chris Blackmore,Benjamin L. Iaquinto

This paper uses metaphor theory and analysis to explore competing and sometimes contested claims about the nature and utility of social learning. Seven metaphor clusters — performance metaphors, action metaphors, communication metaphors, governance mechanism metaphors, social learning as a paradigm, social learning as a form of cognition and social learning as a wheelbarrow full of frogs, were identified from the sustainability and natural resource management (NRM) literature. Rather than seeking to define social learning rigidly, and thus limiting its potential utility to open up spaces for innovation in NR governance, social learning can be positioned in future discourse so that it holds a cluster of revealing and concealing features. This position shifts responsibility for clarity and rigour away from the concept, useful because of its fluidity, to the user of the concept who must then articulate the way(s) in which they choose to use it. This shift is consistent with reflexive, systems practice for systemic and adaptive governance and invites practitioner responsibility rather than conceptual reification.

REDD+and community-controlled forests in low-income countries: Any hope for a linkage?

- Ecological Economics---2013---Randall Bluffstone,Elizabeth Robinson,Paul Guthiga

Deforestation and forest degradation are estimated to account for between 12% and 20% of annual greenhouse gas emissions and in the 1990s (largely in the developing world) released about 5.8Gt per year, which was bigger than all forms of transport combined. The idea behind REDD+ is that payments for sequestering carbon can tip the economic balance away from loss of forests and in the process yield climate benefits. Recent analysis has suggested that developing country carbon sequestration can effectively compete with other climate investments as part of a cost effective climate policy.

Dynamic hypothetical bias in discrete choice experiments: Evidence from measuring the impact of corporate social responsibility on consumers demand

- Ecological Economics---2013---Jorge Araña,Carmelo J. León

This paper is aimed at studying the dynamics of consumers' preferences for corporate social responsibility. The data come from both a Discrete Choice Experiment (DCE) and a field experiment conducted in a real market setting. The results show that in a static setting (first month) predictions of a standard DCE study and real market shares are statistically similar for the various profiles of corporate social responsibility. However, as time evolves real market shares present some dynamic patterns that are not mirrored by the standard DCE predictions. The overall conclusion is that differences between real market behavior and DCE data can be attributed to the lack of learning experience — or adaptation — in DCE surveys rather than to the hypothetical nature of the experiments.

The cost of reducing CO2 emissions: Integrating abatement technologies into economic modeling

- Ecological Economics---2013---Olga Kiwila,T.F. Rutherford

We explore two methods of incorporating bottom-up abatement cost estimates into top-down modeling: an economy-wide method and a sector-specific method. Carbon emissions generally depend on technology and scale. Given the technology options, abatement is possible without a substantial reduction in scale. Otherwise the change must come purely through a reduction in demand. Our analysis shows that the cost of environmental policy is considerably overestimated by top-down models if a bottom-up abatement cost curve is not included. Using the data for the Swiss economy, we demonstrate two techniques of representing an abatement function explicitly in a computable general equilibrium model: a traditional and a hybrid (discrete technology modeling) approach. The results suggest that the current climate policy in Switzerland will not be able to move the economy towards the required 10% CO2 reduction. Both approaches provide virtually the same results when the calibration process is precisely executed, which contradicts the results of previous studies.

Stakeholders' incentives for land-use change and REDD+: The case of Indonesia

- Ecological Economics---2013---Silvia Irawan, Luca Tacconi,Irene Ring

The opportunity costs of Reducing Emissions from Deforestation and Forest Degradation (REDD+) accruing to different stakeholders in Indonesia, including companies and the national, provincial and district level governments, are estimated, with particular emphasis on the influence of alternative discount rates. A cost-benefit analysis of the opportunity costs of avoided deforestation is conducted. The three major land-use activities considered are commercial logging, timber and oil palm plantation. The opportunity cost of oil palm plantations on mineral soil preceded by logging of degraded forest is prohibitively high. REDD+

measures that impose restrictions on the development of those land-use activities would lead to a substantial loss of public revenues at the various government levels. The results of this study reveal that land-use management in Indonesia is rather centralistic, where the national government retains most of the revenues from land-use alternatives to REDD+. To influence their behaviour towards land-use change, REDD+ schemes need to create a direct link between the distribution of public revenues and district governments' decisions on land-use activities in their localities.

Agreeing to pay under value disagreement: Reconceptualizing preference transformation in terms of pluralism with evidence from small-group deliberations on climate change

- Ecological Economics---2013---Alex Lo

Plural values contribute to multiple arrays of expressed preferences. Conventionally, preference convergence toward consensus among initially disagreeing decision makers is understood in terms of diminishing value differences. A cogent account of consensual decision that respects non-diminishing value plurality is lacking. Instead there is a theoretic expectation for categorical consistency between subjective values and expressed preferences. Valuing agents in social interaction are expected to indicate identical preference orderings only if they hold correspondingly identical categories of values. This expectation precludes meaningful conceptualization of preference convergence under divisive normative dispositions. An alternative framework is proposed and illustrated by results from a designed deliberative forum on Australia's climate change policy. Data were analyzed based on Q methodology. Results show that small-group deliberations enabled effective communication between distinctive subjective positions and broadened understandings between individuals. While a consensual decision gained progress, no identified value discourse diminished below a significant degree. Observed changes in values did not run parallel to the converging preferences, suggesting a decline in value-preference consistency. These changes nonetheless are amenable to the principle of value plu-

ralism. An alternative rationality concept is needed to account for this moral ideal within economics.

Climatic impacts across agricultural crop yield distributions: An application of quantile regression on rice crops in Andhra Pradesh, India

- Ecological Economics---2013---Prabhat Barnwal,Koji Kotani

Climatic impact on agricultural production is a serious concern, as it is directly linked to food security and poverty. Whereas there are empirical studies that examine this issue with parametric approaches focusing on the “mean” level of variables, few studies have addressed climatic impacts in general settings. Given this paucity, we characterize the impacts on crop yield distributions with a non-parametric approach. We examine the case of rice yield in Andhra Pradesh, India, an important state producing rice as a main crop but reported to be vulnerable to climate change. Employing 34years of data, we apply quantile regressions to untangle the climatic impacts across the quantiles of rice yield, finding three main results. First, substantial heterogeneity in the impacts of climatic variables can be found across the yield distribution. Second, the direction of the climatic impacts on rice yield highly depends on agro-climatic zones. Third, seasonal climatic impacts on rice yield are significant. More specifically, a monsoon-dependent crop is more sensitive to temperature and precipitation, whereas a winter crop remains largely resilient to changes in the levels of climate variables. These findings clarify the idiosyncratic climatic impacts on agriculture in India, and call for location- and season-specific adaptation policies.

Estimating compensation payments for on-farm conservation of agricultural biodiversity in developing countries

- Ecological Economics---2013---Vijesh Krishna,Adam G. Drucker,Unai Pascual,Prabhakaran Raghu,Edwin Devarathna Israel King

This paper examines the role of direct compensation payments for agrobiodiversity conservation, using minor millet landraces in India as an example. The cost of farmer participation in a hypothetical ‘payments for agrobiodiversity conservation services’ (PACS) scheme is estimated using a stated preference valuation approach. Significant inter-crop and inter-varietal differences are observed with respect to consumption values, upon which the compensation demanded by farm households is shown to primarily depend. Drawing on a categorisation of consumption values and farmer preferences, the paper points to the importance of simultaneously considering a range of potential interventions in order to conserve a priority portfolio of agrobiodiverse resources in predominantly subsistence-based agricultural systems.

Mandatory disclosure of plant emissions into the environment and worker chemical exposure inside plants

- Ecological Economics---2013---Stephen R. Finger,Shanti Gamper-Rabindran

Our study is the first to test if mandatory pollution disclosure programs, exemplified by the Toxics Release Inventory (TRI) program, reduce worker chemical exposure. We examine newly available measurements of personal exposure to air contaminants at 1333 plants in the US chemical manufacturing sector between 1984 and 2009. The maximum ratio of exposure to the legal limits per inspection declined substantially, by 11%, in the post-program period. This result provides the first evidence of a reduction in measured risks coinciding with the inception of the TRI program. We find suggestive, not conclusive, evidence to attribute this reduction in part to the TRI program. Our preferred specifications find that plants that are more responsive to the TRI program, as indicated by larger industry-level TRI emission reduction, had 6.5% to 8% lower exposure. However, not all models find statistically significant larger exposure reductions in plants that are more responsive to the TRI program.

Water flows, energy demand, and market analysis of the informal water sector in Kisumu, Kenya

- Ecological Economics---2013---Laura C. Sima,Evan Kelner-Levine,Matthew J. Eckelman,Kathleen M. McCarty,Menachem Elimelech

In rapidly growing urban areas of developing countries, infrastructure has not been able to cope with population growth. Informal water businesses fulfill unmet water supply needs, yet little is understood about this sector. This paper presents data gathered from quantitative interviews with informal water business operators ($n=260$) in Kisumu, Kenya, collected during the dry season. Sales volume, location, resource use, and cost were analyzed by using material flow accounting and spatial analysis tools. Estimates show that over 76% of the city's water is consumed by less than 10% of the population who have water piped into their dwellings. The remainder of the population relies on a combination of water sources, including water purchased directly from kiosks (1.5million m³ per day) and delivered by hand-drawn water-carts (0.75million m³ per day). Energy audits were performed to compare energy use among various water sources in the city. Water delivery by truck is the highest per cubic meter energy demand (35MJ/m³), while the city's tap water has the highest energy use overall (21,000MJ/day). We group kiosks by neighborhood and compare sales volume and cost with neighborhood-level population data. Contrary to popular belief, we do not find evidence of price gouging; the lowest prices are charged in the highest-demand low-income area. We also see that the informal sector is sensitive to demand, as the number of private boreholes that serve as community water collection points are much larger where demand is greatest.

Rewards for providing environmental services — Where indigenous Australians' and western perspectives collide

- Ecological Economics---2013---Kerstin K. Zander,Desleigh R. Dunnett,Christine Brown,Otto

Campion,Stephen T. Garnett

Rewards for environmental service provision, couched under market-based instruments, are widely touted in Australia as a means of improving natural resource management while empowering indigenous people. We document here the views of indigenous Australians in a community in Arnhem Land about their motivations for, and ways to provide, such services. Most respondents (93%) said that they 'look after country' to fulfil cultural responsibilities. Natural resource management, they said, should be carried out communally, primarily under the direction of elders and family. Sixty percent of respondents preferred direct payments such as cash or salaried remuneration like that commonly offered in return for ranger-like activities such as feral animal/weed control, coastal surveillance and prescribed burning. Some (14%) either did not want or did not need rewards for environmental service provision. Others (19%) preferred rewards in a form that benefited their community or family rather than themselves as individuals. There was agreement that outcomes should be monitored, consistent with the principle that reward payments should be conditional on performance. We suggest that a reward system that is too narrowly defined could thwart the potential for win-win outcomes from indigenous incentive-based natural resource management but that their articulation could allow solutions to be negotiated.

Keeping up appearances: Motivations for socially desirable responding in contingent valuation interviews

- Ecological Economics---2013---Tobias Börger

The tendency to give socially desirable rather than true statements of willingness to pay (WTP) is an often reported form of bias in contingent valuation surveys. While previous research on this bias has exclusively focused on the detection of mode effects, the present study directly assesses a respondent's motivation to state WTP in a socially desirable manner. This study tests the effect of three theoretical motivations for socially desirable responding on WTP responses: A

general need for social approval, a perceived social norm calling for a high contribution and perceived lack of anonymity of the interview situation. Questions for the empirical assessment of these factors are developed.

A global map of coastal recreation values: Results from a spatially explicit meta-analysis

- Ecological Economics---2013---Andrea Ghermandi, Paulo Nunes

This paper examines the welfare dimension of the recreational services of coastal ecosystems. First, we construct a global database of primary valuation studies that focus on recreational benefits of coastal ecosystems. Second, the profile of each of the 253 individual observations is enriched with characteristics of the built coastal environment (accessibility, anthropogenic pressure, human development level), natural coastal environment (presence of protected area, ecosystem type, marine biodiversity), geo-climatic factors (temperature, precipitation), and sociopolitical context. We then propose a meta-analytical framework that is built upon a Geographic Information System (GIS) and allow for the exploration of the spatial dimension of the valued ecosystems, including the role of spatial heterogeneity of the selected meta-regression variables as well as the spatial profile of the transferred values. The empirical outcome results in the first global map of the values of coastal recreation, which may play a crucial role in identifying and ranking coastal area conservation priorities from a socio-economic perspective.

Wind tunnel simulation and evaluation of soil conservation function of alpine grassland in Qinghai-Tibet Plateau

- Ecological Economics---2013---Chun-xia Lu, Ge Yu, Yu Xiao, Gao-di Xie

Aiming at studying soil conservation function of alpine grassland in the Qinghai-Tibet Plateau, this paper simulated soil erosion changes under different degrees of human disturbance in a wind tunnel laboratory. Three types of grasslands were selected, which include alpine meadow (QH-1), alpine steppe meadow (QH-2)

and alpine steppe (QH-3), and the soil erosion rate was taken as the index to measure soil conservation function. The experimental results show that the soil erosion rates of three grassland samples increase with wind velocity under different treatments but the increment of erosion rate varied greatly. Under original status, soil erosion rates are in turn QH-1

Water reallocation in the input-output model

- Ecological Economics---2013---Maria Llop

Water reallocation between economic agents has been and continues to be the subject of a considerable amount of research. This paper proposes a method for evaluating how water is reallocated within the economy in response to changes in final demand and changes in the technical water needs of activities and consumers. The empirical application, which is for the Catalan economy, shows important asymmetries in the effects that exogenous inflows and changes in water technical requirements have on water reallocation. In the process of water distribution, exogenous inflows mostly benefit agriculture and damage private consumers. On the other hand, increases in technical water requirements have negative effects on agriculture and positive effects on the other production activities and consumers. The results of the study suggest that agriculture is an important activity not only in terms of water distribution but also in terms of water reallocation due to changes in final demand and technical water needs.

Flows, funds and the complexity of deprivation: Using concepts from ecological economics for the study of poverty

- Ecological Economics---2013---Arnim Scheidel

Poverty has been increasingly conceptualized as being multidimensional, involving deprivation in many dimensions of life. This paper discusses issues and implications of multidimensional poverty by adopting concepts commonly used in ecological economics. In particular, poverty is approached as an irreducible, complex phenomenon for which many legitimate, but non-equivalent descriptions exist. Issues of social and

technical incommensurability are illustrated for different meanings and measurement types of poverty. Georgescu-Roegen's flow/fund framework is interpreted, informed by the capability approach of Amartya Sen. The paper argues that a predominant focus on flows as a proxy to analyze poverty represents rather a short-term perspective on access to satisfiers to fulfill particular needs. Contrary to that, focusing on valued funds may provide useful information for the analysis of capabilities that persons and societies might pursue in the long term. Furthermore, it is argued that strong poverty alleviation needs to adopt analytical tools that can deal with non-trade-off cases: improvements in one poverty dimension cannot always compensate for the deterioration of other poverties. This implies to rethink the usefulness of aggregate multidimensional poverty indices, as well as the predominant use of income measures.

Analysis of environmental efficiency variations: A nutrient balance approach

- Ecological Economics---2013---Viet-Ngu Hoang,Trung Thanh Nguyen

Recent literature has argued that environmental efficiency (EE), which is built on the materials balance (MB) principle, is more suitable than other EE measures in situations where the law of mass conversation regulates production processes. In addition, the MB-based EE method is particularly useful in analysing possible trade-offs between cost and environmental performance. Identifying determinants of MB-based EE can provide useful information to decision makers but there are very few empirical investigations into this issue. This article proposes the use of data envelopment analysis and stochastic frontier analysis techniques to analyse variation in MB-based EE. Specifically, the article develops a stochastic nutrient frontier and nutrient inefficiency model to analyse determinants of MB-based EE. The empirical study applies both techniques to investigate MB-based EE of 96 rice farms in South Korea. The size of land, fertiliser consumption intensity, cost allocative efficiency, and the share of owned land out of total land are found to be cor-

related with MB-based EE. The results confirm the presence of a trade-off between MB-based EE and cost allocative efficiency and this finding, favouring policy interventions to help farms simultaneously achieve cost efficiency and MP-based EE.

Adoption of climate change mitigation practices by risk-averse farmers in the Ashanti Region, Ghana

- Ecological Economics---2013---Alessandro (Alex) De Pinto,Richard Robertson,Beatrice Darko Obiri

Uncertainty and risk-aversion are notably absent in the modeling of farmers' adoption of climate change mitigation practices in developing countries even though most of the agricultural mitigation practices also have effects on yield variability. The objective of this paper is to explore the implications for climate change mitigation projects of modeling farmers as risk neutral while in actuality they behave as risk-averse agents. Results indicate that when risk averse farmers are modeled as risk-neutral agents, the size of the incentives needed to induce participation to a carbon sequestration program is miscalculated with serious implications either for the success for projects that aim at compensating for climate change mitigation services or for the economic efficiency of such projects.

Estimating the causal effect of water scarcity on the groundwater use efficiency of rice farming in South India

- Ecological Economics---2013---Shalet Korrattukudy Varghese,Prakashan Chellattan Veettil,Stijn Speelman,Jeroen Buysse,Guido Van Huylenbroeck

There is no consensus among researchers on the influence of scarcity on common pool resource use: some suggest that scarcity leads to prudent use, whereas others suggest that it will cause over-extraction of resources. This issue is particularly of interest for developing countries, where natural resources are becoming scarce at an alarming rate. This paper investigates the

causal association between water scarcity and ground-water use efficiency in a rice based cropping system in south India, where groundwater is increasingly becoming a scarce resource. Contextualization of the work is done under the premise of reported contradictions concerning the scarcity — efficiency nexus. Using a two stage approach the causality is estimated: first, farm level groundwater use efficiency (GWUE) scores are calculated using non-parametric efficiency analysis, and then these inefficiencies are linked to farm level scarcity indicators using the Inverse Probability Weighting method. Our results showed a negative causal association between farm level water scarcity and GWUE, indicating the existence of competitive appropriation behavior in the face of scarcity. Hence, policy measures to conserve groundwater should include supply enhancement to remove the threat of immediate scarcity on farm to avoid inefficient pumping in addition to demand management measures and improved governance.

Growing green money? Mapping community currencies for sustainable development

- Ecological Economics---2013---Gill Seyfang,Noel Longhurst

Parallel sustainable monetary systems are being developed by civil society groups and non-governmental organisations (NGOs), informed by ecological economics perspectives on development, value, economic scale and growth, and responding to the unsustainability of current global financial systems. These parallel systems of exchange (or community currencies) are designed to promote sustainable development by localising economic development, building social capital and substituting for material consumption, valuing work which is marginalised in conventional labour markets, and challenging the growth-based monetary system. However, this international movement towards community-based ecological economic practices, is under-researched. This paper presents new empirical evidence from the first international study of the scope and character of community currencies. It identifies the diversity, scale, geography and development trajectory

of these initiatives, discusses the implications of these findings for efforts to achieve sustainable development, and identifies future research needs, to help harness the sustainability potential of these initiatives.

Optimal strategies for the surveillance and control of forest pathogens: A case study with oak wilt

- Ecological Economics---2013---Tetsuya Horie,Robert G. Haight,Frances Homans,Robert C. Venette

Cost-effective strategies are needed to find and remove diseased trees in forests damaged by pathogens. We develop a model of cost-minimizing surveillance and control of forest pathogens across multiple sites where there is uncertainty about the extent of the infestation in each site and when the goal is to minimize the expected number of new infections. We allow for a heterogeneous landscape, where grid cells may be differentiated by the number of trees, the expected number of infected trees, rates of infection growth, and costs of surveillance and control. In our application to oak wilt in Anoka County, Minnesota, USA, we develop a cost curve associated with saving healthy trees from infection. Assuming an annual infection growth rate of 8%, a \$1 million budget would save an expected 185 trees from infection for an average of \$5400 per tree.

Public praise vs. private pay: Effects of rewards on energy conservation in the workplace

- Ecological Economics---2013---Michel J.J. Handgraaf,Margriet A. Van Lidth de Jeude,Kirstin C. Appelt

Any solution to rising levels of CO₂ depends on human behavior. One common approach to changing human behavior is rewarding desired behavior. Because financial incentives often have side effects that diminish efficacy, we predict that social rewards are more effective, because they invoke adherence to descriptive and injunctive social norms. We investigated this by measuring electricity use for 13 weeks at a Dutch firm. Each week, employees were rewarded for conserving energy.

They either received monetary rewards (€0–€5) or social rewards (grade points with a descriptive comment). Rewards were either private or public. In both the short and long term, public rewards outperformed private rewards, and social rewards outperformed monetary rewards. This suggests that private monetary rewards, although popular, may be ineffective. Instead, public social rewards may be a more promising approach to stimulating energy conservation. We argue that this approach should be considered more frequently by policy-makers.

Collaborative approaches to water management and planning: An institutional perspective

- Ecological Economics---2013---Jayanath Ananda,Wendy Proctor

Despite the popularity and rhetoric of collaborative approaches, the successes of such initiatives are not widespread and remain elusive. Some commentators argue that without ‘the noise of participation’, a return to centralised governance should be reconsidered. Whilst this conclusion may be premature given the lack of rigorous analysis of collaborative approaches, it calls for a closer examination of contexts and processes that are conducive to the success of collaborative initiatives. This paper evaluates the scope of collaborative watershed management and planning in the Howard River Catchment in northern Australia. The findings depict the challenges of collaborative planning in a nested hierarchy with multiple institutions. The existing institutional apparatus can potentially constrain the collaborative initiatives to water planning. They include the norms of agency authority, administrative inflexibility and power structures in a nested institutional hierarchy. Delegating decision making responsibility to decentralized structures should be backed up by the development of the capacity of such structures. Considerable transaction costs exist in overlaying collaborative approaches across a nested hierarchy of multiple institutions.

Dominos in the dairy: An analysis of transgenic maize in Dutch dairy farming

- Ecological Economics---2013---Rolf Groen-eveld,Justus Wesseler,Paul Berentsen

EU member states require farmers growing transgenic maize to respect a minimum distance from fields with non-transgenic maize. Previous studies have theoretically argued that such minimum distance requirements may lead to a so-called ‘domino effect’ where farmers who want to grow transgenic maize are forced to grow the non-transgenic variety and in turn impose the same constraints on their neighbors. This article applies a spatially explicit farm model to a dairy region in the Southern Netherlands to assess how farmers growing non-transgenic maize limit other farmers’ potential to grow transgenic herbicide-resistant maize. The results indicate that the minimum distance requirements can severely limit the benefits from herbicide resistant maize. Having different land use options in one farm, however, enables dairy farmers to grow transgenic maize despite having one or more neighbors growing non-transgenic maize. We also find that the share of the domino effect in the overall impact of minimum distance requirements decreases with the density of farmers not growing transgenic maize.

Estimating the value of economic benefits associated with adaptation to climate change in a developing country: A case study of improvements in tropical cyclone warning services

- Ecological Economics---2013---Thanh Nguyen,Jackie Robinson,Shinji Kaneko,Satoru Komatsu

Linking tropical cyclone activity with anthropogenic climate change is subject to on-going debate. However, modelling studies consistently have projected that climate change is likely to increase the intensity of cyclones and the related rainfall rates in the future. A precautionary approach to this possibility is to adapt to the adverse effects of the changing climate by improving early warning services for cyclones as

a ‘no or low-regrets’ option. Given limited funding resources, assessments of economic efficiency will be necessary, and values for benefits are an essential input. This paper aims to estimate the benefits to households of an improved cyclone warning service in Vietnam. Choice experiment surveys with 1014 respondents were designed and conducted to inform this paper. The benefit estimates of the maximal improvements in a number of attributes of cyclone warning services (i.e. forecasting accuracy, frequency of update, and mobile phone based warnings) are approximately USD7.1–8.1 per household, which would be an upper bound estimate. Results from the marginal willingness to pay for the attributes suggest that investments should be dedicated to improvements in the accuracy of warning information and a warning service based on mobile phone short message.

Conflicting values and public decision: The Foz Côa case

- Ecological Economics---2013---Maria de Fátima Ferreira,Maria Eduarda Gonçalves,Ana Costa

This article considers public decision involving conflicting values and interests by presenting a case (Portugal, 1990s) where the construction of a dam already under way following an Environmental Impact Assessment procedure (EIA) was abandoned in order to preserve prehistoric rock engravings. The Foz Côa case illustrates the methodologies currently adopted under European Union law in the support of public decision concerning large infrastructures with significant impact on the environment and/or the cultural heritage, highlighting their limitations when confronted with the complexity and the plurality of values commonly at stake in such circumstances. We assume that the reasonableness of a public decision is meant to emerge from a process through which the various and conflicting reasons for acting are brought together, implying the opening of ends, and not only of means, to discussion and inquiry, a deliberative perspective which is put in contrast with the monistic methodologies supporting public decision-making under the EIA procedure. Some broader lessons may be drawn from the

analysis of this case, we argue, regarding the conditions under which a regulatory system should tackle the diverse and conflicting values involved in public decision that affects today’s highly-prized values like the environment or the cultural heritage.

Potential effects of the Nagoya Protocol on the exchange of non-plant genetic resources for scientific research: Actors, paths, and consequences

- Ecological Economics---2013---Eric W. Welch,Eunjung Shin,Jennifer Long

Scholars have expressed concern that the Nagoya Protocol (NP) might hinder academic research by constraining the exchange and use of genetic resources (Jinnah and Jungcurt, 2009). This paper investigates current genetic resource exchange and use practices as a first step to better understand how the Protocol might affect US agricultural research. The paper addresses three main questions: (1) Who are the main actors sharing genetic resources in the US?; (2) What pathways exist for the exchange and how can they be characterized?; and (3) What consequences are expected to occur as a result of the potential implementation of the NP? Analysis of data from a 2011 national survey of government and university researchers shows that while many of the surveyed researchers are actively involved in exchange of genetic resources, few exchange large quantities of material. Pathways are best described as informal and based on expected reciprocity, and few report paying for genetic resources. While the use of material transfer agreements is low, use is associated with higher levels of expected reciprocity and intellectual property outcomes on projects. Conclusions discuss the implications of the findings for the implementation of the Nagoya Protocol and reflect on possible directions for future research.

Sensitivity analysis of environmentally extended input–output models as a tool for building scenarios of sustainable development

- Ecological Economics---2013---Tuomas Mattila,Sirkka Koskela,Jyri Seppälä,Ilmo Mäenpää

There is an urgent need to develop scenarios and roadmaps for a more sustainable future than where business-as-usual is heading. This paper addresses the use of sensitivity analysis for analyzing environmentally extended input–output (EEIO) models in order to develop cost-effective and comprehensive scenario building. Main components of resource use, emission intensity and final demand are extracted from the complete network of interactions contained in the input–output tables of the national accounts. The method is demonstrated using a detailed Finnish EEIO-model (ENVIMAT). Based on the results, only 0.3% of the 23 103 interactions were found to have a significant effect on Finnish greenhouse gas emissions. The same parameters were also relevant for waste generation and land use, but not for gross domestic product. The identified main components were tested by structural decomposition. Actual development of greenhouse gas emissions from 2002 to 2005 was compared to that predicted by updating only the identified components. Based on the results, the development of greenhouse gas emissions could be predicted with high accuracy using only the identified main components. Generalizing the results, sensitivity analysis can assist in identifying the main components to be included in future scenarios for sustainable development.

The potential of ‘Urban Green Commons’ in the resilience building of cities

- Ecological Economics---2013---Johan Colding,Stephan Barthel

While cultural diversity is increasing in cities at a global level as a result of urbanization, biodiversity is decreasing with a subsequent loss of ecosystem services. It is clear that diversity plays a pivotal role in the resilience building of ecosystems; however, it is less clear what role cultural diversity plays in the resilience building of urban systems. In this paper we provide innovative insights on how common property systems could contribute to urban resilience building. Through a review of recent findings on urban common property systems and the relevant literature, we deal with urban green commons (UGCs) and discuss their potential to

manage cultural and biological diversity in cities. We describe three examples of UGCs, i.e. collectively managed parks, community gardens, and allotment areas, with a focus on their institutional characteristics, their role in promoting diverse learning streams, environmental stewardship, and social–ecological memory. We discuss how UGCs can facilitate cultural integration through civic participation in urban land-management, conditions for the emergence of UGCs, the importance of cognitive resilience building, and what role property-rights diversity plays in urban settings. We conclude by elucidating some key insights on how UGCs can promote urban resilience building.

Estimating a meta-damage regression model for large accidental oil spills

- Ecological Economics---2013---Maria Alló,Maria Loureiro

Oil spills cause major damage to both a wide range of economic sectors and the environment. It is therefore important to anticipate the potential damage caused by these types of disasters, which can occur under many different and unpredictable circumstances. In this paper we study the main determining factors of the damage caused by oil spills, focusing in particular on the role played by the legislation applied in preventing these accidents. We find that more restrictive legislation reduces the economic damage caused by vessel oil spills. Based on the results of this international meta-regression, we are able to predict the marginal contributions to the damage function of the most relevant causing factors. These estimated damages can be used for rapid evaluations in the future, in cases where a direct damage assessment is not possible.

Sustainability in the making? A historical estimate of Swedish sustainable and unsustainable development 1850–2000

- Ecological Economics---2013---Magnus Lindmark,Sevil Acar

In this article we estimate the long-run development of genuine savings in Sweden during the period 1850 to

2000. By doing so we are able to present a first analysis of long-run sustainable development during a single country's transition to modern economic growth rates and high income levels. We find that genuine savings may have been negative up until c. 1910. This suggests a period of transition to positive genuine savings in conjunction with or even preceding the transition to modern economic rates. Important contributions to the transition were increasing investments in human capital, improved sanitary conditions, reduced depletion of forests and accelerated investments in machinery and infrastructure.

Estimating direct and indirect rebound effects for U.S. households with input–output analysis. Part 2: Simulation

- Ecological Economics---2013---Brinda A. Thomas, Inês L. Azevedo

This is the second part of a two-part paper that integrates economic and industrial ecology methods to estimate the indirect rebound effect from residential energy efficiency investments. We apply the model developed in part one to simulate the indirect rebound, given an estimate of the direct rebound, using a 2002 environmentally-extended input–output model and the 2004 Consumer Expenditure Survey (in 2002\$) for the U.S. We find an indirect rebound of 5–15% in primary energy and CO₂e emissions, assuming a 10% direct rebound, depending on the fuel saved with efficiency and household income. The indirect rebound can be as high as 30–40% in NO_x or SO₂ emissions for efficiency in natural gas services. The substitution effect modeled in part one is small in most cases, and we discuss appropriate applications for proportional or income elasticity spending assumptions. Large indirect rebound effects occur as the U.S. electric grid becomes less-carbon intensive, in households with large transportation demands, or as energy prices increase. Even in extreme cases, there is limited evidence for backfire, or a rebound effect greater than 100%. Enacting pollution taxes or auctioned permits that internalize the externalities of energy use would ensure that rebound effects unambiguously increase consumers' welfare.

Estimating direct and indirect rebound effects for U.S. households with input–output analysis Part 1: Theoretical framework

- Ecological Economics---2013---Brinda A. Thomas, Inês L. Azevedo

This is the first part of a two-part paper providing an analytical model of the indirect rebound effect, given a direct rebound estimate, that integrates consumer demand theory with the embodied energy of household spending from environmentally-extended input–output analysis. The second part applies the model developed in part one to simulate the direct and indirect rebound for the average U.S. household in terms of primary energy, CO₂e, NO_x, and SO₂ emissions and for energy efficiency investments in electricity, natural gas, or gasoline services. Part one provides a critical review of the largely independent economic and industrial ecology literatures on the indirect rebound. By studying the two-goods case and the n-goods case, we demonstrate that the indirect rebound is bounded by the consumer budget constraint, and inversely related to the direct rebound. We also compare the common proportional spending and income elasticity spending assumptions with our model of cross-price elasticities including both substitution and income effects for the indirect rebound. By assuming zero incremental capital costs and the same embodied energy as conventional technologies for efficient appliances, we model an upper bound of the indirect rebound. Future work should also consider the increase in consumer welfare possible through the rebound effect.

Urban gardens, agriculture, and water management: Sources of resilience for long-term food security in cities

- Ecological Economics---2013---Stephan Barthel, Christian Isendahl

Food security has always been a key resilience facet for people living in cities. This paper discusses lessons for food security from historic and prehistoric cities. The Chicago school of urban sociology established a

modernist understanding of urbanism as an essentialist reality separate from its larger life-support system. However, different urban histories have given rise to a remarkable spatial diversity and temporal variation viewed at the global and long-term scales that are often overlooked in urban scholarship. Drawing on two case studies from widely different historical and cultural contexts – the Classic Maya civilization of the late first millennium AD and Byzantine Constantinople – this paper demonstrates urban farming as a pertinent feature of urban support systems over the long-term and global scales. We show how urban gardens, agriculture, and water management as well as the linked social–ecological memories of how to uphold such practices over time have contributed to long-term food security during eras of energy scarcity. We exemplify with the function of such local blue–green infrastructures during shocks to urban supply lines. We conclude that agricultural production is not “the antithesis of the city,” but often an integrated urban activity that contribute to the resilience of cities.

Classifying and valuing ecosystem services for urban planning

- Ecological Economics---2013---Erik Gómez-Baggethun,David N. Barton

While technological progress has fostered the conception of an urban society that is increasingly decoupled from ecosystems, demands on natural capital and ecosystem services keep increasing steadily in our urbanized planet. Decoupling of cities from ecological systems can only occur locally and partially, thanks to the appropriation of vast areas of ecosystem services provision beyond the city boundaries. Conserving and restoring ecosystem services in urban areas can reduce the ecological footprints and the ecological debts of cities while enhancing resilience, health, and quality of life for their inhabitants. In this paper we synthesize knowledge and methods to classify and value ecosystem services for urban planning. First, we categorize important ecosystem services and disservices in urban areas. Second, we describe valuation languages (economic costs, socio-cultural values, resilience) that

capture distinct value dimensions of urban ecosystem services. Third, we identify analytical challenges for valuation to inform urban planning in the face of high heterogeneity and fragmentation characterizing urban ecosystems. The paper discusses various ways through which urban ecosystems services can enhance resilience and quality of life in cities and identifies a range of economic costs and socio-cultural impacts that can derive from their loss. We conclude by identifying knowledge gaps and challenges for the research agenda on ecosystem services provided in urban areas.

Valuing green infrastructure in an urban environment under pressure — The Johannesburg case

- Ecological Economics---2013---Alexis Schäffler,Mark Swilling

This article considers the importance of robust planning for green infrastructure in fast changing Southern African cities. A key theme is the extent to which ecosystem services are valued publicly, and the opportunity costs of not investing in the green infrastructure. We explore green infrastructure through pairing insights of social–ecological resilience with perspectives on urban infrastructure transitions. By converging these views, we show how green infrastructure can be viewed as an innovative response to challenged urban environments.

Why garden for wildlife? Social and ecological drivers, motivations and barriers for biodiversity management in residential landscapes

- Ecological Economics---2013---Mark A. Goddard,Andrew J. Dougill,Tim G. Benton

Residential landscapes with private gardens are major land covers in cities and their sustainable management is paramount for achieving a resilient urban future. Here we focus on the value of residential ecosystems for biodiversity conservation and explore the social and ecological factors that influence wildlife-friendly garden management. Using a stratified sampling design across the UK city of Leeds, this interdisciplinary study

develops and applies a mixed method approach, including questionnaires, interviews and ecological surveys across multiple spatial scales. We quantify wildlife-friendly gardening using two measures: (i) the number of wildlife-friendly features within gardens (the wildlife resources index, WRI); and (ii) the frequency of winter bird feeding. Wildlife-friendly gardening is influenced by a combination of garden characteristics and management intensity, householder demographics, wider environmental activity and landscape context. Residents reveal a range of motivations for wildlife-friendly gardening, notably personal well-being and a moral responsibility to nature. Respondents expressed a duty to maintain neighbourhood standards, revealing that social norms are a considerable barrier to uptake of wildlife-friendly activities, but also provide an opportunity where neighbour mimicry results in diffusion of wildlife-friendly practices. Community-driven initiatives that engage, educate and empower residents are better placed to encourage wildlife-friendly gardening than top-down financial incentives.

Ecosystem services as technology of globalization: On articulating values in urban nature

- Ecological Economics---2013---Henrik Ernstson, Sverker Sörlin

The paper demonstrates how ecosystem services can be viewed and studied as a social practice of value articulation. With this follows that when ecosystem services appear as objects of calculated value in decision-making they are already tainted by the social and cannot be viewed as merely reflecting an objective biophysical reality. Using urban case studies of place-based struggles in Stockholm and Cape Town, we demonstrate how values are relationally constructed through social practice. The same analysis is applied on ecosystem services. Of special interest is the TEEB Manual that uses a consultancy report on the economic evaluation of Cape Town's 'natural assets' to describe a step-by-step method to catalog, quantify and price certain aspects of urban nature. The Manual strives to turn the ecosystem services approach into a transportable

method, capable of objectively measuring the values of urban nature everywhere, in all cities in the world. With its gesture of being universal and objective, the article suggests that the ecosystem services approach is a technology of globalization that de-historicizes and de-ecologizes debates on urbanized ecologies, effectively silencing other—and often marginalized—ways of knowing and valuing. The paper inscribes ecosystem services as social practice, as part of historical process, and as inherently political. A call is made for critical ethnographies of how ecosystem services and urban sustainability indicators are put into use to change local decision-making while manufacturing global expertise.

Reaching for a sustainable, resilient urban future using the lens of ecosystem services

- Ecological Economics---2013---Åsa Jansson

Based on recent research on erosion of ecosystem services, planetary boundaries and predicted pace of urbanization, it is now apparent that humans need to reconnect to the biosphere and that cities in this context, properly managed, could provide great opportunities and arenas for social ecological change and transformation towards sustainability. To take advantage of these opportunities one needs to keep in mind that most of the ecosystem services consumed in cities are generated by ecosystems located outside of the cities themselves, not seldom half a world away. In order to operationalize our knowledge, hypothesis and theories on the connections between the work of nature and the welfare and survival of humans over time, we suggest the use of the ecosystem service framework in combination with the merging of the concept "ecology in cities", mainly focusing on designing energy efficient building, sustainable logistics and providing inhabitants with healthy and functioning green urban environments, and the "ecology of cities". The "ecology of cities" framework acknowledges the total dependence of cities on the surrounding landscape and the ever-ongoing dance between urban and rural, viewing the city as an ecosystem.

Positive dependency and virtuous cycles: From resource dependence to resilience in urban social-ecological systems

- Ecological Economics---2013---Keith Tidball,Richard Stedman

We argue that purely deficit-based perspectives regarding urban social-ecological systems (SES) and the human populations within them represent barriers to these systems' ability to move from undesirable system states into more desirable, sustainable ones. We characterize issues such as individual ecological identity, human exemptionalism, anthropocentrism, and resource dependence. We examine notions found in the resource dependency literature, where we trace the roots of ideas about dependency. We use this literature as a spring board into the possibilities of an antipodal notion of resource dependency potentially applicable in urban contexts, what we call positive dependency. Next we describe two possible sources of positive dependency in urban SES, urgent biophilia and restorative topophilia, followed by a brief discussion applying positive dependence to urban systems challenges and management. We conclude with the importance of recognition of positive dependency as a precursor to the development of a heightened sense of ecological self and sense of ecological place in urban SES, and provide insights and suggestions for further research into civic ecology practices that may enhance positive dependency on and investment in ecological assets that contribute to positive ecological senses of self and place, and the importance of these to achieving sustainable, resilient urban futures.

Limits to Growth, environmental science and the nature of modern prophecy

- Ecological Economics---2013---Richard Kool

The voice of the prophet has both disquieted the complacent and comfortable and provided direction for those willing to listen. I argue it is the environmental science community, and especially those engaged in ecological economics, sustainability analysis and climate change research, that are acting as modern-day

prophets in direct continuation of the biblical prophetic voice, and using as an exemplar the 1972 text, *Limits to Growth*. Providing analysis of their contemporary situation and then projecting from those situations into the future, prophets describe the outcome of the trends they see and offer warnings about collective dangers being faced. The life of a prophet, both then and now, is not simple, and those offering penetrating analysis of their society face a variety of hardships and threats.

Command-and-control revisited: Environmental compliance and technological change in Swedish industry 1970–1990

- Ecological Economics---2013---Ann-Kristin Bergquist,Kristina Söderholm,Hanna Kinerneryd,Magnus Lindmark,Patrik Söderholm

This paper addresses the issue of environmental policy instrument choice for achieving deep emission reductions in the industrial sector. Specifically, it provides: (a) a theoretical and empirical review of the conditions under which performance standards can provide efficient incentives for deep emission reductions and technology adoption; and (b) an analysis of the design and the outcomes of the standards-based regulation of industrial pollutants in Sweden during the period 1970–1990. Our empirical findings suggest that the Swedish regulatory approach comprised many key elements of an efficient policy-induced transition towards radically lower emissions in the metal smelting and pulp and paper industries. The regulation relied solely on performance standards, thus granting flexibility to firms in terms of selecting the appropriate compliance measures. These standards were implemented in combination with extended compliance periods. R&D projects and the new knowledge that was advanced incrementally in interaction between the company, the environmental authorities and research institutions provided a direct catalyst to the regulatory process. In these ways the Swedish regulatory approach provided scope for creative solutions, environmental innovation, and permitted the affected companies to coordinate pollution abatement measures with productive investments.

Revocability and reversibility in societal decision-making

- Ecological Economics---2013---Aviel Verbruggen

Reversibility and irreversibility are poorly defined in the decision-making literature. Defining reversibility as “the ability to maintain and to restore the functional performance of a system” is consistent with thermodynamics; specification of its crucial terms is case dependent. Reversibility is coming in degrees from flexibility, over rigidity to preclusion, with irreversibility as an absolute end. Further substantiating reversibility considers three variables: duration of impacts, revoking costs, and substitutability. Substitutability depends on weights assigned to the strict identity or to the functional performance of something valued. For given degrees of substitutability, revocability of an action is measurable in time-dependent revoking costs. Together with future time and doubt, reversibility sets a three-dimensional context for societal decision-making, revealing domes of expanding complexity. Cost–benefit analysis is a useful decision tool at lower complexity but falters at high complexity because there prevail non-monetary trade-offs. A revival and proper use of the concept reversibility are recommended for improved dialog on major societal issues, with climate change outstanding as the case where reversibility could turn into absolute irreversibility. Also shown is the correspondence between reversibility and ecological concepts like resilience, lock-in, tipping points, and others.

Environment, justice and the capability approach

- Ecological Economics---2013---Jerome Ballet, Jean-Marcel Koffi, Jérôme Pelenc

In recent years, several studies have attempted to combine the capabilities approach with sustainable development. However, critics have pointed out that although the capability approach takes the environment into account, it has its shortcomings for not being a complete ethical theory. Our article attempts to go beyond these criticisms, and show that the capabilities approach provides a good analytical framework for an environmental justice approach.

Evaluating the USFS State and Private Forestry Redesign: A first look at policy implications

- Ecological Economics---2013---Michael Cox, Sarah Mincey, Tatyana Ruseva, Sergio Villamayor-Tomas, Burney Fischer

Recently a shift has occurred in the way in which the United States Forest Service (USFS) distributes funds to states through its State and Private Forestry (S&PF) program. Traditionally S&PF has distributed money to states and territories formulaically. Now, under the 2008 Redesign Initiative, 15% of these funds are allocated through a competitive process. In this paper we analyze this initiative through the lens of institutional economics.

The welfare impacts of an invasive species: Endogenous vs. exogenous price models

- Ecological Economics---2013---Shana M. McDermott, David C. Finnoff, Jason Shogren

The “fixed-prices” models used to measure damages from invasive species typically overestimate financial impacts. These fixed-price assessments do not address key behavioral modifications that lower costs as people adapt by changing their mix of inputs and outputs given new economic circumstances. Using the invasive emerald ash borer (*Agrilus planipennis*) in Ohio as a motivating example, we develop a computable general equilibrium model that accounts for these behavioral responses. We estimate annual damages from the beetle to be about \$70million, an order of magnitude less than the \$400–\$900million in damages estimated using a fixed-price model. Damages are lower because people adapt through price and income adjustments that occur after ash trees are devastated from the emerald ash borer.

Assessment of ozone impacts on farming systems: A bio-economic modeling approach applied to the widely diverse French case

- Ecological Economics---2013---Pierre Humblot, Delphine Leconte-Demarsy, Paola

As a result of anthropogenic activities, ozone is produced in the surface atmosphere, causing direct damage to plants and reducing crop yields. By combining a biophysical crop model with an economic supply model we were able to predict and quantify this effect at a fine spatial resolution. We applied our approach to the very varied French case and showed that ozone has significant productivity and land-use effects. A comparison of moderate and high ozone scenarios for 2030 shows that wheat production may decrease by more than 30% and barley production may increase by more than 14% as surface ozone concentration increases. These variations are due to the direct effect of ozone on yields as well as to modifications in land use caused by a shift toward more ozone-resistant crops: our study predicts a 16% increase in the barley-growing area and an equal decrease in the wheat-growing area. Moreover, mean agricultural gross margin losses can go as high as 2.5% depending on the ozone scenario, and can reach 7% in some particularly affected regions. A rise in ozone concentration was also associated with a reduction of agricultural greenhouse gas emissions of about 2%, as a result of decreased use of nitrogen fertilizers. One noteworthy result was that major impacts, including changes in land use, do not necessarily occur in ozone high concentration zones, and may strongly depend on farm systems and their adaptation capability. Our study suggests that policy makers should view ozone pollution as a major potential threat to agricultural yields.

Impacts of natural resource management technologies on agricultural yield and household income: The system of rice intensification in Timor Leste

- Ecological Economics---2013---Martin Noltze, Stefan Schwarze, Martin Qaim

Natural resource management (NRM) technologies, such as the system of rice intensification (SRI), have been proposed to tackle agricultural challenges such

as decreasing productivity growth and environmental degradation. Yet, the benefits of NRM technologies for farmers are often debated. Impacts seem to be context-specific, which are especially relevant in the small farm sector with its large degree of agroecological and socioeconomic heterogeneity. This was not always considered in previous research. We analyze the impacts of SRI adoption on rice yield and household income among smallholder farmers in Timor Leste. Heterogeneity is accounted for in an endogenous switching regression framework. Comparing mean yield and income levels, we find no significant differences between SRI adopters and non-adopters. This is due to negative selection bias; SRI seems to be adopted more on plots and by farmers with less than average yields. Controlling for this bias reveals significant yield and income gains. Poor and non-poor households benefit from SRI adoption; small farms benefit more than larger farms. The results also suggest that in the context of Timor Leste SRI may not be beneficial when compared to conventional rice grown under favorable conditions. Some implications for future research are discussed.

Ecological macroeconomics: An application to climate change

- Ecological Economics---2013---Armon Rezai, Lance Taylor, Reinhard Mechler

Ecological economics has not paid sufficient attention to the macroeconomic level both in terms of theory and modeling. Yet, key topics debated in the field of ecological economics such as sustainable consumption, reduction in working time, the degrowth debate, the energy-exergy link, and the rebound effect require a holistic and macro perspective. While this deficiency has been identified before and Keynesian economics has been generally suggested as a potent vehicle to establish economic systemic thinking, very little concrete theorizing and practical suggestions have been put forward. We give further credence to this suggestion and demonstrate the value of tackling key concerns of ecological economics within a Keynesian growth framework. Contextualized by an application to climate change we suggest that policy relevant recommenda-

tions need to be based on a consistent view of the macroeconomy. We end with laying out key building blocks for a Keynesian model framework for an ecological macroeconomics.

Combining performance-based and action-based payments to provide environmental goods under uncertainty

- Ecological Economics---2013---Sandra Derissen,Martin Quaas

Payments for environmental services (PES) are widely adopted to support the conservation of biodiversity and other environmental goods. Challenges that PES schemes have to tackle are (i) environmental uncertainty and (ii) information asymmetry between the provider of the service (typically a farmer) and the regulator. Environmental uncertainty calls for action-based payment schemes, because of the more favorable risk allocation if the farmer is risk-averse. Information asymmetry, on the other hand, calls for a performance-based payment, because of the more direct incentives for the farmer. Based on a principal-agent model, we study the optimal combination of both, performance-based and action-based payments under conditions of environmental uncertainty and asymmetric information. We find that for a risk-neutral regulator a combination is optimal in the majority of cases and that the welfare gain of the combined scheme over a pure action-based (performance-based) payment increases with information asymmetry (environmental uncertainty). We further show that for a regulator who is risk-averse against fluctuations in environmental goods provision the optimal performance-based payment is lower than for a risk-neutral regulator. We quantitatively illustrate our findings in a case study on the enhancement of the butterfly Scarce Large Blue (*Maculinea teleius*) in Landau/Germany.

Economic dynamics and forest clearing: A spatial econometric analysis for Indonesia

- Ecological Economics---2013---David Wheeler,Dan Hammer,Robin Kraft,Susmita Dasgupta,Brian Blankespoor

This paper uses a large panel database to investigate the determinants of forest clearing in Indonesian kabupaten since 2005. Our study incorporates short-run changes in prices and demands for palm oil and wood products, as well as the exchange rate, the real interest rate, land-use zoning, forest protection, the estimated opportunity cost of forested land, the quality of local governance, the poverty rate, population density, the availability of communications infrastructure, transport cost, local rainfall and terrain slope.

Agri-environmental policies for biodiversity when the spatial pattern of the reserve matters

- Ecological Economics---2013---Laure Bamière,Maia David,Bruno Vermont

The aim of this paper is to compare different environmental policies for cost-effective habitat conservation on agricultural lands, when the desired spatial pattern of reserves is a random mosaic. We use a spatially explicit mathematical programming model which studies the farmers' behavior as profit maximizers under technical and administrative constraints. Facing different policy measures, each farmer chooses the land-use on each field, which determines the landscape at the regional level. A spatial pattern index (Ripley L function) is then associated to the obtained landscape, indicating on the degree of dispersion of the reserve. We compare a subsidy per hectare of reserve with an auction scheme and an agglomeration malus. We find that the auction is superior to the uniform subsidy for cost-efficiency. The agglomeration malus does better than the auction for the spatial pattern but is more costly.

The fiscal implications of hurricane strikes in the Caribbean

- Ecological Economics---2013---Bazoumana Ouattara,Eric Strobl

This paper empirically traces the fiscal impacts of hurricane strikes. To this end, a hurricane damage index is derived from a physical wind field model for a panel of Caribbean countries over 36years. Results, based on panel VAR and impulse response functions analysis,

show that, overall, hurricane strikes exert a short-term impact. Indeed, the study finds that the response of government spending is positive and significant while public investment, debt and tax revenue do not appear to respond (significantly) to hurricane strikes. Moreover, the study finds that Governments respond to hurricane strikes by engaging in short term deficit financing.

The valuation of landfill disamenities in Birmingham

- Ecological Economics---2013---Yun-Ju Ham,David Maddison,Robert Elliott

The disposal of waste by landfill generates community concerns, during both site operations and following the cessation of activities. Whilst previous hedonic studies have generally examined the impact on property prices of distance to the nearest active landfill site this paper presents a study for Birmingham in England in which properties are simultaneously located close to numerous active and historical landfill sites. Accounting for the proximity of historical landfill sites alters the perceived disamenity impact of active sites and furthermore, reveals evidence of significant disamenity impacts, decades after site closure, albeit over shorter geographical distances. Estimated disamenity impacts are however somewhat sensitive to assumptions regarding the geographical range of the externalities generated by landfill.

Policy dilemma of innovation: An info-gap approach

- Ecological Economics---2013---Yakov Ben-Haim,Craig D. Osteen,L. Joe Moffitt

New ideas or technologies are often advocated because of their purported improvements on existing methods. However, what is new is usually less well-known and less widely tested than what is old. New methods may entail greater unknown dangers as well as greater potential advantages. The policy maker who must choose between innovation and convention faces a dilemma of

innovation. We present a methodology, based on info-gap robustness, to deal with the innovation dilemma. We illustrate the approach by examining the policy decisions for managing the light brown apple moth in California.

Ethics and the economist: What climate change demands of us

- Ecological Economics---2013---Julie Nelson

Climate change is changing not only our physical world, but also our intellectual, social, and moral worlds. We are realizing that our situation is profoundly unsafe, interdependent, and uncertain. What, then, does climate change demand of economists, as human beings and as professionals? A discipline of economics based on Enlightenment notions of mechanism and disembodied rationality is not suited to present problems. This essay suggests three major requirements: first, that we take action; second, that we work together; and third, that we focus on avoiding the worst, rather than obtaining the optimal. The essay concludes with suggestions of specific steps that economists should take as researchers, teachers, and in our other roles.

Pushing the boundaries of climate economics: critical issues to consider in climate policy analysis

- Ecological Economics---2013---Silviu Scrieciu,Terry Barker,Frank Ackerman

Climate policy choices are influenced by the economics literature which analyses the costs and benefits of alternative strategies for climate action. This literature, in turn, rests on a series of choices about: the values and assumptions underlying the economic analysis; the methodologies for treating dynamics, technological change, risk and uncertainty; and the assumed interactions between economic systems, society and the environment, including institutional constraints on climate policy. We identify and discuss such critical issues, pushing at the boundaries of current climate economics research. New thinking in this area is gathering

pace in response to the limitations of traditional economic approaches, and their assumptions on economic behaviour, ecological properties, and socio-technical responses. We place a particular emphasis on the role of induced technological change and institutional setups in shaping cost-effective climate action that also promotes economic development and the alleviation of poverty.

CRED: A new model of climate and development

- Ecological Economics---2013---Frank Ackerman,Elizabeth A. Stanton,Ramón Bueno

This paper describes a new model, Climate and Regional Economics of Development (CRED), which is designed to analyze the economics of climate and development choices. Its principal innovations are the treatment of global equity, calculation of the optimum interregional flows of resources, and use of McKinsey marginal abatement cost curves to project the cost of mitigation.

Game theory and climate diplomacy

- Ecological Economics---2013---Stephen Decanio,Anders Fremstad

Starting with the “New Periodic Table” (NPT) of 2×2 order games introduced by Robinson and Gorforth (2005), we provide an exhaustive treatment of the possible game-theoretic characterizations of climate negotiations between two players (e.g., Great Powers or coalitions of states). Of the 144 distinct 2×2 games in which the players have strict ordinally ranked utilities, 25 are potentially relevant to climate problem. The negotiations may be characterized as a No-Conflict Game, Prisoner’s Dilemma, Coordination Game, Chicken, Type Game, or Cycle, depending on the payoff matrix. Which game corresponds to the actual state of the world depends both on the severity of risks associated with climate change and the perceptions of the governments engaged in the negotiations. Nash equilibrium or Maxi-min equilibrium (or neither) may be the outcome. Achieving universal abatement of greenhouse gas emissions may require side payments or

enforcement mechanisms outside the game framework, but we show how the negotiations themselves may offer opportunities to select between Nash equilibria or alter the payoff rankings and strategic choices of the players. In particular, scientific information pointing to the severity of the risks of climate change suggests characterization of the negotiations as a Coordination Game rather than a Prisoner’s Dilemma.

Distributional biases in the analysis of climate change

- Ecological Economics---2013---Peter Skott,Leila Davis

The economic analysis of global warming is dominated by models based on optimal growth theory. These representative-agent models have an intrinsic distributional bias in favor of the rich. The bias is compounded by the use of ‘revenue-neutrality’ in the allocation of emission permits. The result is mitigation recommendations that are biased downwards.

Valuing life: Experimental evidence using sensitivity to rare events

- Ecological Economics---2013---Olivier Chanel,Graciela Chichilnisky

Global environmental phenomena like climate change, major extinction events or flutype pandemics can have catastrophic consequences. By properly assessing the outcomes involved – especially those concerning human life – economic theory of choice under uncertainty is expected to help people take the best decision. However, the widely used expected utility theory values life in terms of the low probability of death someone would be willing to accept in order to receive extra payment. Common sense and experimental evidence refute this way of valuing life, and here we provide experimental evidence of people’s unwillingness to accept a low probability of death, contrary to expected utility predictions. This work uses new axioms of choice defined by Chichilnisky (2000), especially an axiom that allows extreme responses to extreme events, and the choice

criterion that they imply. The implied decision criteria are a combination of expected utility with extreme responses, and seem more consistent with observations.

Giving voice to the future in sustainability: Retrospective assessment to learn prospective stakeholder engagement

- Ecological Economics---2012---Mark W. Anderson, Mario Teisl, Caroline Noblet

There is a broad understanding that intergenerational equity is a necessary, if not sufficient, condition for sustainability. Likewise, there is a growing consensus that sustainability science requires stakeholder engagement to be successful. These two ideas demand some meaningful way of engaging the future as a stakeholder if sustainability is to be operationalized. Rawls' theory of justice provides a model for how this might be accomplished, yet there are both conceptual and practical problems with a Rawlsian approach. We propose using retrospective assessment as a means of learning how to approach future stakeholder engagement in sustainability.

The valuation of biodiversity conservation by the South African Khomani San "bushmen" community

- Ecological Economics---2012---Johane Dikgang, Edwin Muchapondwa

The restitution of parkland to the Khomani San "bushmen" and Mier "agricultural" communities in May 2002 marked a significant shift in conservation in the Kgalagadi Transfrontier Park and environs in South Africa. Biodiversity conservation will benefit from this land restitution only if the Khomani San, who interact with nature more than do other groups, are good environmental stewards. To assess their attitude toward biodiversity conservation, this study used the contingent valuation method to investigate the economic values the communities assign to biodiversity conservation under three land tenure arrangements in the Kgalagadi area. For each community and land tenure arrangement, there are winners and losers, but

the winners benefit by more than the cost that losers suffer. The net worth for biodiversity conservation under the various land tenure regimes ranged from R928 to R3456 to R4160 for municipal land, parkland, and communal land respectively for the Khomani San, compared to R25600 to R57600 to R64000 for municipal land, parkland, and communal land respectively for the Mier.

Regime shifts and management

- Ecological Economics---2012---Anne-Sophie Crépin, Reinette Biggs, Stephen Polasky, Max Troell, Aart de Zeeuw

Regime shifts are substantial reorganizations in system structure, functions and feedbacks, which can lead to changes in the provision of ecosystem services with significant impacts on human well-being. Recent research has documented cases of regime shifts in local and regional systems and there is mounting concern about regime shifts of global significance. In this paper we discuss management of social-ecological systems in light of the potential for regime shift. Management that increases system resilience and lowers the probability of regime shifts is beneficial when regime shifts are likely to reduce human well-being. It may not always be possible to avoid harmful regime shifts, so building capacity to adapt should a regime shift occur is beneficial too. Adaptive management can help reduce uncertainty about the likelihood of regime shifts, how this likelihood can be affected by management action, and the impact of regime shifts on well-being. Linking scientific understanding with decision-making is important but distributional consequences can impede decision making and action.

The dynamics of land-use in Brazilian Amazon

- Ecological Economics---2012---Mário Jorge Mendonça, Paulo Loureiro, Adolfo Sachsida

This paper studies the dynamics of land-use in the Brazilian Amazon using a structural vector autoregressive (SVAR) model. A fixed effect panel data specification is used to control for the heterogeneity in the data.

Meanwhile, spatial autocorrelation is also diagnosed by a statistical methodology that allows us to split the model in subsamples (clusters) of more homogeneous municipalities. The clustering analysis shows that there are three clusters whose land-use patterns are strongly different in an economical point of view. The first cluster identifies municipalities dedicated to logging, natural resources exploitation and slash-and-burn cultures; the second cluster shows a more diversified agriculture; while the third cluster presents very developed intensive agriculture municipalities.

Does ecological economics have a future?

- Ecological Economics---2012---Blake Anderson, M'Gonigle, Michael

This paper addresses the role of neoclassical methodologies in ecological economics and the contradictions these methodologies pose to the field's critical founding principles. We first consider Robert Costanza's treatment of Nicholas Stern's Global Deal and then survey climate change-related articles published in this journal over the past five years. This survey reveals how mainstream (neoclassical) methodologies dominate discourse, and do so by marginalizing more critical (political economy) analyses. This situation imperils the field's founding vision of a no-growth 'steady state'; it also fails to address the (related) growth dynamics of capitalism. Without such a critical treatment, the field's formal embrace of 'methodological pluralism' actually entails an ideological empiricism that renders ecological economics theoretically incoherent. This situation undermines the field's historical promise as an alternative economic paradigm. Ecological economics now faces a problematic future. Its survival in a form faithful to its founding vision will require an explicit choice to address its internal contradictions, and reinvent itself in ways relevant to our contemporary context. Without such a choice, ecological economics will likely succumb to an implicit acceptance of the hegemony of mainstream economic methodologies and their pro-growth imperatives.

The economic and financial dimensions of degrowth

- Ecological Economics---2012---Damir Tokic

We respond to the call for future research on degrowth and specifically analyze the implications of economic degrowth on the monetary and financial system. We argue that any early indications of degrowth would cause the stock market to crash, which would trigger further deleveraging (contagion) and a deflation. As a result, the economy would implode, which would eventually allow for a new rapid growth cycle, given the likely extraordinary fiscal and monetary policy response during the implosion. Thus, in our view, degrowth as an explicit strategy option is economically unsustainable and unfeasible. As a limitation, our analysis centers on the examples of unplanned crisis leading to an economic implosion, which imperfectly represent the idea of planned/voluntary degrowth.

Income-based environmental responsibility

- Ecological Economics---2012---Alexandra Marques, João Rodrigues, Manfred Lenzen, Tiago Domingos

A strong mitigation effort is underway to reduce the levels of anthropogenic greenhouse gas emissions. An allocation of the mitigation effort among multiple agents requires understanding which agent is responsible for what emissions, according to a defined measure of carbon responsibility. The metric adopted by current international climate policy is production-based (or territorial) responsibility. However, other types of responsibility have been discussed in the literature, namely consumption-based (or upstream) responsibility and downstream responsibility. In this paper we study the latter, which is little explored in the literature. We clarify the term through a novel nomenclature, income-based responsibility and present a case-study, with the quantification of income-based responsibility for 112 world regions, and the comparison of the results with production and consumption-based responsibilities.

Global effects of national biomass production and consumption: Austria's embodied HANPP related to agricultural biomass in the year 2000

- Ecological Economics---2012---Helmut Haberl,Thomas Kastner,Anke Schaffartzik,Nikolaus Ludwiczek,Karl-Heinz Erb

Global trade of biomass-related products is growing exponentially, resulting in increasing ‘teleconnections’ between producing and consuming regions. Sustainable management of the earth’s lands requires indicators to monitor these connections across regions and scales. The ‘embodied human appropriation of NPP’ (eHANPP) allows one to consistently attribute the HANPP resulting from production chains to consumers. HANPP is the sum of land-use induced NPP changes and biomass harvest. We present the first national-level assessment of embodied HANPP related to agriculture based on a calculation using bilateral trade matrices. The dataset allows (1) the tracing of the biomass-based products consumed in Austria in the year 2000 to their countries of origin and quantifying the HANPP caused in production, and (2) the assigning of the national-level HANPP on Austria’s territory to the consumers of the products on the national level. The dataset is constructed along a consistent system boundary between society and ecosystems and can be used to assess Austria’s physical trade balance in terms of eHANPP. Austria’s eHANPP-trade balance is slightly negative (imports are larger than exports); import and export flows are large in relation to national HANPP. Our findings show how the eHANPP approach can be used for quantifying and mapping the teleconnections related to a nation’s biomass metabolism.

Exploring worldviews and their relationships to sustainable lifestyles: Towards a new conceptual and methodological approach

- Ecological Economics---2012---Annick Hedlund-de Witt

In the global debate on sustainable development, there appears to be a growing recognition of the crucial importance of worldviews vis-à-vis the urgently needed

transition to an ecological economy and society. This study therefore aims to support (survey) research exploring worldviews and their complex relationships to sustainable lifestyles. I do this by analyzing and critically challenging existing measures such as the New Environmental Paradigm, and by developing a new conceptual and methodological approach. First, a review of multiple survey-approaches, stemming from different disciplinary and theoretical traditions, is conducted. This results in a meta-analysis of their strengths and weaknesses. On this basis it is concluded that a more optimal approach should be comprehensive and systematic, measure structural worldview-beliefs, and be able to account for human and cultural development. Then, the Integrative Worldview Framework (IWF) is proposed in order to support such a systematic, comprehensive, structural, and dynamic operationalization of the worldview-construct. In this way, a conceptually and methodologically innovative approach to exploring worldviews and their relationship to sustainable behaviors is developed.

Utopias and realism in ecological economics — Knowledge, understanding and improvisation

- Ecological Economics---2012---Stig Ingebrigtsen,Ove Jakobsen

“What we are going through at the present time is not just an economic-financial crisis, but a crisis of humanity” (Max-Neef, 2010, p. 200). Despite problems within it, it is ecological economics which is now emerging as the most potent opponent to neo-classical economics. “It is ecological economics which addresses the most profound failure of neoclassical economics, the failure to deal adequately with resource depletion and environmental destruction both locally and globally” (Costanza, 1991). The complex challenges are anchored in a deep conflict between mainstream economics and the natural and social conditions, to harmonize this connection it would seem necessary to develop a valid understanding of the interconnectedness between economy, nature and society. The idea behind this article is four-fold. Firstly, we describe and discuss the ontological worldview in ecological economics. Secondly,

the epistemological consequences of the ontological preconditions are discussed. Thirdly, some of the main concepts and principles in ecological economics are focused on. Fourthly, we discuss the realism of radical solutions in ecological economics.

The impact of environmental performance on firm performance: Short-term costs and long-term benefits?

- Ecological Economics---2012---Eva Horváthová

We examine the intertemporal effect of environmental performance on financial performance and propose a method to assess the environmental performance in a fuller manner based on the weighting various pollutants according to their dangerousness to environment. Using our improved measures of environmental performance applied to the firm level data from the Czech Republic, the results suggest that while the effect of environmental performance on financial performance is negative for environmental performance lagged by 1year lag, it becomes positive for 2years lag. As a consequence, our findings indicate that Porter hypothesis holds in the long-run.

Land use change impacts of biofuels: Near-VAR evidence from the US

- Ecological Economics---2012---Giuseppe Piroli,Pavel Ciaian,d'Artis Kancs

The present paper studies the land use change impacts of fuels and biofuels. We test the theoretical hypothesis, which says that changes in fuel prices cause changes in land use both directly and indirectly and that, because of price inter-dependencies, biofuels reinforce the land use change impacts. We apply time-series analytical mechanisms to five major traded agricultural commodities, the cultivated area of agricultural land and crude oil price. Our data consists of yearly observations extending from 1950 to 2007 for the US. The empirical findings confirm that markets for crude oil and cultivated agricultural land are interdependent: an increase in oil price by 1dollar/barrel increases land use between 54,000 and 68,000ha. We also find that

the increase of bioenergy sector accelerates land use change in the US, i.e. food commodities are being substituted for bioenergy crops.

Weighting social preferences in participatory multi-criteria evaluations: A case study on sustainable natural resource management

- Ecological Economics---2012---Eneko Garmendia,Gonzalo Gamboa

The use of multi-criteria evaluation tools in combination with participatory approaches provides a promising framework for integrating multiple interests and perspectives in the effort to provide sustainability. However, the inclusion of diverse viewpoints requires the “compression” of complex issues, a process that is controversial. Ensuring the quality of the compression process is a major challenge, especially with regards to retaining the essential elements of the various perspectives. Based on the lessons learned during a case study that assessed sustainable management options for the Urdaibai Estuary (Basque Country-Southern Europe), we propose a process in which the explicit elicitation of weights (the prioritisation of criteria) within a participatory multi-criteria evaluation serves as a quality assurance mechanism to check the robustness of the evaluation process. The results demonstrate that diverse individual priorities can be grouped in a reduced set of social preferences by means of cluster analysis reinforced with a deliberative appraisal among a wide variety of social actors. The approach presented retains relevant information regarding extreme and sometimes irreconcilable positions, allows an explicit social sensitivity analysis of the MCE process, and enables participants to learn from and reflect upon diverse social preferences without forcing their consensus.

Adequate responsiveness to scope in contingent valuation

- Ecological Economics---2012---William Desvousges,Kristy Mathews,Kenneth Train

The standard test for scope sensitivity in contingent

valuation studies determines whether the response to changes in scope is statistically significant; it does not address whether the magnitude of response is appropriate given the specified changes in scope. We examine contingent valuation studies that implemented scope tests to determine what they imply about the adequacy of response to scope. We find that in the vast majority of studies, the magnitude of response cannot be assessed. Only three studies permit such an assessment: Samples and Hollyer (1990), Diamond et al. (1993) and Chapman et al. (2009). The first two papers find that responses to their surveys did not vary adequately with scope. The third study passed the standard scope test, but we show that the magnitude of response in this study is inadequate by straightforward methods of assessment and cannot be explained by diminishing marginal utility or substitution. More research is needed on this issue, including wider application of adding-up tests on incremental parts, as well as the development of other methods that permit an assessment of the magnitude of response or other tests of rationality.

Forecasting scenarios for UK household expenditure and associated GHG emissions: Outlook to 2030

- Ecological Economics---2012---Mona Chitnis, Angela Druckman, Lester Hunt, Tim Jackson, Scott Milne

Using the modelling tool ELES (Econometric Lifestyle Environment Scenario Analysis), this paper describes forecast scenarios to 2030 for UK household expenditure and associated (direct and indirect) greenhouse gas (GHG) emissions for 16 expenditure categories. Using assumptions for real household disposable income, real prices, ‘exogenous non-economic factors’ (ExNEF), average UK temperatures and GHG intensities, three future scenarios are constructed. In each scenario, real expenditure for almost all categories of UK expenditure continues to grow up to 2030; the exceptions being ‘alcoholic beverages and tobacco’ and ‘other fuels’ (and ‘gas’ and ‘electricity’ in the ‘low’ scenario) leading to an increase in asso-

ciated GHG emissions for most of the categories in the ‘reference’ and ‘high’ scenarios other than ‘food and non-alcoholic beverages’, ‘alcoholic beverages and tobacco’, ‘electricity’, ‘other fuels’ and ‘recreation and culture’. Of the future GHG emissions, about 30% is attributed to ‘direct energy’ use by households and nearly 70% attributable to ‘indirect energy’. UK policy makers therefore need to consider a range of policies if they wish to curtail emissions associated with household expenditure, including, for example, economic measures such as taxes alongside measures that reflect the important contribution of ExNEF to changes in expenditure for most categories of consumption.

Agglomeration bonus in small and large local networks: A laboratory examination of spatial coordination

- Ecological Economics---2012---Simanti Banerjee, Anthony M. Kwasnica, James Shortle

The Agglomeration Bonus (AB) is a subsidy mechanism intended to induce adjacent landowners to coordinate environmental conservation activities. This paper explores the effects of landowner group size on spatial coordination under the AB in laboratory experiments where players are located on circular local networks. The experiments indicate a significant difference in patterns of coordination between groups. Additionally, global coordination on a single strategy is obtained in half of the groups and in the remaining half, both strategies exist giving rise to localized areas of coordinated land uses on the network.

Time, gender and carbon: A study of the carbon implications of British adults’ use of time

- Ecological Economics---2012---Angela Druckman, Ian Buck, Bronwyn Hayward, Tim Jackson

In order to meet the UK’s challenging greenhouse gas (GHG) reduction targets, behaviour change will be necessary in addition to changes in technology. Traditionally this has been approached from the angle of shifting the goods people purchase towards lower

impact options. But an equally valid angle is through changing the way people use their time. This study explores the GHG emissions per unit time for different types of activities. It focuses on ‘non-work’ time, and examines how different activities, such as household chores and leisure pursuits, give rise to varying amounts of household carbon emissions. We do this first for an average British adult, and then examine how time use varies within households, and how this impacts on resulting carbon emissions. We find, for example, that leisure activities are generally associated with lower carbon emissions than non-leisure activities, and that a higher proportion of an average man’s carbon footprint is due to leisure than an average woman’s. In the discussion we explore the implications of our findings for the varying roles carried out within different types of household, we investigate the concept of carbon as a potential marker for social justice, and discuss the implications for work-time reduction policies.

The role of fairness norms the household-based natural forest conservation: The case of Wolong, China

- Ecological Economics---2012---Zhiyuan Song,Zhiyun Ouyang,Weihua Xu

The shadow of “the tragedy of the commons” with its popularized assumption of selfish individual behavior concerns policy-makers, and consequently the cooperative capability of local communities in common resource management is usually underrated. Nevertheless, here we propose a hypothesis, based on a game theory model, that the social norm of fairness rather than self-interest might motivate cooperation in natural resource conservation by discounting the utility gain from illegal logging at the cost of another household’s subsidy loss. In Wolong Nature Reserve of China, a recent household-based natural forest conservation program has led to remarkable progress in protecting the habitat of giant pandas (*Ailuropoda melanoleuca*) with low monitoring pressure. We undertook experiments based on a one-shot Ultimatum Game to test the prevalence of the norm of fairness

in the local communities. Most proposers in the experiments showed strong preferences for fair offers in spite of the responders’ reluctance to reject low offers, and the result contradicted the expectation of pure self-interest. Taking into account the norm of fairness, the prediction of the model is consistent with the local performance of the household-based conservation policy. It highlights the potential of local social norms to facilitate participation and cooperation by the local community in common natural resource conservation.

American passage: Towards a new economy and a new politics

- Ecological Economics---2012---James Gustave Speth

America’s present system of political economy is failing across a broad front — economic, social, political, and environmental.

Degrowth and the supply of money in an energy-scarce world

- Ecological Economics---2012---Richard Douthwaite

Degrowth is going to happen whether governments want it or not because, as fossil fuels run out, incomes will shrink along with the energy supply. This degrowth can either be unplanned and catastrophic or managed and relatively benign. This paper argues that three tools are essential to avoid degrowth becoming a catastrophic collapse. These are (i) a system to share the benefits from using increasingly-scarce fossil fuels, (ii) new ways of financing businesses and (iii) the introduction of debt-free regional and local currencies.

Long-run welfare under externalities in consumption, leisure, and production: A case for happy degrowth vs. unhappy growth

- Ecological Economics---2012---Ennio Bilancini,Simone D’Alessandro

In this paper we contribute to the debate on the relationship between growth and well-being by examining

an endogenous growth model where we allow for externalities in consumption, leisure, and production. We analyze three regimes: a decentralized economy where each household makes isolated choices without considering their external effects, a planned economy where a myopic planner fails to recognize both leisure and consumption externalities but recognizes production externalities, and a planned economy with a fully informed planner. We first compare the balanced growth paths under the three regimes and then we numerically investigate the transition to the optimal balanced growth path. We provide a number of findings. First, in a decentralized economy growth or labor (or both) are greater than in the regime with a fully informed planner, and hence are sub-optimal from a welfare standpoint. Second, a myopic intervention which overlooks consumption and leisure externalities leads to more growth and labor than in both the decentralized and the fully informed regime. Third, we provide a case for happy degrowth: a transition to the optimal balanced growth path that is associated with downscaling of production, a reduction in private consumption, and an ongoing increase in leisure and well-being.

Growth, degrowth and climate change: A scenario analysis

- Ecological Economics---2012---Peter A. Victor

The paper proceeds with a discussion of the interplay of scale and intensity in determining greenhouse gas emissions. This is followed by the presentation of several macroeconomic scenarios using LowGrow, a simulation model of the Canadian economy. The scenarios considered are ‘business as usual’ which is a projection into the future of past trends, ‘selective growth’ in which differential growth rates are applied to parts of the economy according to their direct and indirect greenhouse gas emissions, and ‘degrowth’ where the average GDP/capita of Canadians is reduced towards a level more consistent with a world economy the size of which respects global environmental limits. The paper ends with a comparison of the scenarios.

Consumption of market goods and wellbeing in small-scale societies: An empirical test among the Tsimane’ in the Bolivian Amazon

- Ecological Economics---2012---Elena Masferrer-Dodas,Luis Rico-Garcia,Tomás Huanca,Victoria Reyes-García

Researchers propose sustainable degrowth as an alternative economic model to face current environmental crisis. Standard economic theory criticizes the viability of degrowth under the assumption that there is a causal link between wellbeing and the consumption of goods and services. Here we test the universality of the association between human wellbeing and the consumption of market goods (a standard indicator of economic growth) using a unique body of data collected among 600 adults in a small-scale foraging-horticultural society in the Bolivian Amazon, the Tsimane’. Data include two measures of consumption (weekly expenditures and annual consumption of durables) and two measures of wellbeing (self-reported wellbeing and frequency of smiles). Multivariate analyses suggest that, for this society in the early stages of integration to the market economy, consumption of market goods is not associated with wellbeing. The result is robust to the two measures of wellbeing, to the measurement of consumption at the individual and at the household level, and to other changes in the estimation model. The analysis provides support to one of the social premises in which the theory of sustainable degrowth is based: that human wellbeing does not necessarily bear a direct link with consumption of market goods.

Measuring progress in the degrowth transition to a steady state economy

- Ecological Economics---2012---O’Neill, Daniel W.

In order to determine whether degrowth is occurring, or how close national economies are to the concept of a steady state economy, clear indicators are required. Within this paper I analyse four indicator approaches that could be used: (1) Gross Domestic Product, (2) the Index of Sustainable Economic Welfare, (3) bio-physical and social indicators, and (4) a composite

indicator. I conclude that separate biophysical and social indicators represent the best approach, but a unifying conceptual framework is required to choose appropriate indicators and interpret the relationships between them. I propose a framework based on ends and means, and a set of biophysical and social indicators within this framework. The biophysical indicators are derived from Herman Daly's definition of a steady state economy, and measure the major stocks and flows in the economy–environment system. The social indicators are based on the stated goals of the degrowth movement, and measure the functioning of the socio-economic system, and how effectively it delivers well-being. I discuss some potential applications of the indicators, including a method that allows national economies to be placed into one of five categories: desirable growth, undesirable growth, desirable degrowth, undesirable degrowth, and a steady state economy.

The euthanasia of the rentier — A way toward a steady-state economy?

- Ecological Economics---2012---Dirk Loehr

A positive interest rate has many impacts on ecology. One of them is the pushing of economic growth. In the present economy, accumulation of capital is an end in itself. According to the “Golden Rule of Accumulation”, the extension rate of the capital stock is equal to the interest rate. However, in the present economic conditions the interest rate is always significantly higher than zero, due to the liquidity premium of money (Keynes). In this context, old proposals such as the “free money” approach of Silvio Gesell could provide interesting solutions. Gesell wanted to neutralize the liquidity premium by putting “artificial” carrying costs on money. By increasing the stock of capital assets without being interrupted by economic crises, the interest and profitability level should be reduced down to zero. Because in this situation every marginal saving and marginal investment would cause a negative interest or profitability rate, they would be stopped. Though Keynes was very excited by the proposals of Gesell, he criticized the fact that Gesell did not see many of the further obstacles. However,

these obstacles could be overcome by means of further institutional reforms.

“This is a bit of the good life” : Recognition of unpaid work from the perspective of degrowth

- Ecological Economics---2012---Linda Nierling

The decommodification of work activity is central for conceiving work from a degrowth perspective. Yet personal dependence on paid work is very high, whereas unpaid work activity, such as providing care, community service and subsistence, continues to be neglected by individuals and society. By using the analytical approach related to recognition as employed by Axel Honneth, I argue on the basis of empirical findings that unpaid work can play a significant role in one's personal well-being at the individual level. With regard to the transition process towards a society of degrowth, however, a key seems to be a change in the normative paradigm concerning work at the individual level.

Ecological economics, degrowth, and institutional change

- Ecological Economics---2012---Kent A. Klitgaard, Lisi Krall

Ecological economics has made great strides in the understanding of how the human economy is embedded in a finite and limited biophysical system. However less progress has been made in understanding the internal dynamics of the economy that produce periods of slow growth, even in the absence of biophysical constraints. The real economy is a complex system, replete with myriad positive feedback loops. By looking at the economy from a systems perspective ecological economists can better understand the internal dynamics of a market system that lead to the periodic depressions and recessions that characterize “the failed growth economy.” A non-growing or declining economy exacerbates formidable economic problems such as unemployment, debt, and poverty. Since the middle of the 20th century governments have pursued growth strategies to solve social problems. But the age of economic growth is coming to an end, driven by its

own internal dynamics and by biophysical forces such as climate change and peak oil. Degrowth implies less, and the steady state implies less on a permanent basis. Ecological economists need to pay more attention to the implications of less for a market economy and the effects upon people under our present economic configuration.

Overcoming accumulation: Is a capitalist steady-state economy possible?

- Ecological Economics---2012---Frederik Berend Blauwhof

This article critically reviews the case for a steady-state, zero growth economy posing the question whether such an economy can be stable and socially just, given that in the current global economy lack of growth is synonymous with crisis. The SSE thesis is analysed within a framework of Marxian political economy concluding that a stable and just SSE is possible, but not feasible within the social relations of capitalism. Using the Marxian analysis of capital accumulation, the article then considers whether the reforms proposed by ecological economists can form an effective countervailing force to the drive for accumulation. The conclusion is that such reforms can be successful, but only in so far as they are complemented and brought to their logical conclusion by a wider attempt to transcend the capitalist relations of production.

Bona diagnosis, bona curatio: How property economics clarifies the degrowth debate

- Ecological Economics---2012---Pascal van Griethuysen

This contribution postulates that a theoretical explanation of the foundational conditions of economic growth is a prerequisite for conceptually elaborating on the ways to foster degrowth. It suggests that reorienting the current unsustainable and inequitable path and implementing the degrowth transition in an ecologically sustainable and socially equitable manner requires a shift in the hierarchy of social norms, from the property-based economic rationale, where social and ecological

considerations are subordinated to the specific requirements of capitalist expansion, towards an eco-social economic rationale, where economic activities are subordinated to social and ecological considerations and imperatives. Such an eco-social rationale could subordinate property capitalist expansion through the following, interrelated ways: limiting the scope of the property domain, regulating capitalisation practices, orienting investments, distributing returns and limiting the capitalist expansion of property. Nonetheless, getting out of the involutory path of western development might require more radical alternatives, such as non-property, possession-based institutional arrangements and partnerships.

The value of reducing eutrophication in European marine areas — A Bayesian meta-analysis

- Ecological Economics---2012---Heini Ahtiainen, Jarno Vanhatalo

One of the threats to the marine environment is eutrophication, which causes many adverse impacts that reduce human well-being. Determining the benefits of improving the state of marine areas has drawn increasing attention, especially with the establishment of the European Union Marine Strategy Framework Directive. However, existing knowledge of the benefits provided by marine ecosystem services in Europe is limited and context-specific. This study applies meta-analysis to summarize available information on the value of reducing eutrophication in European sea areas, and to provide welfare predictions for different scenarios. The challenges related to the small number of available studies are addressed by employing a Bayesian meta-regression. Several models are compared with prior and posterior predictive checks, and value predictions are estimated using Bayesian model averaging. The results indicate that the perceived benefits of reducing eutrophication in European marine areas can be considerable, with the predicted annual willingness to pay per person ranging from \$6 for small local changes to \$235 for substantial changes covering large sea areas. The findings suggest that values differ

between marine regions, highlighting the importance of investigating previously unstudied geographical areas. As marine policy requires international cooperation, future studies would also benefit from collaboration between countries.

Global governance for sustainable energy: The contribution of a global public goods approach

- Ecological Economics---2012---Sylvia I. Karlsson-Vinkhuyzen,Nigel Jollands,Lawrence Staudt

Achieving a sustainable energy future requires a revolution in the energy system. At the heart of such a transformation lies strong and coherent governance at all political levels, including the global level. While the need for global governance is taken for granted in a number of issue areas such as health, peacekeeping and environment, pursuit of global energy governance has been almost a taboo in political and foreign policy circles and has also had limited attention in the literature. In this paper, we explore how the viewing of a sustainable energy system as a global public good could serve as one approach to reducing the sensitivity towards global energy governance. The global public good concept together with the principle of subsidiarity is applied as a framework for understanding the role that the international community could play in, and the key ingredients for, global energy governance. Using two examples of international energy efficiency and renewable energy policy, we identify some types of international collaboration measures that would be both efficient and necessary to support a sustainable energy system.

Understanding the impacts of the 2007–08 Global Financial Crisis on sustainable forest management in the Brazilian Amazon: A case study

- Ecological Economics---2012---Natalia P. Canova,Gordon M. Hickey

In 2007 and 2008, the world experienced a significant Global Financial Crisis (GFC). Several factors were

perceived as drivers of the crisis, however, its dynamics and consequences for natural resources and the environment remain largely unknown, particularly in Brazil. Combining grounded theory and case study methodologies, this research explores and contrasts the perspectives of highly knowledgeable stakeholders on how the GFC impacted sustainable forest management in the Brazilian Amazon, using the State of Pará as a case study. Our findings indicate that the GFC cannot be considered as a unique phenomenon impacting SFM and that it is intimately linked to other political, social and environmental events unfolding within Brazil and at the global level. Decreased deforestation was perceived to have occurred due to restrained production, increased risk aversion, increased public awareness and enhanced government efforts towards law enforcement. The forest-based exporting segment was seen to suffer the most severe impacts of the crisis. Environmentally friendly initiatives were perceived to offer forest product differentiation in the market; while investments in non-market-oriented initiatives were restrained. Our results suggest that in times of economic crisis, forest policy-makers need to focus on both formal and informal forest economies in order to promote sustainable forest management objectives.

A framework for evaluating collective action and informal institutional dynamics under a resource management policy of decentralization

- Ecological Economics---2012---H.M. Tuihedur Rahman,Gordon M. Hickey,Swapan Kumar Sarker

The decentralization of resource property rights has become an increasingly popular policy in many natural resource-dependent communities of the developing world. However, the success of this policy approach depends on both collective action and institutionalization. It is therefore important to evaluate collective action and institutionalization where the process of property rights decentralization is in progress. This paper presents a modified version of the Institutional Analysis and Development (IAD) Framework designed to analyze the decentralization of property rights and the collective action of community members to obtain

these rights. It describes a three-phased framework for analyzing: i) the government property right decentralization policy, ii) the stock of capital assets in the community required to achieve property rights by initiating collective action, and iii) the development of an informal institution for effective property right distribution in the community. Finally, to demonstrate its utility to collective action research, we present a case study application of our modified framework to the fisheries property right decentralization policy of the Bangladesh government and the subsequent collective action of a wetland-dependent community.

On the deliberative capacity of private multi-stakeholder governance: The Roundtables on Responsible Soy and Sustainable Palm Oil

- Ecological Economics---2012---Greetje Schouten,Pieter Leroy,Pieter Glasbergen

The democratic quality of private multi-stakeholder governance is an important subject of academic and political debate. On the one hand, private multi-stakeholder arrangements are seen as a way of democratizing international environmental governance. On the other hand, the democratic potential of these arrangements has been heavily criticized and interpreted as a privatization of what should be public. To nuance this debate, this paper assesses the democratic potential of one specific type of arrangement: Roundtables. These Roundtables are presented as being based on a deliberative democratic rationale. This paper therefore assesses the deliberative capacity of the Roundtables on Responsible Soy and Sustainable Palm Oil and shows to what extent the communicative processes in these Roundtables are inclusive, consequential and authentic. This paper concludes that the Roundtable model tends to fall short on two criteria of deliberative democracy: inclusiveness (of actors and discourses) and consequentiality.

Shifting environmental perspectives in agriculture: Repeated Q analysis and the stability of preference structures

- Ecological Economics---2012---Ben B. Davies,Ian Hodge

A critical issue in behavioural environmental studies is the evolution of attitudes over time. This analysis reports a unique longitudinal study of individual farmers' perspectives using Q methodology, with a group of UK farmers' opinions assessed in both 2001 and 2008. Three main outcomes are evident. Firstly, the set of farmers' perspectives identified in 2001 appears to be still adequate to summarise the range of views present in 2008; thus substantially new sets of concerns do not appear to be forming over this period. Secondly, the proportions of farmers aligning themselves with particular perspectives appear to have shifted, indicating some clear reorientations of attitudes. Thirdly, these shifts indicate a small number of specific directions of change, oriented towards more productivist positions and away from more environmental interests. In summary, the key dimensions of agri-environmental concern amongst farmers overall do not appear to be significantly changing over this period, but the proportions of farmers that are sensitive to particular concerns do appear to have undergone some change. Given the unusual methodology, sample size and recruitment methods used these results most certainly cannot be translated into population-wide effects, but they do provide a valuable opportunity for consideration of pathways of change.

Does eco-certification have environmental benefits? Organic coffee in Costa Rica

- Ecological Economics---2012---Allen Blackman,Maria A. Naranjo

Eco-certification of coffee, timber and other high-value agricultural commodities is increasingly widespread. In principle, it can improve commodity producers' environmental performance, even in countries where state regulation is weak. But eco-certification will have limited environmental benefits if, as one would expect, it

disproportionately selects for producers already meeting certification standards. Rigorous evaluations of the environmental effects of eco-certification in developing countries that control for selection bias are virtually nonexistent. To help fill this gap, we use detailed farm-level data to analyze the environmental impacts of organic coffee certification in central Costa Rica. We use propensity score matching to control for selection bias. We find that organic certification improves coffee growers' environmental performance. It significantly reduces chemical input use and increases adoption of some environmentally friendly management practices.

An evaluation of monetary and non-monetary techniques for assessing the importance of biodiversity and ecosystem services to people in countries with developing economies

- Ecological Economics---2012---Mike Christie, Ioan Fazey, Rob Cooper, Tony Hyde, Jasper Kenter

Biodiversity supports a range of ecosystems services that are of fundamental importance to people in poor countries. Economic valuation of biodiversity is important for the development of policies that protect biodiversity and alleviate poverty. This paper provides an evaluation of monetary and non-monetary techniques for assessing the value of biodiversity to people in least developed countries (LDCs). Specifically, research questions include: 1) To what extent have monetary and non-monetary techniques been used to assess the value of biodiversity and ecosystem services in LDCs? 2) What are the key methodological, practical, epistemological and policy challenges to assessing the value of biodiversity and ecosystem services in LDCs? 3) How can valuation methods be improved to allow more accurate valuation in LDCs?

Enhancing U.S. hazardous waste accounting through economic modeling

- Ecological Economics---2012---Christa D. Court

Amid changing attitudes about the environment and emerging sustainability concerns in the late 1960s and 1970s, countries around the world began regulating

multiple aspects of solid and hazardous wastes. Initial regulations and those occurring since all share the broader goal of curbing waste generation, especially that of hazardous wastes; but with few signs of progress. Using an input-output accounting framework that focuses on the domestic economy, data on the economy and hazardous waste generation are combined to provide a more complete picture of hazardous waste generation in the United States. The framework developed in this paper can be used to inform decision-makers of the current state of the "hazardous waste economy" and can also be extended to account for other types of environmental factors.

The role of farmers' property rights in soil ecosystem services conservation

- Ecological Economics---2012---Sébastien Foudi

This paper analyzes the role of property rights in soil conservation. The conventional wisdom in soil conservation and property rights argues that tenants invest less than landlords in sustainable management practices and tend to overexploit soil biota services. The paper examines how this issue is linked to bioeconomic considerations. In an optimal control approach to the modeling of soil ecosystem services exploitation, the paper shows how economic, biological and ecological variables drive the rewards of investment in soil conservation through agricultural practices.

Comparison of energy flow accounting, energy flow metabolism ratio analysis and ecological footprinting as tools for measuring urban sustainability: A case-study of an Irish city-region

- Ecological Economics---2012---David Browne, O'Regan, Bernadette, Richard Moles

This paper seeks to apply a number of biophysical sustainability metrics to an Irish city-region in order to evaluate the effect of methodological pluralism when measuring urban sustainability and to determine the outcome of using more than one method when measuring the sustainability of the same system boundary at

a city-region level. It is concluded that a ‘toolkit’ approach can be useful in highlighting commonalities and differences between different metrics as well as capturing some of the deficiencies inherent in using a single biophysical metric. In addition, this paper develops an approach to measuring energy metabolism by outlining and applying the ‘energy flow metabolism ratio analysis’ methodology, which is used to measure the ratio of greenhouse gas (GHG) emissions as a function of energy material inputs.

Economic value of the nutrient retention function of restored floodplain wetlands in the Elbe River basin

- Ecological Economics---2012---Malte Grossmann

This paper presents an application of an indirect method, the alternative or replacement cost method to value a regulatory ecosystem service: the retention of river nutrient loads by floodplain wetlands. The paper presents a cost-minimisation model for nutrient abatement measures for the River Elbe. The model is applied to estimate the shadow price of phosphate and nitrogen nutrient retention services by restored floodplains. It is shown that the shadow price of restored floodplain area is a function of the nutrient load reduction target for the river basin. The scope of the floodplain restoration projects is shown to have a lesser impact on the estimated shadow price.

An integrated assessment model with endogenous growth

- Ecological Economics---2012---Michael Hübner,Lavinia Baumstark,Marian Leimbach,Ottmar Edenhofer,Nico Bauer

We introduce endogenous directed technical change into numerical integrated climate and development policy assessment. We distinguish expenditures on innovation (R&D) and imitation (international technology spillovers) and consider the role of capital investment in creating and implementing new technologies. Our main contribution is to calibrate and numerically solve the model and to examine the model’s sensitivity. As

an application, we assess a carbon budget-based climate policy and vary the beginning of energy-saving technology transfer. Accordingly, China is a main beneficiary of early technology transfer. Herein, our results highlight the importance of timely international technology transfer for efficiently meeting global emission targets. Most of the consumption gains from endogenous growth are captured in the baseline. Moreover, mitigation costs turn out to be insensitive to changes in most of the parameters of endogenous growth. A higher effectivity of energy-specific relative to labor-specific expenditures on innovation and imitation reduces mitigation costs, though.

International and domestic pressures and responses of Chinese firms to greening

- Ecological Economics---2012---Qinghua Zhu,James Cordeiro,Joseph Sarkis

Organizational responses to international and domestic institutional pressures may help proactive corporate environmental practices and routines diffuse to Chinese organizations, who are key participants in global product chains. Using the 2006 survey data on 377 Chinese manufacturers in six major industrial groups in Suzhou, Dalian, and Tianjin cities, we propose and test a relationship between normative, coercive and mimetic international institutional pressures and the adoption of three important proactive corporate environmental practices (routines) – ISO 14001, TQEM (total quality environmental management), and eco-auditing – by Chinese firms. We also argue for and find that this relationship is greater than that arising from corresponding normative, coercive, and mimetic internal domestic pressures. Finally, we find a positive effect of international parenting or partnering on the adoption of proactive corporate environmental practices and routines. These findings have important implications as Chinese organizations continue to go global and international organizations seek global product supply chain partners within China.

Environmental and social responsibility in supply chains: The practise of choice and inter-organisational management

- Ecological Economics---2012---Beatrice Kogg,Oksana Mont

The general concern for the state of the environment sets requirements on strategies developed by companies to curb environmental and social impacts of their activities. One of the most notable changes in the way companies work with sustainability issues is the shift of the focus from own operations to improving the performance of supply chains. This paper aims to analyse the practise of corporate responsibility in the supply chain through the lens of two distinct but related fields of research: Global Value Chain analysis and Supply Chain Management. Using data from two empirical studies that were designed to study the practise of Swedish buyers in addressing social and environmental issues in their respective supply chains, we demonstrate that both fields offer vital insights about how companies can and do exercise environmental and social responsibility in their respective supply chains. We suggest that one can better integrate these two perspectives on governance in the supply chain by acknowledging that responsibility in the supply chain can both be exercised through choice and through inter-organisational management. We discuss role of certification schemes in this context and provide recommendations for future research.

The shaping of environmental impacts from Danish production and consumption of clothing

- Ecological Economics---2012---Michael Søgaaard Jørgensen,Charlotte Louise Jensen

The article analyses environmental impacts from production and consumption of clothing in Denmark based on 10 business case studies, an ethnographic study of clothing practices among a group of young women, and a statistical analysis of clothing consumption. The environmental strategies and impacts are shaped by the businesses' on-going interpretation of external pressures and opportunities, transnational outsourcing of

production to newly industrialised countries, changes towards 'fast fashion' and lower retail prices. Differences are identified with respect to whether and when companies take and embed environmental initiatives. The companies make environmental demands to suppliers in newly industrialised countries to different degrees. Some companies cancelled eco-labelling, because it was too demanding to manage, while some fashion companies recently launched eco-labelling, because they see a need to show environmental commitment publicly. The fast changing fashions and low price strategies encourage increased clothing consumption among young women, unused clothing in their wardrobes and frequent changes of clothing during the week. Concerns about environmental impacts are limited. The dominating business strategy of only few eco-labelled products seems to have had limited impact on these women's practices, and thereby on the environmental impacts from Danish consumer choices in general.

Greening of supply chain in developing countries: Diffusion of lead (Pb)-free soldering in ICT manufacturers in China

- Ecological Economics---2012---Xin Tong,Jin Shi,Yu Zhou

The paper examines the diffusion of lead-free soldering in ICT manufacturers in China as response to EU's RoHS directives, in order to investigate the global-local networks linking the lead market with the producers in developing countries. The result shows rapid diffusion of the technological change triggered by such regulation among Chinese firms. The diffusion however occurs at varied rates in different regions, depending on their export orientation. The logistic regression model shows that, other than firm attributes, such as the position in the product chains and the firm-level environmental performance, two geographical factors, i.e., target markets and local cluster effects, are also significant in influencing firm's technological choices, while capital sources is less important.

Government interventions in sustainable supply chain governance: Experience in Dutch front-running cases

- Ecological Economics---2012---W.J.V. Vermeulen,M.T.J. Kok

Numerous multi-actor governance systems have recently emerged, ensuring sustainability of international traded products. Business and civil society actors play a dominant role in initiating and governing ‘sustainable supply chain governance systems’ (SSCG systems). Within specific product markets we see the emergence of various competing SSCG systems.

National contexts matter: The co-evolution of sustainability standards in global value chains

- Ecological Economics---2012---Stephan Manning,Frank Boons,Oliver von Hagen,Juliane Reinecke

In this paper, we investigate the role of key industry and other stakeholders and their embeddedness in particular national contexts in driving the proliferation and co-evolution of sustainability standards, based on the case of the global coffee industry. We find that institutional conditions and market opportunity structures in consuming countries have been important sources of standards variation, for example in the cases of Fairtrade, UTZ Certified and the Common Code for the Coffee Community (4C). In turn, supplier structures in producing countries as well as their linkages with traders and buyers targeting particular consuming countries have been key mechanisms of standards transmission and selection. Unlike prior research, which has emphasized the role of global actors and structures in promoting – and hindering – sustainability initiatives, we argue that national economic and institutional conditions in consuming and producing countries have not only served as important drivers of standards multiplicity and co-evolution, but also as catalysts for the entire global sustainability movement.

Sustainability solution space of the Swiss milk value added chain

- Ecological Economics---2012---C.R. Binder,Allan Schmid,J.K. Steinberger

Current indicator-based sustainability assessment approaches usually have three shortcomings: (i) ecological aspects are mostly overrepresented in relation to importance and complexity of economic and social aspects; (ii) they center on filling important gaps in scientific knowledge, but miss on utilization and implementation; and (iii) the assessment results themselves are difficult to implement in decision-making, as conflicting goals and the interaction between indicators have not been sufficiently considered. We propose an approach that fulfills systemic criteria, i.e., sufficient representation of the system including functional interaction among indicators; normative criteria, i.e., considering the different value perspectives of stakeholders by including them in the process and designing sustainability ranges rather; and (iii) procedural criteria, i.e. pursuing the assessment in a true transdisciplinary process. We present the SSP and its application for the Swiss milk value added chain. The system is described with a set of 8 ecological and 9 socio-economic indicators. The sustainability ranges were obtained through literature research and stakeholder interviews. The relationship among the indicators was elicited in a transdisciplinary workshop. The SSP program takes a geometric approach to determine the intersection space corresponding to the satisfaction of the normative ranges while taking into account the functional interactions of the indicators.

International trade and shared environmental responsibility by sector. An application to the Spanish economy

- Ecological Economics---2012---María-Ángeles Cadarso,Luis López,Nuria Gómez,María-Ángeles Tobarra

The aim of this paper is to define a shared responsibility criterion for analysing the impact of international trade on CO2 emissions applied to sectors. With the

approach proposed it is possible for sectors in a country to account for only a part of the emissions associated with exported and imported goods. The agents considered as responsible for pollution are sectors two-fold: as producers and suppliers of intermediate inputs and final demand (accounting for direct emissions linked to production), and as consumers of intermediate inputs required for production (accounting for direct and indirect emissions linked to consumption of inputs), and the countries and foreign sectors that trade with these industries. The responsibility of emissions is shared by all the participants along the global product chain depending on the value added of each step. The criterion is applied to the Spanish economy for the period 2000 to 2005, and proves useful for determining what economic policies may be suitable for mitigating anthropogenic impact on the environment and for including all the agents of the supply chain in the development of sustainable supply chain management.

Extended producer responsibility instruments and innovation in eco-design: An exploration through a simulation model

- Ecological Economics---2012---Eric Brouil-
lat, Vanessa Oltra

This paper presents an agent-based simulation model that models both economical and physical relations between firms, recyclers and consumers. This framework allows an investigation into the connection between physical environmental variables (waste flows, virgin material flows) and economic decisions of agents in the product chain i.e. firms innovation strategies, consumers choices and development of recycling activities. The paper highlights the value of using agent-based modeling as an operational tool to investigate the effect of waste prevention policy on economic and technological decisions of agents. We focus on three types of extended producer responsibility (EPR) instruments, which are recycling fees, tax-subsidy and norms. The simulation results show that the impact of each instrument depends on the policy design, in particular on the level of stringency and on the reward system which is implemented. We show that only tax-subsidy systems

and stringent norms can lead to radical innovations and to significant changes in product designs. In the case of tax-subsidy, the impact relies more on an innovation effect, while in the case of norm it mainly relies on a selection effect.

Valuing impacts of the invasive alga *Didymosphenia geminata* on recreational angling

- Ecological Economics---2012---Stephen T. Beville, Geoffrey N. Kerr, Kenneth F.D. Hughey

Recent global spread of the freshwater alga *Didymosphenia geminata* (Didymo) has caused major biosecurity and freshwater management concerns. Didymo degrades river esthetics, alters ecosystems, negatively impacts recreation experiences and may require strict containment measures. This paper assesses the impact of Didymo on nonmarket values for recreational angling using a case study from New Zealand, where Didymo is extraordinarily prolific. Choice experiment data are used to fit a latent class model, identifying five distinct angler preference profiles. For the largest class of anglers the presence of Didymo had no significant effect on angling benefits. However, other classes were negatively affected. Overall, Didymo reduced fishing values by about NZ\$44 per visit. Anglers were sensitive to the scale of Didymo infestation, suffering significantly higher costs when more water bodies are affected. Closure of Didymo-infected mainstem-rivers to prevent spread of Didymo resulted in a significant reduction in angler net benefits, even if the policy were 100% effective. The latent class model identified distributional implications. While three angler classes would not have significantly different benefits if mainstem-rivers were closed to prevent the spread of Didymo, two classes of anglers would be highly impacted by such a policy, particularly those who regularly fish mainstem-rivers for salmon.

Opportunism and environmental management systems: Certification as a smokescreen for stakeholders

- Ecological Economics---2012---Gustavo Lanne-
longue, Javier González-Benito

This paper sets out to explain how the implementation of an environmental management systems (EMS) conditions the way firms respond to environmental pressures exerted by their stakeholders. While the most common approaches to be found in the literature consider the certification of such systems to be an indicator of proactivity and cooperation with stakeholders, this article posits that it is also a mechanism firms use to discriminate between stakeholders, allowing firms to react to the pressure of certain stakeholders only. Specifically, the analyses conducted on a sample of 3748 plants reveal that the implementation of an EMS responds to pressure from stakeholders, but once this system has been certified a firm's environmental actions basically respond to the pressure from internal primary stakeholders, ignoring pressures from external primary and secondary stakeholders and regulators. The key element in the theoretical line of reasoning regarding these results is the opportunistic behavior associated with certification, given that the certification by itself represents incomplete information. Thus, an EMS can serve as a valuable shield against a majority of stakeholders, since only the pressure of those stakeholders who can verify the effects of such pressure will have an influence on the environmental behavior of firms with a certified EMS.

Land use change and its effects on the value of ecosystem services along the coast of the Gulf of Mexico

- Ecological Economics---2012---G. Mendoza-González,M.L. Martínez,D. Lithgow,O. Pérez-Maqueo,P. Simonin

In the central region of the Gulf of Mexico, urban growth occurs mainly to support tourism and results in loss of natural ecosystems and ecosystem services. Our objectives were to analyze land use changes and calculate the value of these changes in terms of lost ecosystem services. We selected three study sites with contrasting infrastructure for tourism: Boca del Río, Chachalacas and Costa Esmeralda. From 1995–2006, we found that urban sprawl was predominant, and occurred over mangroves, grasslands, croplands and

the beach. Using the benefit transfer method, we calculated a net loss (\$US 2006/ha/year) of $\$1.4 \times 10^3$ in Boca del Río, $\$7 \times 10^5$ in Chachalacas and $\$1 \times 10^5$ in Costa Esmeralda. Because the value of urban land is higher (from 45,000 USD/ha (2006) in Costa Esmeralda to 6million in Boca del Río) than the total estimated Ecosystem Services Value (106,000 USD/ha, including all ecosystems and ecosystem services), land use change may seem economically profitable. However, after losing ecosystem services such as coastal protection or scenic value and recreation, the apparent gains from urban development are lost. Land use and policy making should consider ecosystem service losses so that ecosystems are preserved and society benefited.

Do ecosystem services influence household wealth in rural Mali?

- Ecological Economics---2012---Danielle King Liebenow,Matthew J. Cohen,Thomas Gumbrecht,Keith D. Shepherd,Gemma Shepherd

The impact of ecosystem services on human livelihood is rarely demonstrated. We investigated whether ecosystem services influence household wealth in semi-arid rural Mali, where climate variability and soil degradation were expected to regulate subsistence production. Mean rainfall, mean rain use efficiency, and rain use efficiency trends (a land degradation proxy) over the last 25years were used to quantify ecosystem services. Asset wealth was measured in 2527 households from 65 villages spanning the range in ecosystem services. We evaluated effects on wealth, controlling for household size and demographics, ethnicity, village size, crop selection, and distance to open water and markets. While wealth variation was dominated by demographics, significant associations with ecosystem services were observed. Predicted household wealth increased significantly (20%) with rainfall. Effects of rain use efficiency mean and trends were also significant, but only when conditioned on rainfall. With lower rainfall, wealth increased with mean rain use efficiency (+33%) but decreased with rain use efficiency trend (−22%). With higher rainfall, however, wealth decreased with rain use efficiency (−57%) and increased markedly

with rain use efficiency trend (+185%). While ecosystem services are clearly important, their effect on rural poverty is complex and potentially obscured by coping strategies that mitigate environmental limitations.

Fishing industry borrows from natural capital at high shadow interest rates

- Ecological Economics---2012---Martin Quaas,Rainer Froese,Helmut Herwartz,Till Requate,Jörn O. Schmidt,Rüdiger Voss

Fish stocks can be considered as natural capital stocks providing harvestable fish. Fishing at low stock sizes means borrowing from the natural asset. While fishing a particular quantity generates immediate profits and income, an interest rate has to be paid in terms of foregone future fishing income, as the fish stock's reproductive capacity remains low and fishing costs stay high. In this paper we propose to apply the concept of shadow interest rate to quantify the degree of overfishing. It incorporates the relevant biological and economic information and compares across fish stocks. We calculate the shadow interest rates for 13 major European fish stocks and find these rates to range from 10% to more than 200%. The concept of the shadow interest rate can be used to make the economic consequences of overfishing transparent and to evaluate the profitability of short-term catch reductions as investments in natural capital stocks.

The impacts of pollution and exposure pathways on home values: A stated preference analysis

- Ecological Economics---2012---Dennis Guignet

Hedonic property value methods are an attractive non-market valuation technique. In practice, however, researchers are often forced to make untested assumptions regarding the public's perceptions of the environmental commodity being studied. Stated preference methods offer an opportunity to examine how home values are affected when researchers know exactly what is being valued. A stated preference study is conducted to investigate how people value environmental quality, by measuring impacts on home values from a

leaking underground storage tank (LUST). The study incorporates two experimental treatments, expressing environmental risks in terms of (i) the presence of an exposure pathway, and (ii) pollution concentrations. This mimics information provided to Maryland households whose groundwater is actually impacted by a LUST.

Lifestyle practices and pro-environmental technology

- Ecological Economics---2012---Jonn Axsen,Jennifer TyreeHageman,Andy Lentz

We explore sociological concepts of lifestyle practices as they relate to sustainable consumption. Specifically, we investigate how and why consumers may transition toward adopting and using new pro-environmental technologies (PETs), namely electric vehicles, solar panels, and a green electricity program. We build a conceptual framework from lifestyle theory, where lifestyle is defined as a grouping of related practices that can reflect and inform the consumer's self-concept (or identity). We apply this framework using a novel quantitative survey method, implemented with a representative sample of 711 San Diego households. Through factor analysis, we identify engagement in pro-environmental practices as independent of engagement in other lifestyle types. We then group respondents into five clusters based on lifestyle engagement, attitudes and openness to lifestyle change (liminality). The three clusters with green attitudes ("greens") vary substantially by interest in PETs. "Engaged" and "aspiring" greens are attracted to all three PETs, while "low-tech" greens report mild interest in green electricity only. Non-green "techies" only report interest in solar panels, while "traditionalists" report uniformly low PET interest. Results demonstrate the relevance of lifestyle theory, and provide a unique, empirical application that can improve understandings of opportunities and barriers to sustainable consumption.

The build-up of local sustainable development politics: A case study of company leaders in France

- Ecological Economics---2012---Anne Musson

The purpose of this study is to examine business leaders' perceptions on sustainable development and their expectations about local governments. Using a questionnaire on a cross-section of 32 French business leaders, we examine the following questions: can issues related to sustainable development extend beyond questions of profit and future economic dynamism? The modern global economic crisis, in combination with the ongoing ecological one, makes regional attractiveness more topical than ever. If local governments invest in sustainable development policy, it might satisfy not only citizens but also firms in the territory, while attracting new ones as well. To determine if firms are really interested in such a policy, as well as understand their expectations, this research undertook interviews with 32 business leaders. We found that local governments should act with firms as partners to increase resilience and sustainability. The expectations of business leaders and their sensitivity to sustainable development suggest that sustainable development policies' could improve the attractiveness of a local economy, especially in the context of the current environmental and economic crises.

What factors influence the uptake of GPP (green public procurement) practices? New evidence from an Italian survey

- Ecological Economics---2012---Francesco Testa,Fabio Iraldo,Marco Frey,Tiberio Daddi

Green public procurement (GPP) is becoming a cornerstone of environmental policies both at European Union and Member State levels. Drawing upon a database of public authorities located in three Italian regions, this paper assesses the determinants and drawbacks of green procurement adoption. In particular, using an econometrical approach we tested the following propositions: (i) the existing awareness on GPP practices, tools and regulations does support public

authorities to develop GPP strategies; (ii) the support of external experts in purchasing function does support public authorities to develop GPP practices; (iii) the small dimension of public authority is an obstacle to adopting GPP practices; (iv) ISO 14001 certified public authorities are more likely to develop GPP practices. The econometric analysis shows that the dimension of public authorities and the level of awareness of the existing tools for supporting GPP have a positive and significant effect on the probability that they adopt GPP practices.

William Stanley Jevons' The Coal Question (1865), beyond the rebound effect

- Ecological Economics---2012---Antoine Missemmer

Before his major 1870s economic writings, William Stanley Jevons wrote in 1865 his first important book entitled *The Coal Question*. Jevons displays an interest for the problem of resource depletion, and some opportunism linked to the treatment of a subject in vogue at the time. *The Coal Question* is retrospectively essentially known for having pointed out the first bases of what we call today the rebound effect, known as well as the "Jevons' paradox". No one can deny the major contribution Jevons did by insisting on the energy efficiency paradoxical phenomenon. However, this is not the only interesting idea proposed in *The Coal Question*. This article aims at drawing a larger framework of the ideas developed by Jevons, looking at some specific points that testify to his position as a turning point in the history of environmental studies. We see that Jevons expresses a desire of emancipation from both natural sciences and engineering, yet without ignoring the necessity of interdisciplinary perspectives to deal with environmental matters. It places Jevons as a pioneer of several modern approaches towards environmental economics, including ecological economics.

Navigating coastal values: Participatory mapping of ecosystem services for spatial planning

- Ecological Economics---2012---Sarah C. Klain,Kai M.A. Chan

Monetary values and biophysical features tend to dominate spatial planning data, yet intangible cultural values have a large role to play in decision-making. If left implicit, such considerations may be represented poorly in planning. To foster explicit inclusion of intangible values alongside material values connected to ecosystems, we elicited verbal articulation, spatial identification and quantified marine-related values and threats across the seascape of northern Vancouver Island, Canada. We address: (1) how do our spatial interviews—involving maps and semi-structured interviews—enable and/or impede the elicitation of intangible values? (2) What categories of ecosystem benefits do participants identify as most important? (3) Are spatial distributions of monetary values correlated with non-monetary values and threats? Our findings indicate that (1) while maps were provocative, sizable minorities of interviewees refused to assign different numerical non-monetary values to specific locations (30%), or refused to identify locations of non-monetary importance (16%); (2) people allocated the highest non-monetary values to places notable for wildlife, outdoor recreation, then cultural heritage; and (3) significant pair-wise overlap occurred, but also sizable deviations, among monetary, non-monetary and threat distributions. Despite limitations to representing non-monetary values spatially and quantitatively, these methods offer a straightforward approach to catalog and map ecosystem services to inform spatial planning.

Creating physical environmental asset accounts from markets for ecosystem conservation

- Ecological Economics---2012---Gary Stoneham, O'Keefe, Andrew, Mark Eigenraam, David Bain

Recent developments in economics make it possible to design and create markets in sectors of the economy where they have previously been missing or inefficient. Although of interest from an economic efficiency perspective, market-based approaches to environmental management also reveal information and valuations that could have a role in environmental accounting. Using data from a pilot, involving the creation of a

market (auction) for conservation contracts, we demonstrate a methodology to calculate the contribution of purchased ecosystem services to GDP, and create selected physical environmental asset accounts consistent with the System of Integrated Environmental and Economic Accounts. The paper also examines the role this information might play in developing monetary valuations for environmental assets.

The Clean Development Mechanism in the Solid Waste Management Sector: Sustainable for Whom?

- Ecological Economics---2012---Candace A. Martinez, J.D. Bowen

Using a waste-to-energy project located in a landfill on the outskirts of San Salvador as a case in point, we argue that the UN's Clean Development Mechanism falls short of its stated mandate to promote sustainable development. While the mechanism may provide environmental and economic value creation for some stakeholders, it provides value destruction for others, namely for the disenfranchised communities neighboring the project site. We describe three specific challenges that the solid waste management industry represents for the CDM and suggest that a revised plan would incorporate a social inclusion agenda in partial fulfillment of the requirements for CDM approval.

Water futures: Reviewing water-scenario analyses through an original interpretative framework

- Ecological Economics---2012---Hug March, Olivier Therond, Delphine Leenhardt

Water is a vital need for humans and a critical resource for the maintenance of social-ecological systems. Against the backdrop of global environmental and societal changes, water scarcity looms large in many parts of the world. This uncertainty regarding the future notwithstanding, not until recently has scenario analysis, a technique to envision possible and consistent paths of the evolution of a system, importantly permeated research on water issues. Through review of

theoretical and case-study papers, we built an analytical framework to characterize the use of water-scenario analysis and to evaluate the current situation and future possibilities. By means of qualitative and statistical analyses we propose guidelines to consider before initiating a water-scenario analysis. These recommendations pretend to capture better the complexity of nature–society relationships in scenario analysis and concern i) the representation of drivers guiding water use and in an integrated and transparent manner, ii) the use of participatory approaches and iii) the use of modeling. Despite departing from a water perspective, the framework and recommendations may interest those working with environmental scenarios from local to global scales.

Global environmental governance and planetary boundaries: An introduction

- Ecological Economics---2012---Victor Galaz, Frank Biermann, Carl Folke, Måns Nilsson, Per Olsson

The notion of ‘planetary boundaries’ is rapidly diffusing into a range of policy arenas and has clearly stimulated a discussion on the need to reform international environmental governance. This article summarizes the special section “Global Environmental Governance and Planetary Boundaries”. The articles in this section highlight several dimensions for the governance of ‘planetary boundaries’ and offer a rich picture of the Earth system governance challenges ahead. In essence, these involve exploring issues such as institutional interactions, policy integration, network governance and polycentric coordination in settings where biophysical complexity and non-linear shifts are the rule, rather than the exception.

Planetary boundaries and earth system governance: Exploring the links

- Ecological Economics---2012---Frank Biermann

This article discusses the concept of planetary boundaries that has been advanced by a group of leading experts around Johan Rockström. I place the concept of planetary boundaries in the larger framework of

the emerging research paradigm of earth system governance, welcoming it as a crucial contribution that defines the overall goals of governance. Yet I also elaborate on the political conflicts that surround the identification of planetary boundaries, which are, in the end, a social construct. I then explore the policy and governance responses that may follow from the planetary boundary approach. In the conclusion, I point to several research challenges that flow from the current state of knowledge on planetary boundaries.

Reprint of “Can Earth system interactions be governed? Governance functions for linking climate change mitigation with land use, freshwater and biodiversity protection”

- Ecological Economics---2012---Måns Nilsson, Åsa Persson

Earth system interactions, as highlighted by the planetary boundaries framework, occur within and across natural, social and economic systems and shape global environmental change. This paper addresses the multi-level governance problem of coherently addressing key interactions between four Earth sub-systems – climate change, freshwater use, land use and biodiversity – taking into account concerns over problem shifting. After discussing possibilities for regional downscaling of the boundaries, we explore challenges for the EU region to coherently address this particular set of interacting Earth sub-systems and reduce the risk of problem shifting. This analysis demonstrates that Earth system interactions can be governed, but that they likely require comprehensive packages of governance responses across both sub-systems and levels. Three overarching governance functions are tentatively identified that directly or indirectly address Earth system interactions: reduction of system stress, risks and vulnerabilities; triggering and navigation of transformation of economic activity; and development of a diversity of options. Finally, the paper briefly discusses political and institutional challenges for developing, enabling and stabilising these governance functions.

Polycentric systems and interacting planetary boundaries — Emerging governance of climate change—ocean acidification—marine biodiversity

- Ecological Economics---2012---Victor Galaz,Beatrice Crona, Henrik Österblom, Per Olsson, Carl Folke

Planetary boundaries and their interactions pose severe challenges for global environmental governance due to their inherent uncertainties and complex multi-scale dynamics. Here we explore the global governance challenge posed by planetary boundaries interactions by focusing on the role of polycentric systems and order, a theoretical field that has gained much interest in the aftermath of claims of a stagnant UN-process. In the first part we work toward a clarification of polycentric order in an international context, and develop three propositions. We then present a case study of the emergence of international polycentricity to address interacting planetary boundaries, namely the climate change, ocean acidification and loss of marine biodiversity complex. This is done through a study of the Global Partnership on Climate, Fisheries and Aquaculture (PaCFA) initiative. As the case study indicates, a range of mechanisms of polycentric order (ranging from information sharing to coordinated action and conflict resolution) operates at the international level through the interplay between individuals, international organizations and their collaboration patterns. While polycentric coordination of this type certainly holds potential, it is also vulnerable to internal tensions, unreliable external flows of funding, and negative institutional interactions.

Designing institutions for governing planetary boundaries — Lessons from global forest governance

- Ecological Economics---2012---Gunilla Reischl

The risk of interacting planetary boundaries highlights the challenge for contemporary institutional structures. This article shines light on the need to better understand how regime complexes manage overlaps. In developing this understanding, the article explores overlaps

and coordination in the forest regime complex. By examining the work of an informal high level agency, the Collaborative Partnership on Forests, the article investigates how coordination in a dense regime complex could be achieved. In pursuing this analysis, the article draws lessons for how to manage increasingly complex problems that interacting planetary boundaries could give rise to. The article draws on the literatures of institutional interplay and institutional design in order to understand the more subtle forms of institutional decision-making. The article shows that there are many overlaps among international institutions with forest related mandate, and identifies the innovative mechanism as important in managing these linkages, although it does not take part in actual decision-making. In sum, the article's findings suggest that carefully designed mechanisms might be one way to, if not to overcome, at least to facilitate the institutional response of governance challenges in the complex setting of planetary boundaries.

Optimised whole-landscape ecological metrics for effective delivery of connectivity-focused conservation incentive payments

- Ecological Economics---2012---Kristen J. Williams, Andrew Reeson, Michael J. Drielsma, Jamie Love

Market-based instruments provide incentives for conservation on private lands, combining the economic efficiency of an auction with ecological site prioritization to select the best sites from those offered by landholders. However, landscape-scale goals such as increased habitat connectivity are difficult to deliver with site-based prioritization metrics. Assessing alternative ways to re-connect landscapes is a complex task, requiring knowledge of how biodiversity will respond over time to alternative conservation actions, such as replanting, managing areas of natural regrowth or protecting existing habitat. It also presents computational challenges since projects must be assessed as combinations rather than individually. We investigated practical aspects of ecological metric design to achieve desired spatial configurations. Realistic,

mock bids were submitted by members of the local community in a simulated tender exercise for enhanced cassowary habitat near Mission Beach, Australia. Optimization heuristics helped solve the problem within a reasonable time. Our results demonstrate that integrating whole-landscape assessment models with market-based instruments can feasibly address the inherent complexity when pursuing whole-landscape ecological benefits through cost-efficient and innovative means. Our methodology redresses asymmetries in knowledge about biodiversity in delivering conservation incentive payments, and is justified when policy goals demand a high level of rigor.

Testing benefit transfer of reef protection values between local case studies: The Great Barrier Reef in Australia

- Ecological Economics---2012---John Rolfe, Jill Winkler

Protection values for three different Great Barrier Reef (GBR) sites were elicited to test if the values could be easily transferred to other sites in the region. The sites were chosen to reflect substantial heterogeneity in extent, ecological composition and condition. Values were assessed both for local populations and for a distant population; residents of the state capital city of Brisbane. The results are encouraging for the use of benefit transfer, as values were robust to various site and population differences. No significant difference in protection values between the three local case studies could be identified. There was also no significant difference in values between the local population and the Brisbane population. However, some evidence for distance effects was identified for the Brisbane population, with closer sites valued more highly. There was some limited evidence that respondents have higher values to avoid potential losses compared to potential gains for REEF and SEAGRASS attributes, although this did not hold for the FISH attribute. One implication is that protection values are likely to be higher for closer reef areas at risk of loss than those with opportunity for improvement.

Biocomplexity—conceptual challenges for institutional analysis in biodiversity governance

- Ecological Economics---2012---Martina Padmanabhan, Stefan Jungcurt

Institutions for biodiversity governance are located at the interface of human and ecological systems. The analysis of such institutions is challenged due to addressing a multitude of complex interactions between these two systems occurring at different natural scales and levels of human organization. Due to this complexity, empirical analysis of biodiversity management often leads to context-specific explanations, providing little scope for comparative work or the development of more generalised, theory-based accounts. We aim at reducing complexity in understanding human–biodiversity relations, making cases comparable across sites, and propose that, in order to address complexity, we need a method of abstraction that leads to the development of a more structured analysis, based on selection of explanatory factors according to conceptual models as well as empirical significance. We suggest that the stylisation of typical “resource use-perspectives” – the combination of typical transactions that are inextricably linked by the interest of the actor – can be a useful method for realizing appropriate model selection. In this paper, we provide an account of how use-perspectives can be developed and to what kind of analysis they can contribute, using the example of agrobiodiversity in grain as seed, food, or genetic material.

Environmental externalities and immiserizing structural changes in an economy with heterogeneous agents

- Ecological Economics---2012---Angelo Antoci, Paolo Russu, Elisa Ticci

The way in which natural and physical capital are accumulated, distributed and harnessed underpins the functioning and sustainability of the productive system of each society as well as its social stratification. Significant changes in the interactions between natural and physical capital accumulation give rise to processes

of structural change (SC) which affect not only sectoral composition of the productive system, but also social equity and environmental quality. We propose a taxonomy of different SCs on the basis of distributive, environmental and economic outcomes and we study a two-sector model with environmental externalities to identify under which conditions each SC can occur. Our model shows how the type of SC is shaped by the link between agents' heterogeneity in terms of productive asset endowment and their vulnerability to environmental degradation. In particular, we find that a SC associated with reduction in poverty and in environmental pressures can occur only if productivity of the physical capital-intensive sector increases but its rate of environmental impact remains relatively lower than that of the natural-capital intensive sector.

Dynamic analysis of aluminum stocks and flows in the United States: 1900–2009

- Ecological Economics---2012---Wei-Qiang Chen,T.E. Graedel

A dynamic analysis of anthropogenic aluminum stocks and flows in the U.S. from 1900 to 2009 has been conducted. Key findings include (1) historical cumulative aluminum input into the U.S. anthroposphere amounts to 438 Tg, with only about 35% of it accumulating in domestic in-use stock; (2) less than 5% of most flows take place before 1950, while more than 50% of them happen after 1990; (3) flows into fabrication, manufacturing, and use processes, as well as trade flows, are vulnerable to energy crises; basically, after an energy crisis, the U.S. tends to produce less primary aluminum, less semis, as well as less final products, and therefore import less bauxite and alumina but import more unwrought aluminum and final products; (4) the U.S. has been a net importer of aluminum from the life cycle perspective, with its total annual net import increasing from 1945 to 2005; (5) as a result of the continuous increase of net import, total domestic stock of aluminum in the U.S. dramatically increases in the period of 1945–2009 and amounts to 316 Tg in 2009, about nine times of that in 1900; (6) in-use stock comprises about 48% of total domestic stock in 2009 and is

dominated by two sectors, Buildings and Construction (32%) and Transportation (35%); (7) total per-capita stock in use of aluminum keeps increasing until 2009 and currently amounts to 490kg; (8) per-capita stock of aluminum in Transportation sector increases substantially after 1990s because of the light-weighting of automobiles, while that in the Buildings and Construction and Electrical Engineering sectors seems have reached a saturation level after 2005.

Beyond “benefits” ? Looking at ecosystem services through the capability approach

- Ecological Economics---2012---Yuliana Polishchuk,Felix Rauschmayer

Current conceptual debates on the impacts of ecosystem services (ESS) on human well-being often boil down to discussing the application and limitations of monetisation approaches. Meanwhile we argue that ESS can be understood in a richer and more nuanced way if we revisit the human well-being dimension of the ESS concept, going beyond the widely cited notion of “benefits” as put forward by the Millennium Ecosystem Assessment (MA, 2005) and transcending the currently prevalent utilitarian framing. Hence, we examine ESS through the lens of the capability approach, which offers a multidimensional framework for human well-being as an alternative to mainstream utilitarian and opulence perspectives. Within this framework, ESS can be effectively viewed as contributing – in a diversity of ways – to people’s capabilities, i.e., their freedoms to lead lives they have reason to value. Such a view opens up a richer debate on the human dimension of ESS and points to new potential areas and ways of application of the ESS concept.

Can altruism stabilise international climate agreements?

- Ecological Economics---2012---Thomas van der Pol,Hans-Peter Weikard,Ekko van Ierland

We study the impact of altruism on the stability of international climate agreements. We consider the standard two-stage game for the analysis of international

environmental agreements where countries announce their participation at the first stage and abatement levels are chosen at the second stage. We modify the game to consider altruism in the participation decision, i.e. countries consider, to a certain extent, the net benefits for other countries in their decisions. We study two types of altruism: impartial altruism, where countries show a concern for all other countries, and community altruism, where the concern extends only to coalition partners. We use the stability of coalitions model (STACO) to illustrate the impacts of both types of altruism on the stability of a climate agreement. We find that a limited degree of altruism is sufficient to stabilise the Grand Coalition such that a globally efficient climate policy can emerge while in the absence of altruism only a fraction of countries would join a climate agreement and the benefits of cooperation would largely remain unexploited. Our results indicate how moving beyond national interests can support the success of international climate agreements.

Conservation of forest biodiversity using temporal conservation contracts

- Ecological Economics---2012---Artti Juutinen,Pasi Reunanen,Mikko Mönkkönen,Olli-Pekka Tikkanen,Jari Kouki

Temporal conservation contracts are used to protect biodiversity in privately owned lands worldwide. We examine how stand characteristics and habitat requirements of target species affect the contract length in a boreal forest context. We develop an integrated optimization model and apply the model with data on endangered species occurring in spruce forests in Finland. The results suggest that a cost-effective conservation policy for protecting privately owned forest land involves both short- and long-term contracts between landowners and environmental agencies. The higher the conservation objective, the more intensively long-term contracts should be assigned. Managed stands should be assigned short-term contracts. Regarding unmanaged stands both short- and long-term contracts should be used. However, species habitat requirements affect the results and thus the conservation policy.

Environmental Regulation and Competitiveness: Evidence from Romania

- Ecological Economics---2012---Mohamed Aroui,Guglielmo Maria Caporale,Christophe Rault,Robert Sova,Anamaria Sova

Stricter environmental regulations may increase costs and thereby may lead to a loss of competitiveness which implies a decline in exports, increase in imports and in the long term a shift of pollution intensive industries from countries with stringent regulations towards those with less strict ones. This paper estimates a gravity model to establish whether the implementation of more stringent regulations in Romania in accordance with the environmental aquis has indeed affected its competitiveness and decreased exports towards its European trading partners. Our findings do not provide empirical support to this hypothesis, i.e. environmental stringency is not found to affect significantly either trade or its components.

The tragedy of the commons in a fishery when relative performance matters

- Ecological Economics---2012---Ngo Long,Stephanie McWhinnie

This paper presents a simple model of a common access fishery where fishermen care about relative performance as well as absolute profits. Our model captures the idea that status (which depends on relative performance) in a community influences a person's well-being. In our main specification, relative performance depends on the absolute difference in after-tax profits. We show that overharvesting resulting from the tragedy of the commons problem is exacerbated by the desire for higher relative performance, leading to a smaller steady-state fish stock and smaller steady-state profit for all the fishermen. We also consider alternative specifications where status depends on the absolute difference in harvests or relative difference in profits, or where there is heterogeneity in the degree to which status matters, or allowing for the possibility of extinction. In all these specifications, status further reduces the steady-state fish stock. We examine

taxes and an individual quota as policy alternatives and find support for using the direct quantity method to implement the socially efficient stock level.

Energy consumption in service industries: Challenging the myth of non-materiality

- Ecological Economics---2012---Charlotte Fourcroy,Faïz Gallouj,Fabrice Decellas

This paper addresses the issue of energy consumption in service industries. Official energy statistics show that the amount of energy consumed in service industries is quite small, and this is explained in the theoretical literature by the presumed intangibility of services. Our hypothesis, however, is that the energy consumed by services has been underestimated. After identifying and analyzing the full range of sources of energy consumption in service industries, we show that official energy statistics account for only a part of this consumption. Our work is based on a thorough rereading of the economics literature on services (especially concerning the definition of services and the specificities of the service provision process), done in light of our knowledge about energy consumption. Eventually, using the 2007 French national transportation and travel survey, we estimate one of the overlooked sources of energy consumption, the one pertaining to mobility.

A resilience-based policy evaluation framework: Application to European rural development policies

- Ecological Economics---2012---Marleen A.H. Schouten,C. Martijn van der Heide,Wim J.M. Heijman,Paul F.M. Opdam

Given the major changes that rural areas have undergone, and are continuing to undergo, serious problems of achieving sustainable development are being experienced. These changes have multiple characters, varying from changes in ecosystem conditions to changes in socio-economic impacts, due to, for example, food- and financial crises. Nowadays, there is an increasing awareness of the need to develop rural policies that support adaptive strategies of stakeholders in response

to a disturbance. We propose that resilience thinking offers a framework that could be helpful in the governance of rural changes. This framework is based on the complexity of the social-ecological system and takes into account the unpredictable future, as it emphasizes adaptive approaches to management. As such, it helps evaluate to what extent rural development policies contribute to the resilience of rural areas. Nine criteria were developed including thirteen specifications. In order to evaluate the usability and usefulness of the proposed framework, a case study has been performed that specifically investigated the degree of resilience of a European rural development policy (i.e. the spending of extra funds generated through compulsory modulation under the 2009 Health Check in the Netherlands).

Transdisciplinarity: Between mainstreaming and marginalization

- Ecological Economics---2012---Thomas Jahn,Matthias Bergmann,Florian Keil

Transdisciplinarity has a long history of academic discourse. Promoted as an adequate scientific response to pressing societal problems like climate change, it has recently received common currency in science policy rhetoric. Nevertheless, despite its increasing popularity, transdisciplinarity is still far from academically established and current funding practices do not effectively support it at universities and research institutions. One reason for this deficit is that a universally accepted definition for transdisciplinarity is still not available. Consequently, quality standards that equally guide researchers, program managers and donors are widely lacking. Therefore, a rhetorical mainstreaming of transdisciplinarity prevails which risks marginalizing those who take seriously the integrative efforts creative collaboration requires. The aim of this paper is thus to find common ground in the transdisciplinarity discourse. Based on an analysis of current scientific literature, we first identify main features of an emerging shared framework of transdisciplinarity. Second, building upon this framework, we present a conceptual model of transdisciplinarity that can be used by science and science policy to characterize different types

of transdisciplinarity and their corresponding demands on integration. We also address the way in which ecological economics could benefit from adopting this model. To conclude, we propose a general definition of transdisciplinarity.

The economic influence of community-based dolphin watching on a local economy in a developing country: Implications for conservation

- Ecological Economics---2012---Putu Liza Kusuma Mustika,Alastair Birtles,Riccardo Welters,Helene Marsh

This study examined the direct economic impacts of dolphin watching tourism in Lovina, north Bali (Indonesia). The study applied the direct expenditure approach to tourists who went on dolphin tours in Lovina in 2008 and 2009. This industry depends on predictable access to coastal dolphins, attracts at least 37,000 overnight visitors per annum (~60% of the region's overnight tourists) and contributes at least 46% of the total direct expenditures (USD 4.1 million p.a.) for accommodation, meals, transportation, communication and souvenirs. The 179 boatmen enjoy an above average income and thus have little financial incentive to leave the industry. Nonetheless, trip fees constitute only 3% of the total expenditures generated by dolphin watching tourism. The remainder e.g., for accommodation, restaurants and transport is spent with local businesses which become the substantial beneficiaries and hence these stakeholders should also be consulted prior to any management intervention. This profitable industry supports 35–100 tour boats operating daily. The number of boats should be regulated to address concerns over their impacts on the dolphins and visitor satisfaction.

Directional heterogeneity in WTP models for environmental valuation

- Ecological Economics---2012---Marije Schaafsma,Roy Brouwer,John Rose

Many studies in the stated preference literature on

environmental valuation do not include the effects of substitutes and distance in willingness-to-pay (WTP) models, in spite of the relevance of these effects in aggregation and benefit transfer. Heterogeneity in the availability of substitutes over space may cause multi-directional distance effects in WTP. As a result, disregarding this spatial heterogeneity may lead to biased estimators of the distance effect and associated WTP values (Cameron, 2006). In this paper, we demonstrate that distance decay is subject to significant directional effects which tend to be related to differences in the availability of substitutes across the study area. We apply a straightforward methodology to account for such spatial heterogeneity in choice experiments and assess the effect on WTP for improvements in ecosystem services in a lake district. We model distance-decay effects, whilst controlling for heterogeneity between users and non-users and non-use related WTP reasons. The directional effects result in significantly different WTP estimates, different market sizes reflecting the population with positive WTP, and differences in total WTP up to 32%.

The physical dimension of international trade, part 2: Indirect global resource flows between 1962 and 2005

- Ecological Economics---2012---Monika Ditttrich,Stefan Bringezu,Helmut Schütz

Global trade is increasingly being challenged by observations of growing burden shifting, in particular of environmental problems. This paper presents the first worldwide calculations of shifted burden based on material flow indicators, in particular direct and indirect physical trade balances. This study covers the period between 1962 and 2005 and includes between 82 and 173 countries per year. The results show that indirect trade flow volumes have increased to around 41 billion tonnes in 2005. The traded resources with the highest share of associated indirect flows are iron, hard coal, copper, tin and increasingly palm oil. Regarding the burden balance between regions, Europe is the biggest shifter whereas Australia and Latin America are the largest takers of environmental burden due to resource

extraction. To evaluate the findings from a global perspective, the results are analysed in terms of resource flow induced environmental pressure related to a country's land area in terms of total and per capita area. Resource endowment and population density seem to be more relevant in determining the physical trade balance, including indirect flows, than income level.

REDD and forest transition: Tunneling through the environmental Kuznets curve

- Ecological Economics---2012---Richard Culas

International attention is focused on finding ways to reduce emissions from deforestation because of the emerging concerns over climate change. However the causes of deforestation are rooted in current economic and development paradigms. The causes of deforestation also vary across different geographical regions and have implications for the forest transition. Attempts to reach an international agreement on curbing deforestation have achieved little success despite over 30years of UN negotiations. New initiatives from REDD (Reducing Emissions from Deforestation and forest Degradation) could provide financial incentives to curb deforestation. Hence, alternative development paths for forest cover changes and forest transition are analyzed for the REDD policy within the framework of an environmental Kuznets curve (EKC) for deforestation. The EKC models are estimated for geographical regions of Latin America, Africa and Asia. The results based on the panel data analysis of 43 countries, covering the period 1970–1994, provides evidence that an inverted U-shaped EKC fits for Latin America and Africa, while a U-shaped EKC applies to Asia. The results also indicate that strengthening agricultural and forestry sector policies are important for curbing deforestation. The EKC models' estimates could provide guidance for decisions on financing the REDD policy as specific to each region.

Coordination problems and resource collapse in the commons — Exploring the role of knowledge heterogeneity

- Ecological Economics---2012---Therese Lindahl

The role of environmental uncertainty has not been ignored in the common resource literature, but underlying most of this research is an explicit or implicit assumption of symmetric uncertainty. In this paper I relax the assumption of symmetric uncertainty and analyze how knowledge heterogeneity influences coordination problems that can arise in common resource settings. This paper demonstrates that knowledge heterogeneity can work as a coordination device; the more users differ with respect to knowledge, the smaller is the coordination problem as well as the probability of resource breakdown. Less informed users can take advantage of their ignorance at the expense of more informed users. Furthermore, regulation can reduce the coordination problem further, but only by reinforcing the benefit from ignorance. Thus when analyzing and suggesting policies for reducing the inefficiencies associated with common resources where rivalry prevails, one should not only be concerned about the level of environmental uncertainty, but also the distribution, as it matters too.

Poverty, sustainability, and household livelihood strategies in Zagros, Iran

- Ecological Economics---2012---Arezoo Soltani, Arild Angelsen, Tron Eid, Mohammad Saeid Noori Naieni, Taghi Shamekhi

The study addresses the two intertwined challenges of rural poverty and forest degradation in rural areas of Zagros, Iran. For a watershed in Zagros, a quantitative analysis based on the sustainable livelihood framework approach is used to identify household livelihood strategies, analyze livelihood choices, and investigate which strategies are most sustainable. The study revealed that most households (64%) follow a mixed strategy with a combination of forestry, animal husbandry, and subsistence agriculture. Households following a livelihood strategy that is highly dependent on forest extraction and livestock grazing (27%) are the poorest, whereas those that combine cultivation of commercial crops with non-farm work (9%) are able to earn higher incomes. The results also give some evidence of an Environmental Kuznets Curve: households

that both adopt a mixed strategy and fall into the middle-income category are responsible for the highest overuse of forest resources and pasture. Since the end of 1980s, a number of households have shifted from a strategy based on forest and livestock to a strategy of mixed practices. An increasing share of households is adopting a strategy of non-farm and/or commercial practices, as well as outmigration to urban areas.

Uncertainty in ecosystem services valuation and implications for assessing land use tradeoffs: An agricultural case study in the Minnesota River Basin

- Ecological Economics---2012---Kris A. Johnson, Stephen Polasky, Erik Nelson, Derric Pennington

Ecosystem services analysis can help recognize the full costs and benefits of land management decisions. Quantification and valuation of services can enhance policies and regulations and, if linked with payments or incentives, properly reward private decisions that yield public benefits. However, the field of ecosystem services research is relatively new and quantification and valuation remains highly uncertain. While there is significant uncertainty about the biophysical production of ecosystem services, there is additional uncertainty about the value of services. This paper explores how uncertainty associated with valuation of ecosystem services in agriculture affects the ranking of land use alternatives in terms of social net benefits. We compare the values of four land use scenarios in the Minnesota River Basin, USA, by combining a range of value estimates for these services with varying estimates for returns from agricultural production. Although variations in ecosystem service values are significant, fluctuations in agricultural returns more significantly determine how scenarios rank with regard to delivery of total value. This analysis suggests that addressing uncertainty in ecosystem service valuation is critical to accurately assessing tradeoffs in land use.

Fishing down the food chain revisited: Modeling exploited trophic systems

- Ecological Economics---2012---Christopher D. Wilen, James Wilen

Several highly cited papers suggest that commercial fishing is altering marine ecosystems by “fishing down the food chain”. Recent evidence calls into question the generality of the original findings, but the papers all raise the question: what mechanisms lie behind exploitation patterns in a trophic system? This paper develops a simple model that shows how economic factors drive patterns of exploitation in a trophic system. We show that while fishing down the food chain is possible, there is no reason to suppose that the relevant economic factors favor such an outcome. As we show, other patterns are just as plausible. We also discuss and show how an index of trophic level-weighted harvest is not necessarily a good indicator of ecosystem health if biomass abundance is important.

Balancing hunting regulations and hunter satisfaction: An integrated biosocioeconomic model to aid in sustainable management

- Ecological Economics---2012---Hilde Karine Wam, Hans Chr. Pedersen, Olav Hjeljord

Hunting of game animals needs to be regulated, either through the number of permits or the bag size allowed per hunter. Such regulations may, however, jeopardize hunter satisfaction, on which game managers depend. Consequently, finding the optimal hunting intensity is not straightforward. Using data from Norwegian grouse hunting, we show that an integrated approach combining sociology and bioeconomics can give markedly different priorities than an optimization based exclusively on bioeconomics. Three grouse hunter typologies with contrasting stated preferences regarding bag size and crowding were used to account for varying hunter behavior. Omitting the social constructs from the model pushed the hunter density towards its upper limit, because the gain of selling one more permit generally superseded the loss in hunter satisfaction (expressed as willingness-to-pay). Although this strategy multiplied

the overall profit, it produced a daily bag size that would be unacceptable to practically all hunters. We conclude that biosocioeconomic modeling is a valuable tool in the pursuit of sustainable game management.

Service providing units, existence values and the valuation of endangered species: A methodological test

- Ecological Economics---2012---A. Kontogianni,C. Tourkolias,A. Machleras,M. Skourtos

Non-market valuation approaches for estimating the social value of biodiversity and individual species need to enhance their policy relevance. The concept of service-providing unit (SPU) may help achieve this objective by promoting the systematic quantification of the key components of nature that provide services for human wellbeing. The present paper is the first application of the SPU concept in stated preference surveys. The object of valuation is the highly endangered Mediterranean monk seal (*Monachus monachus*). A split-sample is used testing the hypotheses that the SPU framework would: 1) minimize the part of non-use values that is due to a ‘warm glow’ effect and therefore 2) encourage respondents in reallocating part of their total economic value towards use values. Our results indicate that the difference between the means of existence values in the two sub-samples is statistically insignificant: in both cases respondents attribute a significant percentage of their total economic value to existence value. On the other hand though, the non-use value component of WTP decreases in the sub-sample with SPU in relation to the sub-sample without it. We conclude that existence values in our sample are based on solid preferences related to the species since they persisted in both sub-samples.

Mitigating economic risk from climate variability in rain-fed agriculture through enterprise mix diversification

- Ecological Economics---2012---John Kandulu,Brett A. Bryan,Darran King,Jeffery D. Connor

Climate variability, and its increase with climate change, pose substantial economic risks to agriculturalists and hence, limit their ability to respond to global challenges such as food security. Enterprise mix diversification is the most common, and is widely regarded as the most effective, strategy for mitigating multiple sources of short-term economic risk to agricultural enterprises. However, assessments of enterprise mix diversification as a strategy for mitigating climate risks to ensure long term viability of agricultural enterprises are sparse. Using the Lower Murray region in southern Australia as a case study, we combined APSIM modelling with Monte Carlo simulation, probability theory, and finance techniques, to assess the extent to which enterprise mix diversification can mitigate climate-induced variability in long term net returns from rain-fed agriculture. We found that diversification can reduce the standard deviation by up to A\$200ha⁻¹, or 52% of mean net returns; increase the probability of breaking even by up to 20%, and increase the mean of 10% of worst probable annual net returns (Conditional Value at Risk) by up to A\$100ha⁻¹. We conclude that enterprise mix diversification can also be an effective strategy for hedging against climate-induced economic risk for agriculturalists in marginal areas.

Biofuel from *Jatropha curcas*: Environmental sustainability and option value

- Ecological Economics---2012---Marcello Basili,Fulvio Fontini

This paper considers the use of a non-edible plant, *Jatropha curcas* (J. curcas), for the production of biofuel as a substitute for traditional fossil fuel. It is shown that the net energy balance and greenhouse gases (GHGs) balance are positive. The investment value in biofuel from J. curcas is also studied, and both its intrinsic and option values are calculated. A reference case is evaluated, namely, the cultivation of J. curcas as a substitute for conventional fuel in a specific less-developed country, Kenya, that lies in the tropical region where J. curcas grows. The investment is modeled as a perpetual investment call option. It is

shown that the Net Present Value is positive for a vast range of discount factors and investment costs, while the option value depends crucially on the parameters of the model. A positive option value points out those cases in which it is optimal to defer the investment even if it entails a positive and possibly high Net Present Value.

Stated preferences for tropical wildlife conservation amongst distant beneficiaries: Charisma, endemism, scope and substitution effects

- Ecological Economics---2012---Sian Morse-Jones,Ian Bateman,Andreas Kontoleon,Silvia Ferrini,Neil D. Burgess,R. Kerry Turner

Despite heightened awareness of the need to find additional resources for tropical biodiversity conservation, and recognition that the benefits to populations in developed countries may be significant, very few empirical studies have been conducted to estimate these values. In this article, we report the results of a choice experiment survey that investigated the preferences of UK residents for the conservation of threatened wildlife in the Eastern Arc Mountains in Tanzania, part of the Eastern Afromontane “biodiversity hotspot”. We examine the sensitivity of values to species types, the number of species, the number of conservation sites and, more unusually, to potential substitutes/complements. Critically we find some evidence of coherency in preferences. Respondents are willing to pay significant, positive amounts to conserve charismatic and/or endemic species and are scope sensitive to the number of endemic species. In contrast, species which are neither endemic nor charismatic, and the number of conservation sites, do not contribute significantly to utility. Further, changing the overall scope of the ‘good’ is found to have a significant and differential impact on respondent’s choices depending on the species type: as the availability of wildlife increases, we observe substitution effects for non-endemic charismatic species, and complementarity for endemic (non-charismatic) species.

A multi-actor multi-criteria scenario analysis of regional sustainable resource policy

- Ecological Economics---2012---Aliye Ahu Akgün,Eveline van Leeuwen,Peter Nijkamp

The increasing scarcity of natural resources prompts the need to develop effective strategies for sustainable development at regional levels with a view to balancing the interests of different groups of actors or stakeholders. This study aims to address the stakeholders’ multifaceted viewpoints on future sustainable development, mainly at regional scales. To this end, five experimental test cases – in the form of five different case studies in Europe – are analyzed, to encapsulate different approaches and different needs for sustainable development. A ‘pentagon model’ is used to represent systematically five critical aspects of sustainability. To analyze the trade-offs and synergies between different objectives on sustainable development, four distinct scenarios – competitiveness; continuity; capacity; and coherence – reflecting distinct and relevant images of sustainability are presented. The relative merits of these four scenarios are empirically assessed by means of a particular type of multi-criteria analysis: namely, regime analysis. The analysis is carried out by ranking different attributes of sustainable development, i.e. social, economic, ecological, institutional profile, and physical, from the perspective of different stakeholders. We find that the most preferred sustainable future is the coherence scenario, in which a combination of ecological and social aspects is the most important determinants.

Implementation of the EU Nitrates Directive in the Republic of Ireland — A view from the farm

- Ecological Economics---2012---Cathal Buckley

This paper employs Q methodology to investigate farmer opinions on the operation of the EU Nitrates Directive regulations after the first 4years of National Action Programme phase and explores the level of acceptance and refutation of measures from the view of farmers’ own knowledge and experience of land stewardship. Results indicate 4 main opinion groups. A

“Constrained Productionists” group remains unconvinced about the appropriateness of certain measures from a farm management, environmental and water quality perspective. A second group, “Concerned Practitioners”, shares some of these concerns but are generally more positive regarding other farm management and environmental benefits accruing from the regulations. A third group, “Benefit Accepters”, indicates quite an environmentalist position and is generally very positive towards regulation implementation and associated environmental and farm management benefits. The final group, “Regulation Unaffected”, has some concerns but are mostly unaffected by the regulations. Results suggest that there is a growing acceptance among some farmers of environmental benefits accruing from the regulation but scepticism remains around the validity of certain measures, especially, in the area of temporal farm practices.

Combining income and assets measures to include the transitory nature of poverty in assessments of forest dependence: Evidence from the Democratic Republic of Congo

- Ecological Economics---2012---Martin Reinhardt Nielsen,Mariève Pouliot,Riyong Kim Bakkegaard

A considerable amount of research on poverty–environment relations in developing countries under the CIFOR-PEN initiative focuses on household income generation from forests, using total annual income as a measure of poverty. However, income alone produces a static picture in a snapshot of time while poverty is a dynamic state that can be a transitory phenomenon. Using income only also fails to consider that households can liquidate asset to overcome income shocks. Here we show that using asset quintiles, measured by value of assets, produce a distinctly different pattern than the commonly observed negative relation between income and forest dependence. We then present an approach, enabling categorization of households as chronic or transient poor, transient rich and rich providing a more nuanced picture than that provided by CIFOR-PEN studies so far. The validity of groupings is tested by comparing

household characteristics and exposure to shocks. We then show that the chronic poor are most reliant on forest income, while the transient poor consume a higher share of harvested forest products. The transient rich have higher agricultural productivity and absolute forest income. Rich households relies more on business. Based on the results we suggest recommendations for improving future studies on poverty–environment relations.

Provision of environmental output within a multi-output distance function approach

- Ecological Economics---2012---Francisco Areal,Richard Tiffin,Kelvin Balcombe

This paper redefines technical efficiency by incorporating provision of environmental goods as one of the outputs of the farm. The proportion of permanent and rough grassland to total agricultural land area is used as a proxy for the provision of environmental goods. Stochastic frontier analysis was conducted using a Bayesian procedure. The methodology is applied to panel data on 215 dairy farms in England and Wales. Results show that farm efficiency rankings change when provision of environmental outputs by farms is incorporated in the efficiency analysis, which may have important political implications.

Organic farmers or conventional farmers: Where's the money?

- Ecological Economics---2012---Hiroki Uematsu,Ashok Mishra

There is growing evidence that organic farming is a rapidly expanding economic sector in the U.S. However, an unanswered question is whether organic farmers are better off than conventional farmers when it comes to farm household income. Using large farm-level data and a matching estimator, this study explores the relationship between organic certification and farm household income with its various components. Contrary to expectations, certified organic farmers do not earn significantly higher household income than conventional farmers. Though certified organic crop producers earn

higher revenue, they incur higher production expenses as well. In particular, certified organic producers spend significantly more on labor, insurance, and marketing charges than conventional farmers. The results suggest that the lack of economic incentives can be an important barrier to conversion to organic farming.

Impact of payments for carbon sequestered in wood products and avoided carbon emissions on the profitability of NIPF landowners in the US South

- Ecological Economics---2012---Puneet Dwivedi, Robert Bailis, Andrew Stainback, Douglas R. Carter

This study determines economic impact of payments for carbon sequestered in wood products and avoided carbon emissions due to use of forest biomass for electricity generation instead of fossil fuels on the profitability of non-industrial private forest (NIPF) landowners in the US South. Penalties for carbon emitted at the time of undertaking various silvicultural activities and exponential decay of wood products were also considered. We used life-cycle assessment to evaluate carbon emissions from various silvicultural activities. We modified the traditional Faustmann forest rotation model to incorporate identified carbon payments and penalties. Slash pine (*Pinus elliottii*) was selected as a representative species. We found that the overall global warming impact (GWI) for managing a hectare of intensively managed slash pine plantation was 6539kg carbon dioxide equivalent. The maximum land expectation value (LEV) for the scenario when all carbon payments and penalties along with payments for timber products were considered was \$1299/ha using a 20year rotation age. This value is about 71% higher than the LEV when only payments for timber products were taken into account (\$760/ha using a 21year rotation age). Our results clearly indicate that emerging carbon markets could greatly benefit southern NIPF landowners.

A spatial model of coastal ecosystem services

- Ecological Economics---2012---Edward Barbier

Evidence suggests that the ecological functions underlying many ecosystem goods and services are spatially variable. For coastal systems, a simple model is developed incorporating a spatial production function that declines across an ecological landscape. The basic model demonstrates how spatial production of ecosystem services affects the location and extent of landscape conversion. An extension allows for the risk of ecological collapse, when the critical size of the remaining landscape that precipitates the collapse is not known. Both models are simulated using the example of spatial variation in ecosystem services across a mangrove habitat that might be converted to shrimp aquaculture.

Enhancing the reliability of benefit transfer over heterogeneous sites: A meta-analysis of international coral reef values

- Ecological Economics---2012---Luz M. Londoño, Robert Johnston

We estimate a meta-analysis of willingness to pay for tropical coral reef recreation and evaluate its potential for international benefit transfer. The goal is improved value surface estimation and benefit transfer reliability. We compare model results to those of Brander, L., P. van Beukering and H. Cesar. 2007. The recreational value of coral reefs: A meta-analysis. *Ecological Economics*, 63(1), to our knowledge the only prior published meta-analysis of coral reef values. We seek to improve upon this prior model through (1) stricter attendance to methodological guidance in the meta-analysis literature, (2) greater attention to meta-data uniformity, and (3) supplementation of primary study metadata with additional information obtained through secondary sources, such as information on reef characteristics from international coral reef databases. The estimated models provide value surface insights unavailable elsewhere and improve benefit transfer reliability. Results also highlight challenges in benefit transfer across heterogeneous sites and provide insight into the relevance of welfare consistency for meta-analysis. While the analysis suggests that substantial improvements in transfer reliability may be achieved through closer adherence to guidance from the meta-analysis

literature, resulting transfers may still be subject to considerable errors.

Modeling the effect of social factors on improving biodiversity protection

- Ecological Economics---2012---George Halkos,Nikoleta Jones

The aim of this study is to investigate the effect of social factors (expressed as social and institutional trust social norms, and social networks) on the decision of individuals to pay for improvement of environmental protection of biodiversity. For this purpose an empirical study was carried out in two National Parks of Northern Greece. Three scenarios were proposed differing in the management options (regulatory, market-based and community-based scenarios) and the payment mechanism. Our empirical results show that social capital variables, especially social norms and social trust, have a strong influence both on the decision of individuals to pay and the specific amount stated. Specifically, we find that social norms have a positive influence for the willingness to pay (WTP) of individuals of a state-tax and an entrance fee (regulatory and market-based scenario respectively). Furthermore, social trust has a positive impact for the WTP through an entrance fee and a community tax (market-based and community-based scenario respectively). We also find a higher WTP of individuals towards the market based scenario where participation of citizens is higher compared to the current management status. Concerning the impact of demographic factors, we find that income does not influence the specific amount stated by individuals.

Environmental corporate social responsibility and financial performance: Disentangling direct and indirect effects

- Ecological Economics---2012---Abraham Lioui,Zenu Sharma

This paper assesses the impact of environmental corporate social responsibility (ECSR) on Corporate Financial Performance (CFP) measured by ROA and Tobin's

Q. We show that the relationship between firms' return on assets (ROA) and ECSR, strengths and concerns, is negative and statistically significant. We also show that firms' Tobin Q and ECSR, strengths and concerns, are negatively correlated in a statistically significant way. However, accounting for the interaction between firms' environmental efforts and R&D yields a different perspective: while the direct impact of ECSR on CFP is still negative, the interaction of ECSR and R&D has a positive and significant impact on it. ECSR strengths and concerns harm CFP since they are perceived as a potential cost. However, this CSR activity fosters R & D efforts of firms which generates additional value (indirect effect).

Determinants of eco-innovations by type of environmental impact — The role of regulatory push/pull, technology push and market pull

- Ecological Economics---2012---Jens Horbach,Christian Rammer,Klaus Rennings

Empirical analyses of eco-innovation determinants have rarely been able to distinguish between different areas of environmental impact. The present paper tries to close this gap by employing a new and unique dataset based on the German Community Innovation Survey, conducted in 2009. The main purpose of this paper is to test whether different types of eco-innovation (according to their environmental impacts) are driven by different factors. Beside a complex set of different supply, firm-specific, and demand factors, the literature on determinants of eco-innovation accentuates the important role of regulation, cost savings and customer benefits. We find that current and expected government regulation is particularly important with regard to pushing firms to reduce air (e.g. CO₂, SO₂ or NO_x) as well as water or noise emissions, avoid hazardous substances, and increase recyclability of products. Cost savings are an important motivation for reducing energy and material use, pointing to the role of energy and raw material prices as well as taxation as drivers for eco-innovation. Customer requirements are another important source of eco-innovations, particularly with regard to products with improved environmental

performance and process innovations that increase material efficiency, and reduce energy consumption, waste and the use of dangerous substances. Firms confirm a high importance of expected future regulations for all environmental product innovations.

Comparing willingness-to-pay between residents and non-residents when correcting hypothetical bias: Case of endangered spotted seal in South Korea

- Ecological Economics---2012---Ju-Yeon Kim,James W. Mjelde,Tae-Kyun Kim,Choong-Ki Lee,Kyung-Mo Ahn

Two threads within the contingent valuation literature are potential biases created by the hypothetical nature of the method and defining the population to sample. To our knowledge, this is the first study to combine these threads, namely examining how attempting to control for hypothetical bias interacts with how the population is defined. Results indicate controlling for hypothetical bias makes the two samples, residents of Baengnyeong Island (where the spotted seal is located) and the general South Korea population, more similar than if bias is not corrected. Without correcting for bias, for example, residents' willingness-to-pay for preservation of the seal is 33% higher than the general population; however, after controlling for hypothetical bias this percent decreases to 21%.

Bycatch risk pools for the US West Coast Groundfish Fishery

- Ecological Economics---2012---Daniel S. Holland,Jason E. Jannot

Individual transferable quotas (ITQs) in multispecies fisheries create incentives for fishermen to avoid bycatch of species for which quota is scarce. However, when bycatch is highly uncertain, individual quota demand and prices may be volatile creating substantial financial risk for fishermen. The US Pacific Groundfish fishery recently introduced an ITQ system with low quotas for several overfished species with highly uncertain bycatch rates. Some fishery participants formed risk

pools where bycatch quota is pooled and available to all pool members. Risk pools can reduce financial risk and transactions costs for individuals, but they also create moral hazard and adverse selection problems. We present an empirical analysis of bycatch risk that informs several issues of risk pool design including which bycatch species to include, pools size, and how to evaluate and mitigate adverse selection and moral hazard problems.

The curse of the haven: The impact of multinational enterprise on environmental regulation

- Ecological Economics---2012---Lammertjan Dam,Bert Scholtens

We analyze the behavior of multinational enterprises in the context of resource rich and poor countries and regarding high and low income countries. We depart from the pollution haven hypothesis and the resource curse. The pollution haven hypothesis states that multinational enterprises move their dirty operations to countries with weak environmental regulation. The resource curse holds that economic growth in countries abundant in natural resources is reduced. We find that more polluting firms are relatively more often located in countries with weak environmental regulation. However, multinational enterprises do not have a significant impact on environmental regulation in the host country. It appears that it is mainly the quality of institutions that drives both the pollution haven and the resource curse.

An analysis of the methodological underpinnings of social learning research in natural resource management

- Ecological Economics---2012---Romina Rodela,Georgina Cundill,Arjen E.J. Wals

This analysis is focused on research that uses a social learning approach to study natural resource issues. We map out the prevailing epistemological orientation of social learning research through the de-construction

of the methodological choices reported in current social learning literature. Based on an analysis of 54 empirical investigations of social learning and natural resources published after peer review, we investigated aspects of research design that include data collection methods, evidence types and the researcher's role. We consider these against different research-orientations (positivist, interpretive, critical, and post-normal). We discuss which research-orientation appears most congruent with the overall commitment and premises of social learning studies. In line with initial expectations this study shows that positivist stances are hardly present, however research that follows a postnormal approach is less frequent than initially assumed. Instead, findings suggest that researchers using a social learning perspective to study resource issues tend to choose methodologies that allow for in-depth descriptions, for meaning making and enquiry as a form of action.

Where is the consensus? A proposed foundation for moving ecosystem service concepts into practice

- Ecological Economics---2012---Amanda M. Nahlik, Mary E. Kentula, M. Siobhan Fennessy, Dixon H. Landers

Inconsistent terms, definitions, and classifications hinder advancement of the study and application of ecosystem services. A unified approach among disciplines involved in researching and implementing ecosystem services is imperative to moving concepts into practice. An operational definition needs to be adopted by the ecosystem service community as the basis of a classification system so that ecosystem goods and services may be measured by ecologists, valued by economists, and utilized by decision-makers. We propose a transdisciplinary approach centered upon shared principles, an ecosystem services definition, and a classification system. This shared foundation provides a common set of ecosystem goods and services that serves as the focus for and connection among multiple disciplines. This foundation is specific enough to be operational while remaining relevant to a multitude of ecosystem service

objectives for which frameworks and implementation plans may be developed. Although numerous ecosystem service frameworks exist in the literature, many of them are non-operational or are focused toward a single discipline. An evaluation of these frameworks identifies knowledge gaps and suggests how we may advance ecosystem services into practice. Our evaluation demonstrates that foundational concepts (especially a definition and classification system, and community involvement) are often poorly addressed in ecosystem service frameworks.

New foundations for ecological economics

- Ecological Economics---2012---Clive Spash

Ecological economics has been repeatedly described as transdisciplinary and open to including everything from positivism to relativism. I argue for a revision and rejection of this position in favour of realism and reasoned critique. Looking into the ontological presuppositions and considering an epistemology appropriate for ecological economics to meaningfully exist requires rejecting the form of methodological pluralism which has been advocated since the start of this journal. This means being clear about the differences in our worldview (or paradigm) from others and being aware of the substantive failures of orthodox economics in addressing reality. This paper argues for a fundamental review of the basis upon which ecological economics has been founded and in so doing seeks improved clarity as to the competing and complementary epistemologies and methodologies. In part this requires establishing serious interdisciplinary research to replace superficial transdisciplinary rhetoric. The argument places the future of ecological economics firmly amongst heterodox economic schools of thought and in ideological opposition to those supporting the existing institutional structures perpetuating a false reality of the world's social, environmental and economic systems and their operation.

Environmental regulation and French firms location abroad: An economic geography model in an international comparative study

- Ecological Economics---2012---Sonia Ben Kheder,Natalia Zugravu-Soilita

In this study, we re-examine the pollution haven hypothesis by a fresh take on both its theoretical and empirical aspects. The originality of our work is twofold. First, we apply an economic geography model with the aim of deriving a rigorous specification for the impact of environmental regulation on firms' location choice. Second, we test a conditional logit model using French firm-level data in an international comparative study. We confirm evidence of a strong pollution haven effect for our pooled sample of countries receiving French direct investments. However, through a sensitivity analysis, we validate this finding for developed countries and most of emerging economies and Central and Eastern European countries, but not for most countries of the Commonwealth of Independent States and developing countries, where a more stringent environmental regulation seems to attract investments. Furthermore, we highlight a forward looking behavior of firms, in terms of their location decision-making.

Are community-based forest enterprises in the tropics financially viable? Case studies from the Brazilian Amazon

- Ecological Economics---2012---Shoana Humphries,Thomas P. Holmes,Karen Kainer,Carlos Gabriel Gonçalves Koury,Edson Cruz,Rosana de Miranda Rocha

Community-based forest management is an integral component of sustainable forest management and conservation in the Brazilian Amazon, where it has been heavily subsidized for the last ten years. Yet knowledge of the financial viability and impact of community-based forest enterprises (CFEs) is lacking. This study evaluates the profitability of three CFEs in the Brazilian Amazon: Ambé, an industrial-scale, upland forest operation producing logs in a national forest, in Pará state; ACAF, a small-scale operation in flooded forests

producing boards with a portable sawmill in Amazonas state; and Mamirauá, one of 30 CFEs in a reserve in Amazonas state producing logs and boards in flooded forests. Costs for each CFE were compiled by forest management activity and cost type. Annual total costs were calculated as the sum of fixed and variable costs and then subtracted from total revenue to obtain annual profit. The annual rate of return on investment was calculated by dividing profits by total costs. The Ambé and Mamirauá cases were profitable, demonstrating rates of return of approximately 12% and 2%, respectively; the ACAF case was not profitable. This study illustrates the benefits of cost-sharing among CFEs, and the potential return for investments in small and large-scale community forestry.

Communicating Trade-offs amid Controversial Science: Decision Support for Climate Policy

- Ecological Economics---2012---Terrence Iverson

The paper considers the decision that arises in climate policy where there is expert disagreement about the correct scientific model and where a group of stakeholders needs to agree on a common policy target. Policy choice is posed as a decision under Knightian uncertainty, where decision-makers lack grounds for assigning a particular probability distribution across contending forecasting models. The decision is then framed as one of balancing two competing objectives that plausibly align with the dominant concern of stakeholders from each side in the policy debate. A decision criterion is proposed to identify options for compromise that balance these objectives in different ways. The criterion spans three standard non-Bayesian decision criteria. Policies generated by the criterion are combined with visual tools to communicate “what’s at stake” in an environmental policy decision in which stakeholders disagree both about scientific models and about the relative importance of risks to the environment versus risks to economic growth. The approach summarizes information that could be useful to policy-makers tasked with negotiating a compromise. The framework is applied to climate policy using DICE-2007 (Nordhaus 2008). The results highlight a basic

asymmetry between the mistake of “doing too little” and that of “doing too much” that suggests a strong argument for avoiding the current status quo of global inaction.

Precision phosphorus management and agricultural phosphorus loading

- Ecological Economics---2012---Antti Iho, Marita Laukkanen

This article puts forward a model of the role of phosphorus in crop production, soil phosphorus dynamics and phosphorus loading that integrates the salient economic and ecological features of phosphorus management, with grain production in southern Finland as an application. The model accounts for the links between phosphorus fertilization, crop yield, accumulation of soil phosphorus reserves, and phosphorus loading into waterways. It can be used to guide precision phosphorus management as a means to mitigate agricultural phosphorus loading. Erosion control is considered as an additional measure to reduce phosphorus loading through soil loss. A dynamic programming approach and numerical solution method are used to analyze the intertemporally optimal combination of fertilization and erosion control and the associated soil phosphorus development. The optimal fertilizer application rate changes markedly over time in response to changes in the soil phosphorus level. Erosion control was found to increase welfare only on land that is highly susceptible to erosion.

Reforming the tax system to promote environmental objectives: An application to Mauritius

- Ecological Economics---2012---Ian Parry

Fiscal instruments are potentially among the most effective, and cost-effective, options for addressing externalities related to poor air quality, urban road congestion, and greenhouse gases. This paper takes a case study, focused on Mauritius (a pioneer in the use of green taxes) to illustrate how existing taxes, especially on fuels and vehicles, could be reformed to

better address these externalities. We discuss, in particular, an explicit carbon tax; a variety of options for reforming vehicle taxes to meet environmental, equity, and revenue objectives; and a progressive transition to usage-based vehicle taxes to address congestion.

Linking process to outcomes — Internal and external criteria for a stakeholder involvement in River Basin Management Planning

- Ecological Economics---2012---K.L. Blackstock, K.A. Waylen, J. Dunglinson, K.M. Marshall

Within the natural resource management and environmental governance literature, a number of authors have argued that there is a need to pay better attention to how the social processes of planning and management influence the outcomes of such processes. These outcomes are often measured through the quality of their outputs (plans or strategies) as well as whether the objectives of the plans or strategies are achieved. This paper contributes to this debate by reporting on a longitudinal evaluation of stakeholder engagement in developing and implementing River Basin Management Planning (RBMP) in Scotland. We illustrate how many of the process and outcome criteria promoted in the literature (the external perspective) appear to be less important to stakeholders than would be expected (the internal perspective). The paper argues that a combination of internal and external criteria is best placed to understand how to judge a ‘good’ process. This paper draws on literature from water management, other natural resource management sectors, spatial planning and environmental management, so the findings are of interest to scholars interested in evaluation, participation, environmental or natural resource management, as well as those specifically interested in RBMP under the Water Framework Directive (WFD).

The effect of scaling and connection on the sustainability of a socio-economic resource system

- Ecological Economics---2012---Rachata Muneeppeerakul, Murad R. Qubbaj

Policy makers dealing with complex systems oftentimes rely on “linear thinking.” This is understandable due to the ease and convenience offered by the simplicity of such conceptualization. Although this line of thinking may help facilitate decision making processes, it is only as defensible as the degree at which the system under consideration behaves linearly. Recent work shows that diverse properties of cities exhibit power-law relationships with population size. Such relationships may invalidate the reliance on linear thinking. Furthermore, in the era of globalization, resources and people move virtually freely through bounds of any confines used to define a system. We incorporate into a simple resource-population model the power-law scaling behavior and the influence of import and immigration, and investigate their effects on sustainable growth of communities. We explore through bifurcation analysis the different scenarios of how an unsustainable system could be sustained. Import can be effective if: the import exceeds a critical level and a critical mass of people populates the system. In contrast, increasing immigration alone can rescue the intrinsically unsustainable system, both directly through people entering the system and indirectly by increasing its harvesting ability, although critical values exist that cause the population to sharply rise or shrink.

Long-term trajectories of the human appropriation of net primary production: Lessons from six national case studies

- Ecological Economics---2012---Fridolin Krausmann, Simone Gingrich, Helmut Haberl, Karl-Heinz Erb, Annabella Musel, Thomas Kastner, Norbert Kohlheb, Maria Niedertscheider, Elmar Schwarzmüller

The ‘human appropriation of net primary production’ (HANPP) is an integrated socio-ecological indicator measuring effects of land use on ecological biomass flows. Based on published data for Austria, Hungary, the Philippines, South Africa, Spain and the UK, this paper investigates long-term trends in above-ground HANPP and discusses the relations between population, economic growth, changes in biomass use

and land-use intensity and their influences on national HANPP trajectories. During early stages of industrialization, population growth and increasing demand for biomass drive land-cover change, often resulting in deforestation, which raises HANPP. During later stages, industrialization of agriculture boosts agricultural yields often faster than biomass demand grows, resulting in stable or even declining HANPP. Technological change improves agricultural area-efficiency (biomass provision per unit area), thereby decoupling population and economic growth from HANPP. However, these efficiency gains require large inputs of fossil fuels and agrochemicals resulting in pressures on ecosystems and emissions. Our findings corroborate the argument that HANPP alone cannot – as sometimes suggested – be used as a simple measure of carrying capacity. Nevertheless, analyses of long-term HANPP trajectories in combination with accounts of material and energy flows can provide important insights into the sustainability of land use, thereby helping to understand limits to growth.

Afforestation and timber management compliance strategies in climate policy. A computable general equilibrium analysis

- Ecological Economics---2012---Melania Michetti, Renato Rosa

This paper analyzes the role of forest-based carbon sequestration in a unilateral EU27 emissions reduction policy under a Global Computable General Equilibrium (CGE) framework. Forestry mitigation is introduced into the model relying on carbon sequestration curves provided by a global forestry model. The structure of the original CGE is extended to consider land use change and timber supply effects, resulting from the use of forest sinks to reduce carbon emissions. Results show that afforestation and timber management could lead to substantially lower policy costs. By using forest-carbon sinks it is possible to achieve the 30% emissions reduction target with an additional European effort of only 0.2% of GDP compared with the cost of a 20% emissions reduction without forestry. Carbon price is also reduced, by approximately 30% in 2020. European

forest-carbon sequestration may have, however, the perverse effect of increasing timber production in areas of the world which already have high deforestation rates. A sensitivity analysis on main parameters confirms the robustness of our results.

Irrigated agriculture and climate change: The influence of water supply variability and salinity on adaptation

- Ecological Economics---2012---Jeffery D. Connor, Kurt Schwabe, Darran King, Keith Knapp

Increased irrigation has been identified as an important potential adaptation to meet growing world food demand. Yet many of the world's major irrigation regions are in arid and semi-arid regions that face climate change projections of hotter and drier weather. A growing body of analysis assesses irrigated agriculture impacts of climate change in such regions. Most published literature focuses on reductions in the mean-levels of freshwater supplies; less information is available on the potential impacts from changes in the reliability and quality of those diminishing water supplies. This article investigates the combined impacts on irrigated agricultural food supply from reduced, more variable and more saline water supply for a representative semi-arid irrigation region. Results indicate that understanding the potential impacts of climate change on agricultural production requires an understanding of not only how production may adapt to changes in mean water supplies, but also how it may respond to changes in water supply variability and salinity. We illustrate, using an Australian, Murray Darling Basin semi-arid region example, that ignoring these combined water-related climate effects lead to results that overlook thresholds where the structure of production and cost incurred fundamentally change above certain levels of variability and salinity.

Timber concessions in Madre de Dios: Are they a good deal?

- Ecological Economics---2012---Renzo Giudice, Britaldo S. Soares-Filho, Frank Merry, Hermann O. Rodrigues, Maria Bowman

This study contributes to the design of public policies for the forestry sector in Madre de Dios, Peru. We developed a timber rent model that estimates optimal stumpage fees and compared three scenarios of harvestable areas access versus two harvest methods to calculate potential revenues to the State. We found that current stumpage fees undervalue timber resources and thus provide windfall profits to loggers. Annual forest revenues to the State could be increased from US\$1 million to a maximum annual average of US\$23.4±1.4 million over a 20-year period if the fee structure suggested from our estimations were adopted. Similarly, we show that the spatial distribution of current fees encourages timber harvesting outside of timber concessions, in particular from Brazil-nut concessions, which compete with timber concessions to supply timber to markets. Our results suggest that timber harvesting should be limited to a maximum volume of 5m³/ha inside Brazil-nut concessions and that timber harvesting in all Madre de Dios could be increased by up to ~200% over the next 20 years without threatening conservation areas. This would in turn provide additional revenues to the State that could be applied to better monitoring and forest management.

The relationship between technical efficiency in agriculture and deforestation in the Brazilian Amazon

- Ecological Economics---2012---Sébastien Marchand

This paper analyzes the impact of agricultural technical efficiency on the propensity of farmers to convert natural land into agricultural plots, i.e., to deforest, in the Brazilian Legal Amazon (BLA). A two-step econometric approach is adopted. A bootstrapped translog stochastic frontier that is a posteriori checked for functional consistency is used to assess technical efficiency and these estimates are put into a land-use model to assess the impact of productivity on deforestation. Analysis of agricultural census tract data suggests that technical efficiency has a U-shaped effect: both less and more efficient farms use more land for their agricultural activities and so have a positive ef-

fect on deforestation. However, the majority of farms in the BLA are on the ascendant slope, so that efficiency implies more deforestation in the BLA. The poor environmental valuation of the Brazilian forest, the uneven land distribution, and the problem of the de facto openly accessed forested and “unproductive” lands in the BLA could explain the U-shaped effect of technical efficiency on the conversion of forested land into agricultural land.

Not only subterranean forests: Wood consumption and economic development in Britain (1850–1938)

- Ecological Economics---2012---Iñaki Iriarte-Goñi, María-Isabel Ayuda

This paper analyzes wood consumption in Britain over the period 1850–1938. We calculate the apparent consumption of wood, taking into account both net imports of wood and the home harvest. We then develop some quantitative exercises that correlate wood consumption with GDP, with prices of wood and iron (as an alternative material to wood) and with other measures. The main conclusion is that, although wood had lost its economic centrality after the energy transition, wood consumption continued to grow in Britain both in absolute and relative terms, showing a positive elasticity to GDP superior to the unit. This result allows us to reach a more complete understanding of the socio-metabolic transition associated with the Industrial Revolution. Britain faced the increase in wood demand by relying almost entirely on imported wood, reinforcing the idea that the decoupling of economic growth from land use must to be handled with care, and should be observed not at the national level but on a global scale. Although British economic development was to a great extent focussed on what has been called the “subterranean forests” of coal, it simultaneously supported large tracts of surface foreign forest.

Preferences for government enforcement of a common pool harvest quota: Theory and experimental evidence from fishing communities in Colombia

- Ecological Economics---2012---Maria Vélez, John Stranlund, James Murphy

We examine individual harvesters’ preferences for government enforcement of a quota imposed on the exploitation of a common pool resource. We develop a model of Nash behavior by identical risk neutral harvesters to explain individual equilibrium preferences for enforcement of an efficient harvest quota. If the quota is not enforced well, we demonstrate that individual harvesters will always prefer increased enforcement—either increased monitoring or increased penalties—of the quota. We conduct a test of this theoretical result with data from framed common pool resource experiments conducted in artisanal fishing communities in three regions of Colombia. Subjects were given the opportunity to express their preferences for enforcement by voting on two levels of enforcement of a harvest quota, with and without communication. The two enforcement strategies involved the same probability that the government would audit individual harvesters, but differed in the level of the penalty for noncompliance. Contrary to theory, individuals voted for the lower inefficient penalty about 80% of the time and groups implemented this weaker enforcement strategy over 90% of the time. Giving subjects the opportunity to vote on the enforcement strategy did not lead to more efficient harvests, nor did allowing subjects to communicate before voting.

Environmental and ecological economics in the 21st century: An age adjusted citation analysis of the influential articles, journals, authors and institutions

- Ecological Economics---2012---Andreas G.F. Hoepfner, Benjamin Kant, Bert Scholtens, Pei-Shan Yu

We investigate the influence of articles, authors, journals and institutions in the field of environmental and

ecological economics. We depart from studies that investigated the literature until 2001 and include a time period that has witnessed an enormous increase of importance in the field. We adjust for the age effect given the huge impact of the year of an article's publication on its influence and we show that this adjustment does make a substantial difference — especially for disaggregated units of analysis with diverse age characteristics such as articles or authors. We analyse 6597 studies on environmental and ecological economics published between 2000 and 2009. We provide rankings of the influential articles, authors, journals and institutions and find that Ecological Economics, Energy Economics and the Journal of Environmental Economics and Management have the most influential articles, they publish very influential authors and their articles are cited most. The University of Maryland, Resources for the Future, the University of East Anglia and the World Bank appear to be the most influential institutions in the field of environmental and ecological economics.

The impact of age structure, uncertainty, and asymmetric spatial dynamics on regulatory performance in a fishery metapopulation

- Ecological Economics---2012---Daniel S. Holland,Guillermo E. Herrera

Failure to manage the harvest of a metapopulation at its underlying ecological scale can lead to extirpation of discrete subpopulations and reduce productivity. However, it may be difficult and costly to assess and manage stocks at a finer spatial scale, and there is generally greater uncertainty about the size of substocks than about the aggregate stock. We use a two-patch, age-structured metapopulation model to compare the performance of global vs. area-specific total allowable catch constraints (TACs). The relative performance of these approaches, in terms of profits and risk of depleting subpopulations, depends upon biological, technical and economic parameters — in particular various kinds of uncertainty, aggregation of fish stocks, and the spatial dynamics of different age classes. Surprisingly, a global TAC is less risky when there is little mixing of the subpopulations, as long as target mortality rates

are not set too high. The advantage of the global TAC is reduced when there is mixing and migration between the subpopulations, particularly when these dynamics are asymmetric. However, a regulator naïve to the nature of the true spatial dynamics (and hence the spatially optimal target fishing mortality rates) may still be better off employing a global TAC.

Climate damages in the FUND model: A disaggregated analysis

- Ecological Economics---2012---Frank Ackerman,Charles Munitz

We examine the treatment of climate damages in the FUND model. By inserting software switches to turn individual features on and off, we obtain FUND's estimates for 15 categories of damages, and for components of the agricultural category. FUND, as used by the U.S. government to estimate the social cost of carbon, projects a net benefit of climate change in agriculture, offset by a slightly larger estimate of all other damages. Within agriculture there is a large benefit from CO₂ fertilization, a moderate cost from the effect of temperature on yields, and a much smaller impact of the rate of change.

Fishery resource recovery strategy without reducing the number of landings: A case study of the ocellate puffer in Japan

- Ecological Economics---2012---Yukichika Kawata

This study proposes a new fishery resource recovery strategy and empirically examines its feasibility. The proposed strategy is unique because it may help fishermen recover fishery resources by closing for the first several months of the fishing season without decreasing their average annual landings. If demand is elastic, it is feasible that they could recover biomass without reducing average annual revenue. To demonstrate the validity of this strategy, this study empirically examines the ocellate puffer in the vicinity of Japan, as it has experienced a drastic depletion of biomass. The results indicate that if fishing were to be prohibited, for example, between October and February (current

fishing season is between October and March), ocellate puffer recovery in the first year would be 30,453kg, which would have the same effect as an 18.4% reduction in the current average landings. The price elasticity for ocellate puffer is elastic, which implies not only that fishery revenue would not decrease, but that the strategy could be a promising means of recovering ocellate puffer stocks.

Expected utility theory and the tyranny of catastrophic risks

- Ecological Economics---2012---Wolfgang Buchholz, Michael Schymura

Expected Utility theory is not only applied to individual choices but also to social decisions, e.g. in cost-benefit analysis of climate change policy measures that affect future generations and hence incorporate an ethical dimension. In this context the crucial question arises whether EU theory is able to deal with “catastrophic risks”, i.e. risks of high, but very unlikely losses, in an ethically appealing way. In this paper we show that this is not the case. Rather, if in the framework of EU theory a plausible level of risk aversion is assumed, a “tyranny of catastrophic risk” (TCR) emerges, i.e. project evaluation is dominated by the catastrophic event. Or, contrary to that, with low degrees of risk aversion, the catastrophic risk eventually has no impact at all (“negligence of catastrophic risk” (NCR)) which is ethically not acceptable as well.

On the automatic application of inequality indexes in the analysis of the international distribution of environmental indicators

- Ecological Economics---2012---Juan Duro

In recent years traditional inequality measures have been used to quite a considerable extent to examine the international distribution of environmental indicators. One of the main characteristics of these measures is that each one assigns different weights to the changes that occur in the different sections of the variable distribution and, consequently, the results they yield can potentially be very different. Hence, we suggest the

appropriateness of using a range of well-recommended measures to achieve more robust results. We also provide an empirical test for the comparative behaviour of several suitable inequality measures and environmental indicators in the international context. Our findings support the hypothesis that in some cases there are differences among measures in both the sign of the evolution over time and its size.

A boundary object for scale selection — Moderating differences and synergising understanding

- Ecological Economics---2012---S.S. Keshkamat, A. Kooiman, M.F.A.M. van Maarseveen, A. van der Veen, M.H.P. Zuidgeest

Lack of attention to scale selection may limit the utility of multidisciplinary assessments and studies. This paper integrates research on scale from several disciplines to identify commonalities.

Dynamic misspecification in the environmental Kuznets curve: Evidence from CO2 and SO2 emissions in the United Kingdom

- Ecological Economics---2012---Jack Fosten, Bruce Morley, Timothy Taylor

This study looks at the behaviour of emissions when in disequilibrium with respect to the environmental Kuznets curve (EKC) relationship. We use the non-linear threshold cointegration and error correction methodology and a long dataset beginning in 1830, in an application to the United Kingdom. There is significant evidence that, not only does the ‘inverse-U’ shape hold between per capita CO2 and SO2 emissions and GDP per capita, but we also find that temporary disequilibrium from the long-run EKC is corrected in an asymmetric fashion. This may be due to the historical pressure of environmental regulation in the UK to reduce emissions that are higher than permitted. However further analysis suggests that technological change can partially account for the asymmetric adjustment.

Integrated innovations and recommendation domains: Paradigm for developing, scaling-out, and targeting rainwater management innovations

- Ecological Economics---2012---Kindie Get-net,Charlotte MacAlister

The technical, economic, and ecological aspects of rainwater management are interlinked and spatially bounded. Developing, scaling-out, and targeting rainwater management innovations as adaptive strategies to upgrade rainfed agriculture are therefore preferably best approached through integrated innovations and recommendation domains as a paradigm. At the level of scenario development, the integrated innovations paradigm helps to understand and address integrity between technical, economic, and ecological issues that affect technology adoption, impact, and sustained use. At the level of scaling-out and targeting, recommendation domains provide the spatial dimension that embraces the economic, institutional, biophysical, and agro-ecological conditions in which integrated rainwater management innovations can be accommodated to address heterogeneity. This paper reviews Ethiopia's experience in rainwater management (adoption, performance, and impact) to get insights about the proposed paradigm and the factors entering the paradigm. The findings suggest that integrated innovations and the conditions of success embraced in a recommendation domain provide the necessary and sufficient conditions for a successful rainwater management intervention at a landscape level.

Do drought management plans reduce drought risk? A risk assessment model for a Mediterranean river basin

- Ecological Economics---2012---Carlos Gomez,Carlos Dionisio Pérez Blanco

Groundwater resources are traditionally overexploited in arid and drought-prone regions with profitable irrigated agriculture, and the depletion of this groundwater results from a combination of the physical scarcity of surface sources and the lack of effective control of use rights on the part of water authorities. This is

the case in the Segura River Basin of southern Spain. As a result, drought risks and structural deficits have steadily increased over the last 50 years. The Drought Management Plan recently approved by the Segura River Basin Authority aims to enforce more stringent water supply restrictions from surface sources, but the plan does not include any explicit policy to handle illegal groundwater abstraction. By using a stochastic risk assessment model, this paper shows that the implementation of the drought plan will increase the expected irrigation deficits of surface water and can, paradoxically, lead to higher drought and aquifer depletion risks than the traditional rules that the new plan replaces.

Economic structure, development policy and environmental quality: An empirical analysis of environmental Kuznets curves with Chinese municipal data

- Ecological Economics---2012---Jie He,Hua Wang

In many cases, the relationship between environmental pollution and economic development can be depicted by an inverted U-shaped curve, or an environmental Kuznets curve, where pollution initially increases with income and then decreases after a certain level of income has been reached. However, what determines the shape of an environmental Kuznets curve, such as the height and the turning point of the curve, has not been thoroughly studied. A good understanding of the determinants is vital to those interested in development, especially in the developing world, where income growth is a high priority, yet environmental pollution also needs to be carefully controlled. This study analyzes the impact of economic structure, development strategy and environmental regulation on the shape of the environmental Kuznets curve by an analysis of a panel dataset at the city level obtained from China. The results show that economic structure, development strategy and environmental regulation can all have important implications for the relationship between environmental quality and economic development but that the impact can vary at different development stages.

India's biophysical economy, 1961–2008. Sustainability in a national and global context

- Ecological Economics---2012---Simron Jit Singh,Fridolin Krausmann,Simone Gingrich,Helmut Haberl,Karl-Heinz Erb,Peter Lanz,,Joan Martinez-Alier,Leah Temper

India's economic growth in the last decade has raised several concerns in terms of its present and future resource demands for materials and energy. While per capita resource consumption is still extremely modest but on the rise, its sheer population qualifies India as a fast growing giant with material and energy throughput that is growing rapidly . If such national and local trends continue, the challenges for regional, national as well as global sustainability are immense in terms of future resource availability, social conflicts, pressure on land and ecosystems and atmospheric emissions. Using the concepts of social metabolism and material flow analysis, this paper presents an original study quantifying resource use trajectories for India from 1961 up to 2008. We argue for India's need to grow in order to be able to provide a reasonable material standard of living for its vast population. To this end, the challenge is in avoiding the precarious path so far followed by industrialised countries in Europe and Asia, but to opt for a regime shift towards sustainability in terms of resource use by building on a host of promising examples and taking opportunities of existing niches to make India a trendsetter.

How responsible is a region for its carbon emissions? An empirical general equilibrium analysis

- Ecological Economics---2012---Karen Turner,Max Munday,Peter McGregor,John Swales

CO₂ reduction targets tend to be set in terms of the amount of pollution emitted within a given region. However, there is increasing public and policy interest in the notion of a carbon footprint, or CO₂ generated globally to serve final consumption demand within a region. This raises an issue in that, despite the local economic benefits, the latter involves effectively

absolving the region of responsibility for CO₂ generated in the production of exports. Using a CGE model of Wales, we illustrate by simulating an increase in export demand for the output of an industry (metal production) that is both carbon and export intensive and generally produces to meet intermediate rather than final demands. The key result is economic growth accompanied by a widening gap between regional CO₂ generation and the carbon footprint, raising questions as to the identification of precisely 'whose' carbon footprint these additional emissions should be allocated to.

Valuing the mortality risk of wildlife reintroduction: Heterogeneous risk preferences

- Ecological Economics---2012---Yukichika Kawata,Masahide Watanabe

This study is the first to value the mortality risk incurred from wildlife reintroduction. We conducted choice experiments on wolf reintroduction in Hokkaido, Japan, in order to value the resulting mortality risk. This process involves three unique factors: the mortality risk is zero before the reintroduction, the increment of the risk caused by the reintroduction is substantially small, and the risk largely depends on citizens' individual characteristics concerning reintroduction. Because of these factors, the heterogeneity of risk preference is expected to be large. In order to examine these heterogeneous risk preferences, we use a random parameter logit model. The estimation results confirm that considerable heterogeneous risk preferences exist. Finally, the mean marginal willingness to pay to prevent the loss of one person per one billion people because of wolf reintroduction is several hundred yen.

Designing watershed programs to pay farmers for water quality services: Case studies of Munich and New York City

- Ecological Economics---2012---Gilles Grolleau,Laura M.J. McCann

While preserving water quality by contracting with farmers has been examined previously, we analyze these

arrangements from a different perspective. This study uses a transaction cost framework, in conjunction with detailed case studies of two water quality payment schemes, to examine factors that increase and decrease transaction costs in order to improve policy choice as well as policy design and implementation. In both the Munich and New York City cases, agreements with farmers to change land management practices resolved the water quality problems. In Munich, factors including lack of rural/urban antipathy, homogeneous land use, utilization of well-developed organic standards, and strong demand for organic products decreased transaction costs. Using existing organic institutions addressed a range of environmental issues simultaneously. Factors that decreased transaction costs in both cases included: highly sensitive land was purchased outright and the existence of one large “buyer”. Adequate lead time and flexibility of water quality regulations allowed negotiation and development of the watershed programs. Tourism and eco-labels allow urban residents to become aware of the agricultural production practices that affect their water supply. We conclude with recommendations based on the experiences of these cities, both of which have been proposed as models for other schemes.

Towards the integration of spread and economic impacts of biological invasions in a landscape of learning and imitating agents

- Ecological Economics---2012---L. Roman Carrasco,David Cook,Richard Baker,Alan MacLeod,Jon D. Knight,John D. Mumford

We develop an agent-based model integrated with a spatial stochastic simulation harmful non-indigenous species (NIS) spread model in which farmers have learning and imitation capabilities. The model is applied to the western corn rootworm (WCR) invasion in the UK. The invasion is never eradicated due to the high dispersal capacity of WCR, particularly under climate change conditions. The lowest expected welfare losses arise with a laissez faire policy against the invasion. The effectiveness of NIS control programmes that require participation by land managers is shown to depend

greatly on their learning and imitation dynamics. Control programmes might fail completely if there is global knowledge of the burdens of compliance – e.g. through the media – and the land managers can foresee the future consequences of new actions. This is due to coordinated noncompliance occurring across the landscape. If the agents need to experience compliance to learn its consequences or communicate only locally, potential noncompliant behaviour spreads more slowly than the invasion front and trails behind it. In conclusion, negative opinions of land managers over NIS control programmes and their media coverage can strongly undermine programmes. Identification and management of these factors may increase the odds of success of the programmes.

Heterogeneity of preferences for the benefits of Environmental Stewardship: A latent-class approach

- Ecological Economics---2012---Guy Garrod,Eric Ruto,Ken Willis,Neil Powe

Since 2005, Environmental Stewardship (ES) has been the principal agri-environment scheme for England and is the key instrument for the delivery of increased environmental benefits from agricultural landscapes. The main objective of this study is to investigate whether or not individuals’ preferences for the environmental benefits associated with ES vary depending on types of landscapes within which these benefits are delivered. A latent class model is applied to data obtained from a choice experiment survey of over 1000 respondents sampled across England. The results suggest that individuals have heterogeneous preferences for the benefits of ES, though different segments of the population with more homogeneous preferences can be identified. In particular, higher levels of benefit are often associated with the operation of ES in landscapes close to where respondents live. This leads to the suggestion that, in order to maximise the benefits of ES, its implementation could take this result into account by encouraging greater uptake from farmers whose land is closer to large populations.

Is conceptual vagueness an asset? Arguments from philosophy of science applied to the concept of resilience

- Ecological Economics---2012---Sebastian Strunz

Is conceptual vagueness an asset or a liability? By weighing arguments from philosophy of science and applying them to the concept of resilience, I address this question. I first sketch the wide spectrum of resilience concepts that ranges from concise concepts to the vague perspective of “resilience thinking”. Subsequently, I set out the methodological arguments in favor and against conceptual vagueness. While traditional philosophy of science emphasizes precision and conceptual clarity as precondition for empirical science, alternative views highlight vagueness as fuel for creative and pragmatic problem-solving. Reviewing this discussion, I argue that a trade-off between vagueness and precision exists, which is to be solved differently depending on the research context. In some contexts research benefits from conceptual vagueness while in others it depends on precision. Assessing the specific example of “resilience thinking” in detail, I propose a restructuring of the conceptual framework which explicitly distinguishes descriptive, evaluative and transformative aspects.

Accruing benefit or loss from a protected area: Location matters

- Ecological Economics---2012---Catrina A. Mackenzie

The spatial distribution of protected area direct benefits and losses were mapped for twenty-five villages around Kibale National Park, Uganda. Benefits included park-based employment, tourism revenue sharing, integrated conservation and development projects, and resource access agreements. Losses were caused by park-protected animals raiding crops and preying on livestock. Local perceptions of benefit and loss associated with the park were collected from focus groups and a household survey. Valuation data were derived from interviews, the survey, and measurement of crop losses. Eight villages accrued an annual net benefit as

a result of the park, while 17 villages accrued a net loss. Net benefitting villages were located near park-based employment and resource access associations involved in beekeeping. Households within 0.5km of the park boundary accrued the highest losses, while benefits distributed up to 15km away. The Ugandan Wildlife Authority (UWA) needs to focus benefits closer to the park boundary to support those who lose most from park-protected animals, and away from areas with park-based employment to more evenly distribute benefits around the circumference of the park. Attitudes toward the park appear to be shaped by loss aversion, suggesting UWA and conservation agencies should focus on loss mitigation, rather than benefit provision.

On dimensions of ecological economics

- Ecological Economics---2012---Giovanni Baiocchi

A recent paper (Ecological Economics 69, 2010, pp. 1604–1609) has addressed the issues of dimensional homogeneity of equations and non-linear transformations of variables in economic and ecological economic models. The authors argued that logarithmic transformation cannot be used when variables are dimensional, presented several examples of purportedly incorrect use in applied economics and ecological economics publications, and concluded that these applications “make no sense.”

Dimensions and logarithmic function in economics: A comment

- Ecological Economics---2012---Constantin Chilarescu, Ioana Viaşu

In this paper we give some comments onto the paper of Kozo Mayumi and Mario Giampietro, recently published in this journal and, finally we present some conclusions.

Nonmarket valuation of water quality: Addressing spatially heterogeneous preferences using GIS and a random parameter logit model

- Ecological Economics---2012---Peter Tait,Ramesh Baskaran,Ross Cullen,Kathryn Bicknell

The spatial distribution of agri-environmental policy benefits has important implications for the efficient allocation of management effort. The practical convenience of relying on sample mean values of individual benefits for aggregation can come at the cost of biased aggregate estimates. The main objective of this paper is to test spatial hypotheses regarding respondents' local water quality and quantity, and their willingness-to-pay for improvements in water quality attributes. This paper combines choice experiment and spatially related water quality data via a Geographical Information System (GIS) to develop a method that evaluates the influence of respondents' local water quality on willingness-to-pay for river and stream conservation programmes in Canterbury, New Zealand. Results showed that those respondents who live in the vicinity of low quality waterways are willing to pay more for improvements relative to those who live near to high quality waterways. The study also found that disregarding the influence of respondents' local water quality data has a significant impact on the magnitude of welfare estimates and causes substantial underestimation of aggregated benefits.

Negotiation analysis for mechanisms to deliver ecosystem services: The case of soil conservation in Costa Rica

- Ecological Economics---2012---Raffaele Vignola,Tim L. McDaniels,Roland W. Scholz

The nature and structure of institutional mechanisms is fundamental for commons management, and yet has received relatively little attention for ecosystem service provision. In this paper, we develop and employ a value-focused structured decision process for a negotiation analysis about mechanisms to maintain and enhance ecosystem service (ES) provision at the watershed scale. We use a case study in the Birris watershed

of Costa Rica where upstream farmers and downstream hydropower might jointly benefit from the design of a mechanism to foster the provision of soil regulation services (SRS). We identify and use parties' fundamental objectives, and views on means to achieve these objectives, to structure a negotiation template representing the important components that a soil conservation program should include. A voting-based elicitation process was employed to identify sub-alternatives acceptable both parties, which in turn identifies the zone of bargaining, or negotiation space in which future negotiations should focus. We conclude with discussion of the potential for application of this approach to other ES contexts, and the importance of the overall policy framework to provide resources and incentives to achieve enhance ES provision.

A stochastic viability approach to ecosystem-based fisheries management

- Ecological Economics---2012---Luc Doyen,O. Thébaud,C. Béné,Vincent Martinet,S. Gourguet,M. Bertignac,S. Fifas,F. Blanchard

Academia and management agencies show a growing interest for ecosystem-based fishery management (EBFM). However, the way to operationalize this approach remains challenging. The present paper illustrates how the concepts of stochastic co-viability, which accounts for dynamic complexities, uncertainties, risk and sustainability constraints, can be useful for the implementation of EBFM. In the present case, this concept is used to identify fishing strategies that satisfy both ecological conservation and economic sustainability in a multi-species, multi-fleet context. Economic Viability Analysis (EVA) and the broader Co-Viability Analysis (CVA), are proposed to expand the usual Population Viability Analysis (PVA) and precautionary approach. An illustration is proposed, using data on the fisheries of Bay of Biscay (France) exploiting the stocks of nephrops and hake. Stochastic simulations show how CVA can guarantee both ecological (stock) and economic (profit) sustainability. Using 2008 as a baseline, the model is used to identify fishing efforts that ensure such co-viability.

Political affiliation and willingness to pay: An examination of the nature of benefits and means of provision

- Ecological Economics---2012---Diane Dupont,Ian Bateman

Non-market techniques are widely used for valuing environmental goods and services. Recent articles obtain results showing respondents to the right of the political spectrum are significantly less likely to vote in favour of environmental programs that provide public goods through public means. In consequence, their WTP is lower than that of individuals on the political left. We examine whether WTP differs systematically in accordance with political affiliation by using data from three stated preference surveys. We obtain results similar to the previous literature from only one survey. Our other two surveys employ different contexts that change the nature of the benefits from the good and/or its provision mechanism. The first of these finds no significant differences in WTP by respondent political affiliation and the second finds that respondents on the right of the political spectrum have statistically higher WTPs for a good when it is privately provided than under collective provision. Our results provide further support that context matters and that preferences elicited from surveys for environmental goods are not necessarily independent of the means by which the good is provided.

Voting for environmental donations: Experimental evidence from Majorca, Spain

- Ecological Economics---2012---Esther Blanco,Maria Claudia Lopez,Eric A. Coleman

This paper presents the results of a modified dictator game where donors are tourists in the island of Majorca, Spain, and the recipient is an environmental foundation. In this experiment we explore if the level of voluntary donations varies under different treatments that include taxes (high and low levels) and voting treatments on choosing and obligatory imposition of taxes (high vs. low and low vs. no tax). Our results

show that participants only self-impose mandatory contributions when they must choose between a high or low tax, and rarely passing the high tax. In addition, we find that those individuals who voted for a high tax and are in a group where the majority votes for the low tax conform to their earlier vote by contributing more. Further, our data supports an incomplete crowding-out of voluntary donations by the application of tourism taxes ear-marked for environmental purposes. From a policy perspective, this result supports the potential for a complementary use of taxes and voluntary donations for fundraising environmental projects in tourism destinations.

Can Earth system interactions be governed? Governance functions for linking climate change mitigation with land use, freshwater and biodiversity protection

- Ecological Economics---2012---Måns Nilsson,Åsa Persson

Earth system interactions, as highlighted by the planetary boundaries framework, occur within and across natural, social and economic systems and shape global environmental change. This paper addresses the multi-level governance problem of coherently addressing key interactions between four Earth sub-systems – climate change, freshwater use, land use and biodiversity – taking into account concerns over problem shifting. After discussing possibilities for regional downscaling of the boundaries, we explore challenges for the EU region to coherently address this particular set of interacting Earth sub-systems and reduce the risk of problem shifting. This analysis demonstrates that Earth system interactions can be governed, but that they likely require comprehensive packages of governance responses across both sub-systems and levels. Three overarching governance functions are tentatively identified that directly or indirectly address Earth system interactions: reduction of system stress, risks and vulnerabilities; triggering and navigation of transformation of economic activity; and development of a diversity of options. Finally, the paper briefly discusses political and institutional challenges for developing, enabling

and stabilising these governance functions.

Elephants in the garden: Financial and social costs of crop raiding

- Ecological Economics---2012---Catrina A. Mackenzie, Peter Ahabyona

Residents near protected areas disproportionately bear conservation costs, in part due to crop raiding by protected animals when protected areas are situated within an agricultural landscape. These costs increase as conservation efforts lead to recovery of animal populations, and human population growth increases the proportion of land outside the parks used for agriculture. Financial and social costs associated with crop raiding were studied in 25 villages around Kibale National Park, Uganda. Perceptions about crop raiding were collected using focus groups and household surveys, while damage was evaluated based on physical monitoring of crop raiding incidents. The average financial loss for farmers around the park over six months was US\$74 (1.5% of median household capital asset wealth) and damage was particularly high within 0.5km of the park boundary. Households experiencing crop raiding were more prone to food insecurity, and higher rates of self-reported human and livestock diseases, while children from villages bordering the park tended to have poorer scholastic achievement. Compensation is not affordable for the wildlife authority, nor is it sustainable as crop raiding is escalating. To mitigate costs for local communities, funding has been justified for the implementation of crop raiding defenses.

Introducing individual transferable quotas on nitrogen in Danish fresh water aquaculture: Production and profitability gains

- Ecological Economics---2012---Rasmus Nielsen

The purpose of this paper is to investigate the potential gains from changing the existing regulatory framework for fresh water aquaculture production in Denmark. The regulatory framework is changed from an input regulation based on farm-specific feed quotas, to an individual transferable quota system on nitrogen

pollution. The regulatory change is analyzed using Data Envelopment Analysis to model the underlying production structure. The effect of allowing trading of nitrogen quotas on production and profitability is analyzed in a joint production model with good and bad output under different behavioral and technical assumptions, whilst keeping the overall pollution level of nitrogen constant. Furthermore, the effect of a catchment area restriction on nitrogen is analyzed to comply with the EU Water Framework Directive. The paper quantifies the gains of a policy change from a command and control system to an incentive based system. The estimated results suggest that the changed regulation could increase Danish aquaculture production by 16 to 55%, whilst actual profitability could be increased 5 to 10 times.

Greenhouse gas emissions of self-selected individual diets in France: Changing the diet structure or consuming less?

- Ecological Economics---2012---F. Vieux, N. Darmon, D. Touazi, L.G. Soler

The aim was to estimate the greenhouse gas emissions (GHGE) associated with self-selected diets and to evaluate the impact of modifying dietary structures on diet-associated GHGE. Food consumption data from 1918 adults participating in the French national dietary survey and GHGE of 73 highly consumed foods (in g CO₂e/100g of edible food) were used to estimate the GHGE of each individual diet. The mean diet-associated GHGE was 4170g CO₂e/day and a high inter-individual variability was observed. When the total caloric intakes were reduced to meet the individual energy needs, the diet-associated GHGE decreased by either 10.7% or 2.4%, depending on the assumption made on the average physical activity level of the population. The meat and deli meat food group represented the strongest diet-associated GHGE contributor, but the impact of different meat reduction scenarios was modest. In particular, when fruit and vegetables were iso-calorically substituted for meat, either null or even positive diet-associated GHGE variations were observed because the needed amounts of fruit and veg-

etables to maintain the caloric content of the diet were high. Therefore, substituting fruit and vegetables for meat (especially deli meat) may be desirable for health but is not necessarily the best approach to decreasing diet-associated GHGE.

Alternative use systems for the remaining Ethiopian cloud forest and the role of Arabica coffee — A cost-benefit analysis

- Ecological Economics---2012---Anke Reichhuber,Till Requate

This paper presents a cost-benefit analysis of three different use systems for the remaining cloud forests in Ethiopia, which at present are being depleted at the rate of 8% per year. These use systems are a) traditional conversion to crop land, b) sustainable management of the forest (e.g. by growing high-quality, semi-forest coffee), and c) strict conservation. We find that under business as usual conversion to cropland yields the highest net present income value for the local population. Taking into account watershed services, sustainable forest use is in the best interests of the country for discount rates of 10% or lower. Taking into account the global benefits of biodiversity conservation and carbon storage, sustainable forest management also yields the highest total economic value while strict conservation does not pass a cost-benefit test even at a discount rate of 3%.

Pollution, shadow economy and corruption: Theory and evidence

- Ecological Economics---2012---Amit K. Biswas,Mohammad Reza Farzanegan,Marcel Thum

We study how the shadow economy affects pollution and how this effect depends on corruption levels in public administration. Production in the shadow economy allows firms to avoid environmental regulation policies; a large informal sector may be accompanied by higher pollution levels. Our theoretical model predicts that controlling the levels of corruption can limit the effect of the shadow economy on pollution. We use panel

data covering the period from 1999 to 2005 in more than 100 countries to test this theoretical prediction. Our estimates confirm that the relationship between the shadow economy and the levels of pollution are dependent on the levels of corruption. Our results hold when we control for the effects of other determinants of pollution, time varying common shocks, country-fixed effects and various additional covariates.

Heterogeneous users and willingness to pay in an ongoing payment for watershed protection initiative in the Colombian Andes

- Ecological Economics---2012---Rocio Moreno-Sanchez,Jorge Maldonado,Sven Wunder,Carlos Borda-Almanza

Flat fees in payment for environmental services (PES) schemes promote administrative ease, and are perceived as egalitarian. However, when environmental-service (ES) buyers are heterogeneous in their income and water-consumption levels, this scheme may not be optimal, as total payments might become too low and services under-supplied. This paper estimates willingness to pay (WTP) higher fees from hydrological-service buyers in an ongoing PES initiative in an Andean watershed in Colombia, where small, flat user payments have been introduced. ES users fall into two highly heterogeneous categories: smallholder peasants and recreational-house owners. We perform a contingent valuation analysis in a representative sample of 218 households. For improved water services, ES buyers on average are willing to pay monthly about US\$1 premium over current flat PES rate. Users' heterogeneity, however, affects significantly this outcome: while recreational-house owners are willing to pay monthly on average US\$1.61 more than the current fee, smallholders only US\$0.41. Spatial variables, such as distance to the water distribution point and to the town center, importantly influence WTP. Results may help designing user-driven PES schemes in line with efficiency and equity objectives.

On the economics of virtual water trade

- Ecological Economics---2012---Jeffrey Reimer

Virtual water trade is increasingly recognized as a useful metaphor for thinking about freshwater resources in an international context. Its legitimacy in terms of economic theory has been questioned by a number of authors, however. In this article I develop new theoretical results that place the virtual water concept on a firm economic foundation, and which correct several misconceptions within the existing literature on virtual water economics.

Migration, class and environmental inequality: Exposure to pollution in China's Jiangsu Province

- Ecological Economics---2012---Ethan D. Schoolman, Chunbo Ma

Systematic research into social inequalities in the distribution of environmental hazards, though well-established in American sociology, has largely not been conducted using quantitative data from developing countries. In this study we consider whether theory and methods developed to test for and explain environmental inequality in the U.S. can be extended to a major developing country such as China. We argue that, due in part to the state's hukou registry system, urban workers in China with an official rural residence may be subject to disproportionate exposure to environmental pollution. We also argue that environmental inequalities in China may be shaped in part by social processes analogous to those which have been held to explain racial differences in pollution exposure in the U.S. In an analysis of the locations and emissions of pollution-producing facilities in China's Jiangsu province, we find that townships with a higher percentage of rural migrants are more likely to be exposed to high levels of air and water pollution. This finding holds even after we control for income and for the presence of "dirty and hard" industries in which rural migrants are most likely to find work.

Does household composition matter? The impact of the Grain for Green Program on rural livelihoods in China

- Ecological Economics---2012---Yicheng Liang, Shuzhuo Li, Marcus W. Feldman, Gretchen C. Daily

This research introduces family composition into the sustainable livelihoods framework for policy analysis. We apply this approach to a case study on the Grain for Green Program in western China. Using recent survey data from Zhouzhi County, we show that the impact of the policy on rural livelihoods varies across household compositions. The environmental program neither targets asset-poor households, nor does it necessarily shift the on-farm labor to non-farm sectors, which would improve household incomes (after controlling for the effect of assets). Households with children but without the elderly tend to have lower migration rates and lower incomes after participation in the program. Policy strategies should consider household heterogeneity, particularly household composition in rural China.

Production-based and consumption-based national greenhouse gas inventories: An implication for Estonia

- Ecological Economics---2012---Olga Gavrilova, Raivo Vilu

Two national greenhouse gas (GHG) inventories were prepared for Estonia: (1) an inventory that includes GHG emissions from the production of goods and services (i.e., commodities) within its national territory and (2) an inventory of GHG emissions occurring within and outside its national boundaries due to Estonia's consumption of commodities, whether produced domestically or traded bilaterally. The inventories included estimates of energy-related and non-energy-related carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) emissions (converted to CO₂-equivalent, CO₂eq) associated with the production and consumption of commodities, grouped in three main sectors: energy, industrial processes and agriculture. Input-output (IO) analysis, emissions embodied in

bilateral trade (EEBT) approaches and the basic methods of the 2006 IPCC Guidelines were used to perform the estimates. The results of the study illustrated that the total CO₂eq emissions associated with consumption in Estonia in 2005 were 18% higher than those associated with production, primarily due to the net import of CO₂eq emissions from countries outside of the European Union.

Rethinking ecosystem services to better address and navigate cultural values

- Ecological Economics---2012---Kai M.A. Chan, Terre Satterfield, Joshua Goldstein

Ecosystem service approaches have become a prominent basis for planning and management. Cultural services and non-use values are included in all major typologies and present some of the most compelling reasons for conserving ecosystems, though many barriers exist to their explicit characterization. The values that conform least well to economic assumptions—variously lumped together with/as cultural services—have proven elusive in part because valuation is complicated by the properties of intangibility and incommensurability, which has in turn led to their exclusion from economic valuation. We argue that the effectiveness of the ecosystem services framework in decision-making is thwarted by (i) conflation of services, values, and benefits, and (ii) failure to appropriately treat diverse kinds of values. We address this challenge by (1) distinguishing eight dimensions of values, which have implications for appropriate valuation and decision-making; (2) demonstrating the interconnected nature of benefits and services, and so the ubiquity of intangible values; (3) discussing the implications of these propositions for ecosystem-services research; and (4) outlining briefly a research agenda to enable decision-making that is ecologically appropriate and socially just. Because many ecosystem services (co-)produce ‘cultural’ benefits, full characterization of services must address non-material values through methods from diverse social sciences.

Ecosystem services and Australian agricultural enterprises

- Ecological Economics---2012---Harpinder S. Sandhu, Neville D. Crossman, F. Patrick Smith

The role of ecosystem services in agro-ecosystems is often poorly understood by those in agricultural production. Yet food production, itself an ecosystem service, is critical to the survival of humanity and dominates much of the world’s terrestrial and marine environments. There is a need to address the under-estimation of ecosystem services in farmland and develop concepts, policies and methods to evaluate them. In this paper, we develop a conceptual framework and consult with agro-industry experts to identify the impacts of different agricultural practices on ecosystem services. We also identify the ecosystem services crucial to the long term functioning of agroecosystems in Australia. Our results demonstrate that the regulating ecosystem services are the most relevant to all of the agriculture sectors we examined. Most concern is the recognised impact that the agricultural sector has had on ecosystem services provision. Results from our survey indicate that the agricultural sector in Australia negatively impacts on all regulating and supporting ecosystem services, despite the importance of these services in the process of agricultural production. We conclude with various policy arguments for better and more explicit recognition of ecosystem services in the management of agroecosystems.

Inferring the rate of pure time preference under uncertainty

- Ecological Economics---2012---Liquan Liu

This paper studies how to infer the rate of pure time preference (ρ) from the Ramsey Rule when multiple asset returns exist due to uncertainty. Using a Generalized Uncertainty Ramsey Rule derived from a model that separates intertemporal substitution and risk aversion, we find that the U.S. historical data on consumption growth and asset returns imply that (i) for the reciprocal of the elasticity of intertemporal substitution less than or equal to one, ρ lies within $\pm 1\%$

from zero for a plausible range of the coefficient of relative risk aversion; and (ii) for the larger reciprocal of the elasticity of intertemporal substitution, ρ tends to be negative. These results contradict the widely-held belief in the environmental economics literature that the inferred ρ must be significantly larger than zero and suggest that it is appropriate to use $\rho = 0$ as a benchmark for economic analysis of environmental policies.

Non-cooperative institutions for sustainable common pool resource management: Application to groundwater

- Ecological Economics---2012---Kaveh Madani,Ariel Dinar

As demands for limited natural resources increase, developing management institutions that ensure the sustainability of such resources is essential. Many natural resources are Common Pool Resources (CPRs), managed under different non-cooperative, cooperative, and externally imposed management frameworks. While early studies of non-cooperative CPR management suggest inevitable “tragedy of the commons,” here we discuss how users can avoid tragic outcomes by changing their decision making rationales and exploitation strategies even in a non-cooperative environment. This paper introduces and compares various types of non-cooperative institutions that are available to manage CPRs. These management institutions are then applied, using a numerical groundwater exploitation example, to determine how different planning variables are affected by the choice of management institution. Results indicate that CPR users can improve their gains by considering the externalities and developing long-term exploitation plans, as opposed to short-term plans with no consideration of externalities that result in rapid exhaustion of the resource and lead to the so-called “tragedy of the commons.”

Sustainability of diets: From concepts to governance

- Ecological Economics---2012---Markus Vinari,Petri Tapio

The production of food for consumption produces environmental stress and raises ethical issues. As humans are able to choose different foodstuffs in their diets, food consumption guidance may have large benefits for the environment. Meat consumption is often identified as the most environmentally harmful foodstuff to produce and animal welfare and rights issues are receiving ever more attention. By combining both issues, this article proposes a conceptual framework for combining alternative dietary habits and agricultural production styles in general environmental policy strategies. Two means to lower meat consumption are proposed: 1) Redeveloping the Pigouvian food taxation system introduced by Goodland (1997), in which foodstuffs are taxed according to their environmental burden. An elaborated version could also include an ethical tax that incorporates consumers’ attitudes on animal welfare and a coefficient that takes into account the inherent value of animals; 2) Taking the composition of a national stockpile as a starting point and designing the agricultural production system from a combined environmental and ethical perspective. In this system, the environmentally and ethically preferable foodstuffs would be purchased by the government and sold to the global markets. The premiums between these two prices would constitute the subsidies for the national production.

Efficiency and equity in negotiated resource transfers: Contributions and limitations of trust with limited contracts

- Ecological Economics---2012---Alexander Pfaff,Maria Véléz

We consider a case of water reallocation in Brazil, one which has numerous analogs elsewhere. To permit empirical study of the effects of institutions that can facilitate or restrict allocations, we conducted field experiments to explore trust’s potential when resource contracts are limited, using a novel asymmetric-productivity ultimatum game with a final surplus-sharing step added. As a form of informal institution, trust could in principle make rights and contracts unnecessary. We observe whether trust in compensation

is in fact expected and expressed. We also explore whether trust is exploited, and the effect of communication, within our two bargaining structures: (1) no communication; and (2) with a non-binding message concerning the surplus to be shared. We see that our participants both expect and express trust that some of the surplus will be shared. Trust raises total output and some surplus is indeed shared: those who trust gain a bit on average; and the more trust was shown, the more was shared. However, often the trust was barely repaid. Further, the messages—found to help in other research—had little impact and were often untrue. In sum, trust does matter but both efficiency and equity could well rise with complete contracts.

Additional CO2 emissions from land use change — Forest conservation as a precondition for sustainable production of second generation bioenergy

- Ecological Economics---2012---Alexander Popp,Michael Krause,Jan Philipp Dietrich,Hermann Lotze-Campen,Marian Leimbach,Tim Beringer,Nico Bauer

In the past, deforestation, mainly driven by the conversion of natural forests to agricultural land, contributed up to one-fifth of global human induced carbon dioxide (CO2) emissions. Substitution of bioenergy for fossil energy is an intensely discussed option for mitigating CO2 emissions. This paper, by applying a global land-use model and a global energy–economy–climate model, explores how demand for cellulosic bioenergy crops will add an additional pressure on the land system in the future. In accordance with other studies, we find that CO2 emissions from land use change due to energy crop production will be an important factor in the GHG balance of bioenergy if natural forests will not be protected. But restricting land availability for biomass plantations by conserving natural forests requires additional efforts in the agricultural sector: First, our simulation results indicate that significant additional crop yield increases will be needed due to the combination of forest conservation and the cultivation of dedicated bioenergy crops. Secondly, our simulation

results show that forest conservation in combination with increasing demand for dedicated bioenergy crops will lead to higher agricultural production costs of approximately 20%.

Linking NAMEA and Input output for 'consumption vs. production perspective' analyses

- Ecological Economics---2012---Giovanni Marin,Massimiliano Mazzanti,Anna Montini

We integrate input output and NAMEA tables for Spain and Italy in 1995, 2000 and 2005, in order to address the hot policy issue of sustainable consumption and production. A comparison of production and consumption perspectives may have relevant policy implications. We deal with the domestic technology assumption and primarily the aggregation bias that may result when calculating indirect emission using different sector aggregations in the analyses (e.g. 16, 30, 50). Extended Input Output Analysis provides analyses of the emissions embodied in domestic consumption and domestic production by considering the structure of intermediate inputs and environmental efficiency in each production sector. Our empirical findings show that different sectoral aggregation significantly biases the amount of emissions for the consumption perspective, though differently in the two countries. Italy surprisingly show consumption/production ratios around or lower than one, but in line with some major work at EU level. Our results thus suggest that special attention must be paid when interpreting the EE-IOA of country estimated amounts of embodied emissions, both in domestic final demand and those directly associated with the production sectors when the sectoral aggregation level has a low definition as considered in some recent similar studies.

Does one size fit all? Heterogeneity in the valuation of community forestry programs

- Ecological Economics---2012---Dambala Gelo,Steven Koch

Through the implementation of a choice experiment

valuation exercise, this study set out to identify the set of community plantation attributes that impact the welfare of potential community forestry program participants. We employed a combination of choice models to evaluate the preferences, welfare impacts and choice elasticities associated with alternative community forestry programs, allowing for different assumptions regarding heterogeneity. In line with economic theory, increased participation costs reduced the demand for community forestry, while increases in expected productivity raised the demand. With respect to preferences for the other alternatives considered: type of forest, area enclosure and type of land upon which the forest was to be situated, the results point to significant differences in preferences across the study population, suggesting that programs should be tailored to the communities in which the program is to be implemented.

Sustainable agricultural management contracts: Using choice experiments to estimate the benefits of land preservation and conservation practices

- Ecological Economics---2012---Joshua Duke, Allison M. Borchers, Robert Johnston, Sarah Absetz

This paper describes the results of a choice experiment measuring social benefits for sustainable management practices and agricultural land preservation. Sustainable management is conceptualized with three illustrative practices that impact water quality, carbon sequestration, and soil erosion: fertilizing with a broiler litter product, expanding riparian buffers, and no-till cropping. Data for a choice experiment are collected using a mail survey of residents living near a large, unpreserved agricultural parcel in an urban-influenced area of Delaware. Results identify substantial benefits for land preservation, the use of broiler litter, and riparian buffers but not for conservation tillage. Results also suggest that the estimated household benefits of all three sustainable management practices combined are similar in magnitude to the benefits from land preservation alone. Based on model results, policy

and future research may wish to examine possibilities for subsidizing sustainable management practices in urban-influenced areas as a more cost-effective means of providing benefits similar to those realized through land preservation.

Absolute abundance and relative scarcity: Environmental policy with implementation lags

- Ecological Economics---2012---Corrado Di Maria, Sjak Smulders, Edwin van der Werf

We study the effectiveness of environmental policy in a model with nonrenewable resources and an unavoidable implementation lag. We find that a time lag between the announcement and the implementation of an emissions quota induces an increase in emissions in the period between the policy's announcement and implementation. Since a binding constraint on emissions restricts energy use during the implementation phase, more of the resources must be extracted outside of it. We call this the abundance effect. In the case of multiple resources that differ in their pollution intensity, a second channel emerges: since cleaner sources are relatively more valuable when the policy is implemented, it is optimal to conserve them before the cap is enforced. This ordering effect tends to induce a switch to dirtier resources before the policy is implemented, compounding the increase in emissions via the abundance channel. Using the announcement lag in Title IV of the 1990 CAAA as a case study we are able to empirically show that the abundance effect and ordering effect are both statistically and economically significant. We discuss a number of alternative policy options to deal with these undesirable side effects of policy announcements.

Economic analysis of scenarios for the sustainability of extensive livestock farming in Spain under the CAP

- Ecological Economics---2012---Juan Agustín Franco, Paula Gaspar, Francisco Javier Mesias

This paper proposes a change in the conditions of cross-compliance of CAP payments. Specifically, the eligibility criterion considered is compliance with minimal

requirements of long-term economic and agroenvironmental sustainability. To this end, 69 range farms were surveyed in Extremadura (SW Spain). In these farms, sustainability was studied using the MESMIS framework. MESMIS is based on the evaluation of basic attributes of sustainability (adaptability, self-reliance, equity, stability, and productivity) formed from different indicators. The original indicators are then synthesized by means of qualitative, quantitative, or mixed techniques into a single value measuring the sustainability of the system (sustainability index). Alternative scenarios were then defined in which the perception of CAP subsidies was to a greater or lesser extent linked to levels of sustainability. For each of these scenarios, the economic indicators of the farms were compared with those of the baseline (present) situation. The analysis was completed using a logistic model classification to study the relationship between the maximum levels attainable by the economic indicators in terms of the sustainability indices. The results showed that including sustainability as a condition for receiving aid under the CAP can contribute to improving the economic results of traditional extensive farms.

A parsimonious, stacked latent-class methodology for predicting behavioral heterogeneity in terms of life-constraint heterogeneity

- Ecological Economics---2012---Edward Morey,Mara Thiene

Our conjecture is that for many recreational activities a significant amount of the variation in the sites visited can be explained, and predicted, by variation in life constraints such as kids, BMI (body-mass index) fitness, skill, and health. The objective is to develop a parsimonious method for identifying behavioral heterogeneity caused by life-constraint heterogeneity and separating it from that caused by preference heterogeneity. We estimate, for two different recreational activities, with two independent data sets, how much behavioral heterogeneity can be attributed to life-constraint heterogeneity. We develop and estimate a stacked latent-class

approach to life constraints, assuming individuals have many correlated life constraints. First, at the bottom of the stack, a latent-class life-constraint model is specified and estimated; then life-constraint class becomes a covariate in a behavioral latent-class model of participation and site selection. We find, with both simple statistics and behavioral models, that life-constraint classes explain a significant amount of the observed behavioral heterogeneity. Prediction is a critical reason to distinguish the influence of current constraints from the influence of current preferences: it is easy to directly observe life-constraint levels. Stacked latent-class models have many potential applications, besides ours.

Econometric analysis of the determinants of adoption of raising sheep in folds by farmers in the semiarid Loess Plateau of China

- Ecological Economics---2012---Wan-Shou Zhang,Feng-Min Li,You-Cai Xiong,Qing Xia

Agricultural practices combined with soil erosion resulted in extreme loss of soil fertility and reduced sustainability in the semiarid Loess Plateau of China. Alternative land uses include planting leguminous forage species for cut-and-carry feeding of livestock, and raising sheep in folds (RSFs). In this study, an econometric model was used to quantify the factors determining farmers' decision to adopt RSFs in the area based on a survey of 213 farmer's families in four villages. The analysis showed that families with more female members and fewer children were more likely to adopt RSFs, as well as farmers with more experience raising sheep or goats, households located farther away from markets, and farmers with larger farm sizes and higher grain yields. In contrast, farmers who sold more potatoes, received higher incomes, were well educated or had non-farming sources of income were less likely to adopt RSFs. The probability of adopting RSFs was higher for farmers who have contact with extension agencies working on animal husbandry technologies. RSFs were very consistent with the needs and situations of farming families in the semiarid Loess Plateau. The results would be favor to make policies to improve

the sustainability of crop livestock farming systems.

Beyond food production: Ecosystem services provided by home gardens. A case study in Vall Fosca, Catalan Pyrenees, Northeastern Spain

- Ecological Economics---2012---Laura Calvet-Mir,Erik Gómez-Baggethun,Victoria Reyes-García

Interest in ecosystem services provided by agroecosystems has grown over the last decades with research focusing on the type of environmental, economic and social benefits delivered by agroecosystems. Researchers suggest that, besides the provisioning of food, fuel, and fiber, agroecosystems provide habitat, cultural, and regulating services. One type of agroecosystem that remains relatively unexplored from an ecosystem service perspective is home gardens. In this paper, we aim at advancing the understanding of the value of home gardens by conducting an assessment of home gardens ecosystem services. For the empirical analysis we use home gardens in Vall Fosca (Catalan Pyrenees). We identify and characterize the most important ecosystem services provided by home gardens, and conduct a valuation of the social importance of home garden ecosystem services. The methodological approach for this work included an in-depth literature review, participant observation, semi-structured interviews, a valuation questionnaire, and a scientific panel consultation. We identified and characterized 19 ecosystem functions and related services. According to our informants, home gardens provide a large set of ecosystem services, being cultural services the category most valued. We found that the most important ecosystem services provided by home gardens differ from those provided by other types of agroecosystems.

Is there a causal relation between ethanol innovation and the market characteristics of fuels in Brazil?

- Ecological Economics---2012---Luciano De Freitas,Shinji Kaneko

This study examines whether a causal relation exists

between ethanol related innovation and fuel market variables in Brazil. Patent counts were used as proxy for innovation and assessed market variables include ethanol consumption and price, and gasoline price. The study refers to the period 1975–2008. Empirical evidence is formulated with an Autoregressive Distributed Lag (ARDL) model for cointegration and the causality is examined with a multivariate Granger causality test. The results demonstrate a potential causal relation between ethanol innovation and ethanol consumption, evidencing a unidirectional relation from ethanol consumption to patent registers in the studied period. Such a relation indicates that increments in ethanol consumption can potentially stimulate innovation in the sector. Moreover, the ethanol price and the cross-effect of gasoline price have an indirect effect on ethanol innovation. Several questions are raised regarding the yet to be determined factors driving innovation in the sector. Further studies focused on nonmarket aspects, including policy factors, subsidies and international technology spillovers, would potentially elucidate several unanswered questions concerning ethanol innovation in Brazil.

The viability of local payments for watershed services: Empirical evidence from Matiguás, Nicaragua

- Ecological Economics---2012---Gert Van Hecken,Johan Bastiaensen,William F. Vásquez

Using both qualitative and quantitative approaches, this article investigates the under-researched demand-side of locally-financed Payments for Environmental Services (PES). It assesses downstream users' willingness to pay (WTP) for improved tap water quality in a setting where upstream landowners are clearing watersheds. The research findings are indicative of a considerable WTP for improved drinking water services and a definite local awareness of upstream–downstream interdependencies, suggesting potential for successful PES. Contingent Valuation (CV), however, found a substantially lower WTP under a PES scenario than under an alternative scenario involving infrastructure investments. The qualitative research angle indicates

that the feasibility of a locally-financed PES system may have been negatively affected by the prevailing discursive framing of agricultural externalities and entitlements, raising issues about the fairness of such payments. Moreover, low levels of mutual trust were found to undermine the credibility of the PES framework. These results confirm that institutional failures contribute to environmental degradation and that PES should not be viewed as a market panacea transcending the local institutional context, but rather as a potentially complementary instrument within a broader rearrangement of environmental governance.

Uranium reserve, nuclear fuel cycle delusion, CO2 emissions from the sea, and electricity supply: Reflections after the fuel meltdown of the Fukushima Nuclear Power Units

- Ecological Economics---2012---Kozo Mayumi, John Polimeni

The Great Tohoku-Kanto earthquake and the resulting tsunami have brought considerable attention to the issue of building new nuclear power plants. In this paper we argue that nuclear power is not a sustainable solution to energy problems. First, we explore the stock of uranium-235 and the different methods, fast breeder and MOX fuel reactors, developed by the nuclear power industry to exploit this resource. Second, we show that these fuel reactors are not feasible. Third, we show that the claim that nuclear energy can be used to reduce CO2 emissions is false: the emissions from the increased water evaporation from nuclear power generation must be accounted for. In the case of Japan, water from nuclear power plants is drained into the surrounding sea, raising the water temperature which has an adverse effect on the immediate ecosystem, as well as increasing CO2 emissions from increased water evaporation from the sea. Next, a short exercise is used to show that nuclear power is not needed to meet electricity demand in Japan. Such an exercise should be performed for any country considering the construction of additional nuclear power plants. Lastly, the paper is concluded with a discussion of the implications of our paper.

Personal carbon trading: A critical survey

- Ecological Economics---2012---Richard Starkey

In recent years, there has been considerable discussion within UK climate policy circles regarding the appropriateness of personal carbon trading as an instrument for greenhouse gas emission reduction. This paper is the first in a two-part survey of personal carbon trading (PCT), the term used here to describe proposed (sub-)national greenhouse gas emission trading schemes under which at least some emissions rights are allocated to and surrendered by individuals. After introducing the various proposed PCT schemes, the paper compares, in terms of equity, the two most-discussed PCT schemes with two alternative emission trading schemes and a carbon tax. The papers' two key findings are as follows. First, there are strong arguments that the equal per capita allocation proposed under some instruments is not completely fair. Second, the five instruments compared can be equivalent in terms of their equity. Along with equity, efficiency and effectiveness make up three key criteria for comparing environmental policy instruments. As PCT has no advantage in terms of equity, the paper concludes that any case for PCT will depend on it having advantages in terms of efficiency and/or effectiveness. Whether PCT has such advantages is explored in Part 2.

Personal carbon trading: A critical survey Part 2: Efficiency and effectiveness

- Ecological Economics---2012---Richard Starkey

Equity, efficiency and effectiveness are three key criteria used to assess environmental policy instruments. Part 1 of this survey shows that, in terms of equity, Tradable Energy Quotas (TEQs) – a widely discussed personal carbon trading (PCT) scheme – cannot be differentiated from Cap and Dividend (C&D) or Cap and Share (C&S). Hence, Part 2 explores whether they can be differentiated in terms of efficiency and/or effectiveness. The paper reviews two studies that compare the efficiency of TEQs and C&D. Whilst their estimates of the costs and abatement potential of TEQs differ, neither study considers that there is a case, on efficiency

grounds, for its implementation. The paper goes on to sketch two arguments for the implementation of PCT that might, nevertheless, be made on efficiency grounds and one – relating to public acceptability – that might be made on effectiveness grounds. Exploring the various public surveys conducted on the acceptability of PCT, the paper concludes that support for PCT is not obviously greater than for alternative instruments and notes a methodological limitation in the work reviewed. The paper concludes that, to date, the case against implementation of PCT is stronger than the case for.

Redefining payments for environmental services

- Ecological Economics---2012---Luca Tacconi

The Environmental Economics and the Ecological Economics perspectives on payments for environmental services (PES) propose rather different views on how to define PES, its key elements, and on the role of PES in ecosystem conservation and rural development. This paper compares these two perspectives and addresses the following questions: what is an appropriate definition of PES, grounded in the theory and practice underlying it? What are the key design elements of PES? What should the scope of PES be given the possible trade-offs between efficiency and equity? It is found that PES schemes should focus on cost-effectiveness and best practice for positive livelihood impacts. PES schemes should be transparent, and provide additional services with conditional payments to voluntary providers.

Understanding changes in business strategies regarding biodiversity and ecosystem services

- Ecological Economics---2012---Joel Houdet, Michel Trommetter, Jacques Weber

Business activities play a major role in biodiversity loss so that firms are under increasing pressures from stakeholders to mitigate their negative impacts on ecosystems. As business attitudes, policies and behaviors regarding biodiversity and ecosystem services (BES) progressively change, a better understanding of how business strategies may be framed and implemented is

required. In the first part of this paper, we discuss how biodiversity is usually understood as an external environmental constraint on business activities, and how this perception influences arbitrages. We then discuss how assessing BES interdependencies (impacts and dependencies) may bring about new business strategies and needs: we explore the opportunities and challenges of emerging mechanisms of payments for ecosystem services and expose the need for standardized sets of indicators at different scales for the effective management of their BES dependencies and impacts.

Ecotourism and the development of indigenous communities: The good, the bad, and the ugly

- Ecological Economics---2012---Jessica Coria, Enrique Calfucura

A large part of the literature analyzing the links between biodiversity conservation and community development assumes that nature-based tourism managed by indigenous communities will result not only in conservation of natural resources but also in increased development. In practice, ecotourism has often failed to deliver the expected benefits to indigenous communities due to a combination of factors, including shortages in the endowments of human, financial and social capital within the community, lack of mechanisms for a fair distribution of the economic benefits of ecotourism, and land insecurity. Based on a review of experiences, we analyze the complex interaction among the factors shaping the success and failure of ecotourism experiences in indigenous communities, and we stress the need for a better approach to enhance the indigenous communities' livelihood possibilities coming from ecotourism, as well as to promote land tenure and communities' empowerment.

Ecological restoration programs and payments for ecosystem services as integrated biophysical and socioeconomic processes—China's experience as an example

- Ecological Economics---2012---Runsheng Yin, Minjuan Zhao

Ecological restoration programs and payments for ecosystem services have both attracted broad academic and policy attention. While they are inherently linked and thus should be part of the integrated processes of ecosystem management, they have been largely pursued separately. The majority of restoration ecologists and socioeconomic scholars tend to dwell in their own “comfort zone” and concentrate on different, disciplinary facets of the same issues. However, this situation is not conducive to the accomplishment of their common cause. The objective of this paper is to make a case for more effective efforts in integrating ecological restoration programs and payments for ecosystem services and thus more substantive interdisciplinary collaboration in the science and practice of ecological restoration and ecosystem service provision. To that end, the relevant research developments and bodies of literature are carefully reviewed, and China’s recent experience and lessons in retiring and converting degraded cropland extensively presented. It is hoped that these efforts will highlight the challenges and opportunities in the current state of affairs and convince scientists in different disciplines to work together in better and more broadly integrated research of ecological restoration programs and payments for ecosystem services.

Incorporating the value of ecological networks into cost–benefit analysis to improve spatially explicit land-use planning

- Ecological Economics---2012---Aris Gaaff,Stijn Reinhard

Our research is based on the assumption that cost–benefit analysis facilitates efficient and effective decision-making in spatially explicit land-use planning where there are competing land uses. Land-use planning can be improved if the value of the spatial relationships between land uses can be computed sufficiently easily. In this paper, we developed an economically sound way to incorporate the spatial dimensions (size and connectedness) of ecological networks within cost–benefit analysis. The methodology computes the value of ecological networks by accounting for the es-

sential spatial characteristics (size and configuration) of areas of natural land. This methodology can be generalised to other land uses, which we illustrate using a hypothetical case study that contains all the relevant elements. The optimal configuration of different land uses, which accounts for the value of the ecosystem network, will generate a land-use plan with the highest net benefit.

Cross-cultural environmental research in New Zealand: Insights for ecological economics research practice

- Ecological Economics---2012---Derrylea J. Hardy,Murray G. Patterson

Indigenous cultures and knowledge systems have been virtually ignored by Ecological Economics theory and practice, in spite of the increasing willingness of indigenous peoples to engage in the holistic and integrative research that ecological economists aspire to. This paper draws on the involvement of ecological economists in cross-cultural research in New Zealand, to distill insights on how ecological economists can usefully and legitimately engage with indigenous peoples in environmental research. The main bodies of western ecological knowledge are reviewed and compared with indigenous knowledge, illuminating the main similarities, differences and challenges. This leads into a broader analysis of how these different ‘knowledge systems’ can be mobilised to provide cross-cultural environmental research of practical use to indigenous peoples. Accordingly, principles, characteristics, and structures of applied cross-cultural environmental research are discussed, not as a prescriptive template but as suggestions for future researchers. We conclude that Ecological Economics is well placed to embrace the perspectives and frameworks of indigenous and western knowledge systems. We strongly assert, however, that methodological pluralism needs to be practiced, not just preached. Ecological economists need to resist ‘knowledge imperialism’ and even ‘knowledge integration’ (except where appropriate), which has sometimes been the case in the recent Ecological Economics literature.

Environmental poverty, a decomposed environmental Kuznets curve, and alternatives: Sustainability lessons from China

- Ecological Economics---2012---Lee Liu

Amid increasing recognition of the importance of the environmental factor in understanding poverty and development, this article coins the term “environmental poverty” to refer to the lack of the healthy environment needed for society’s survival and development as a direct result of human-induced environmental degradation. A decomposed environmental Kuznets curve (EKC) demonstrates that places (such as countries, counties, or cities) following the “grow first, clean up later” approach (or the first half of the EKC) may obtain economic gains accompanied by extreme environmental sacrifice, excessive social injustice, and income and environmental inequalities. The same place may include communities whose curves differ in shape. Some communities may prosper at the expense of other communities, which may fall into environmental poverty and eventually irreversible environmental degradation and economic failure. Places following alternatives or “flat EKCs” may be slow in getting out of economic poverty, but enjoy a healthier environment, equality in income and environmental quality, and social justice. Countries, especially developing countries, should aspire to sustainable alternatives.

Useful work and information as drivers of economic growth

- Ecological Economics---2012---Benjamin Warr, Robert U. Ayres

A semi-empirical endogenous growth theory was proposed by the authors in 2005. It is based on a model of the economy as a two-stage materials/energy processing system. Growth is simulated by a two-parameter production function with two traditional factors, labor and capital, and a non-traditional factor, namely ‘useful work’. The non-traditional factor is calculated from primary energy inputs multiplied by an empirically estimated average energy conversion efficiency, which is a function of changing technology over

time. This model ‘explains’ past US growth from 1900 through 1973–74 with satisfactory accuracy but it slightly underestimates subsequent growth (i.e. it leaves a small unexplained but increasing residual) for the period after 1975. However, by subdividing capital stock into traditional and ICT components, we are able to extend the theory to explain US economic growth accurately. In this paper we also extend the results to Japan. The revised production function has only three independent parameters. The new model also has implications for future economic growth, energy and environmental policy that differ significantly from the traditional growth theory. These implications are discussed briefly.

An analysis of the world’s environment and population dynamics with varying carrying capacity, concerns and skepticism

- Ecological Economics---2012---Peter Berck, Amnon Levy, Khorshed Chowdhury

Because of the open-access nature of the environment we consider an ad hoc adjustment of people’s environmental footprint to the quality of the environment. The adjustment is motivated by environmental concern, but hindered by skepticism about announced changes in the state of the environment. Changes in the quality of the environment affect Earth’s carrying capacity. By expanding the Lotka–Volterra predator–prey model to include these features we show that, despite skepticism, the environment does not deteriorate to a state in which humans cannot exist. We also show that in the ideal case of no skepticism, the interplay between the non-optimally changing environmental concerns and carrying capacity leads the world’s environment and human population to a unique interior steady state along an oscillating course. These results require no further technological, social or international progress.

The public finance potential of community forestry in Nepal

- Ecological Economics---2012---Bir Bahadur Khanal Chhetri, Jens Lund, Øystein Juul Nielsen

This paper explores the public finance potential of community forestry in Nepal on the basis of a comprehensive dataset on forest revenue and expenditures of 41 randomly selected community-forest user groups (CFUG) from Gorkha district. The results show that CFUG income distribution is highly skewed; the high- and low-income one-third of CFUGs in the sample account for 74.3 and 4.1% of the total income, respectively. CFUG income depends on age of the CFUG institution, CFUG membership size, and, in particular, on whether the community forest features the valuable timber species Sal (*Shorea robusta*, C. F. Gaertn.) and/or Chir Pine (*Pinus roxburghii* Sarg.). CFUG expenditure pattern is also highly skewed, with 85.2% of all public services and infrastructure financed by the one-third high-income CFUGs. CFUG financing of public services and infrastructure is shaped by income, management costs, and socio-political and contextual factors, such as whether the CFUG jurisdiction covers several wards and the presence of existing public infrastructure in the community. Finally, results show that the amounts of revenue generated through community forestry are negligible when compared to households' private gains from extraction of products from community forests, indicating a limited potential for redistribution of benefits under the current taxation system.

Learning-by-doing and the costs of a backstop for energy transition and sustainability

- Ecological Economics---2012---Pierre-André Joutet, Ingmar Schumacher

We assess the impact of being able to substitute an unlimited but costly energy substitute (like wind, solar) for a non-renewable resource (like oil, coal) in a model of sustainable growth. The prospects for sustainability on the optimal path depend crucially on the costs of this substitute. Furthermore, the poorer a country, measured in terms of capital stock at a given point in time, the later it should switch to the renewable substitute, and the more likely it will be unsustainable. Taking learning-by-doing in account, we find that this leads to an earlier switching time but does not

guarantee sustainability.

Which factors influence the expansion of bioenergy? An empirical study of the investment behaviours of German farmers

- Ecological Economics---2012---Christian Reise, Oliver Musshoff, Karol Granoszewski, Achim Spiller

The German government is planning to increase the share of renewable energy sources. In this context, it is important to understand the decision-making behaviour of farmers regarding investments in renewable energy systems that generate energy from biomass and farmers' reactions to investment-support measures. To study this behaviour, we conduct a survey and confront farmers with a hypothetical opportunity to invest in a biogas plant. Our findings reveal that farmers have heterogeneous investment thresholds. Their investment decisions are mainly driven by capital costs and the subjective perception of the risk resulting from the investment. Other decision parameters like sustainability and non-monetary objectives that are also examined in this paper, play only minor roles. However, bounded rationality is an important factor. Moreover, the influence of an investment subsidy was analysed. Only about half of the amount of the subsidy — as expected according to normative forecast models — is reflected in an increased willingness to invest. Furthermore, farmers who have previously invested in bioenergy plants show lower investment thresholds and have stronger reactions to the subsidy. Regarding the expansion of renewable energies these findings are meaningful for policy impact analysis.

Determinants of participation versus consumption in the Nordic Swan eco-labeled market

- Ecological Economics---2012---Keith Brouhle, Madhu Khanna

This paper analyzes the determinants of demand for Nordic Swan eco-labeled paper products and whether the factors determining the discrete decision to buy

a Swan-labeled product are different from those that determine the quantity purchased. Using observed consumer purchase data from Denmark, we find that prices and socio-demographic characteristics have a strong impact on the decision to purchase a Swan-labeled good. The quantity consumed of Swan-labeled goods, on the other hand, is strongly affected by the availability of Swan goods, discounts, and household size.

Global energy modelling — A biophysical approach (GEMBA) part 1: An overview of biophysical economics

- Ecological Economics---2012---M. Dale,S. Krumdieck,P. Bodger

Economists, investors and policy makers need to understand energy systems and the potential for investment in both alternative energy supply and demand side technologies. Biophysical economics has contributed to conventional economics by incorporating thermodynamic and ecological principles and emphasising the importance of natural resources to economic processes. This paper is presented in two parts. Part 1 gives a historic review of biophysical economics and discusses some previous models of the energy-economy system built around the principles of biophysical economics. Part 2 presents the GEMBA model — a new modelling methodology in the biophysical economics tradition. The methodology proposes a new and important contribution to the field of biophysical economics; a lifetime evolving function for the dynamics of the energy return on investment (EROI). The dynamic EROI function was incorporated into the GEMBA model and implemented in Vensim. The model is calibrated using historical energy production data, i.e. trained to historical data. The trained model is run to 2100 under a variety of assumptions regarding availability of energy resources and corresponding EROI's. The main finding of the model is that growth of the renewable energy sector may impact investment in other areas of the economy and thereby stymie economic growth.

Global energy modelling — A biophysical approach (GEMBA) Part 2: Methodology

- Ecological Economics---2012---M. Dale,S. Krumdieck,P. Bodger

Economists, investors and policy makers need to understand the changing climate of energy systems and the potential for investment in both alternative energy supply and demand side efficiency and management technologies. Biophysical economics has contributed to conventional economics by incorporating thermodynamic and ecological principles and emphasising the importance of natural resources to the economic process. This paper is presented in two parts. Part 1 gives a historic review of biophysical economics and discusses some previous models of the energy-economy system built around the principles of biophysical economics. Part 2 presents the GEMBA model — a new modelling methodology in the biophysical economics tradition. The methodology proposes a new and important contribution to the field of biophysical economics; a lifetime evolving function for the dynamics of the energy return on investment (EROI). In the development stage of a new resource, EROI increases due to technological learning, market growth and capital investment. EROI then reaches a peak as diminishing returns are experienced on further technological innovation and capital investment. In the later stage EROI declines over time as the most accessible resources are developed first, resources become depleted, or scarcity develops for materials needed to extract, process or convert the energy for the market. EROI can also diminish over time as environmental restoration or emission reduction becomes required by the society. The dynamic EROI function was incorporated into a global energy model using a biophysical approach (GEMBA) and implemented in VenSim. The GEMBA model is calibrated using historical energy production data, i.e. training to historical data, then running the trained model to 2100 under a series of varying assumptions regarding availability of energy resources and corresponding EROIs. The main finding of the model is that growth of the renewable energy sector may impact investment in other areas of the economy and thereby stymie economic growth.

Testing participation constraints in contract design for sustainable soil conservation in Ethiopia

- Ecological Economics---2012---Abonesh Tesfaye,Roy Brouwer

This paper focuses on contract design to improve the incentive structure of current coordination mechanisms related to sustainable land use management in the Ethiopian highlands. The main objective is to assess whether, and if so under which terms and conditions, rural households are willing to enter into contractual agreements to invest in soil conservation measures on their land. Participation constraints are tested under different soil erosion and institutional-economic conditions in a choice experiment targeting 750 rural households. We show that contracts provided by local government peasant associations offering additional credit, land use security and extension services could be an effective means to increase the share of farmers implementing soil conservation measures. However, trust in contract terms and conditions appears to play an important role. Farmers living in the most erosion prone areas are most likely to participate, while farmers taking soil conservation measures already are less likely to enter into a contractual agreement with the local government. Farmers not taking soil conservation measures will only do so if the contract price is lower than or equal to the income losses suffered from soil erosion.

The regulation of non-point source pollution and risk preferences: An experimental approach

- Ecological Economics---2012---Eva Camacho-Cuena,Till Requate,Eva Camacho Cuena

Many environmental problems, notably arising from agriculture, can be classified as non-point source pollution problems. In this paper we present results of an experimental study on the performance of three mechanisms designed to deal with such problems: collective fining, random fining, and a tax-subsidy scheme. We find that the fining schemes induce under-abatement, a feature being enforced with experience. We further

elicit the participants' risk attitude and show that the performance of collective fining is not affected by the subjects' risk preferences. Under a system based on random fining the performance of the mechanism worsens in the presence of risk seeking subjects. However, coordination on over-abatement under the tax-subsidy can be alleviated if subjects are risk averse.

Political consumerism and public policy: Good complements against market failures?

- Ecological Economics---2012---Philippe Delacote,Claire Montagné-Huck

Political consumerism has become over the past years an ever growing phenomenon, by which citizens express through their consumption their political, environmental and ethical opinions. This paper discusses political consumerism from an economic science perspective, focusing on the link between political consumerism and public policies. It wonders to what extent political consumerism may represent an effective and fair instrument against market failures. Overall, it seems that it would be better to consider it as a complement to conventional public policies.

A bioeconomic model of trophy hunting

- Ecological Economics---2012---Eric Nævdal,Jon Olaf Olaussen,Anders Skonhoft

During the last few decades wildlife trophy hunting has increasingly replaced traditional meat hunting. The economics of trophy hunting is analyzed with the Scandinavian moose (*Alces alces*) serving as an example. A four-stage model (calf, yearlings, adult female and adult male) is formulated. The calves, yearlings, and females are hunted for meat, while the males are hunted for trophies and where the demand for trophy hunting depends on price and quality. We find that trophy hunting boosts the male population and yields a high ratio of males to females. The main reason for this result is that we consider a management scheme with well defined property rights and not of the 'open-access' type, and where the key mechanism is the quality demand effect in trophy hunting. In an extended model

where ecological theory of animal adoption to hunting is assumed to influence the biology through fertility we still find that trophy hunting boosts the male stock.

Clarifying protected and utilitarian values of critical capital

- Ecological Economics---2012---Leonie J. Pearson, Yoshihisa Kashima, Craig J. Pearson

Sustainable development may be defined as a non-declining value of capital stocks (social, natural, built and human) over time. The ability for substitution between and within each stock over time has been widely debated, resulting in the identification, and then preservation of ‘critical capital stocks’. We propose that ‘critical’ can be defined from two ethical perspectives; teleological or consequentialist (goal or ends based) and deontological (moral duty and rule based). The consequential ethic ensures critical capitals are ‘utilitarian’ in value and they generate goods and services for the maintenance of human well-being. Whilst deontologically critical capital depends on culturally and psychologically ‘protected’ values, which may vary locally or at least (as for, e.g., biodiversity) be open to conflicting opinions. This separation in the basis for defining critical capital stocks leads to awareness that some tradeoffs between critical capital stocks may be irreconcilable or likely to lead to outrage. A framework is developed to guide practitioners as to how to identify critical capital stocks using both protected and utilitarian values. Examples show that ‘protected’ values are likely to be specific to community (ethnic, religious, cultural, etc.) and require different methods for resolving substitutability of capital stocks to achieve sustainable development.

Impacts of carbon-based policy instruments and taxes on tropical deforestation

- Ecological Economics---2012---Sepul K. Barua, Jussi Uusivuori, Jari Kuuluvainen

The impacts of carbon payments and income taxes on curbing tropical forest loss are analyzed under a market equilibrium framework. The supply of cleared

forest land was derived by using a two-period utility maximization model when the carbon sequestration of a private forestholder is credited. The land demand was derived from the profit maximization problem of a cash-crop farmer. The model was applied to data from the humid Chaco eco-region of Paraguay. The results indicate that taxes on cash-crop and forestry incomes may in fact be ineffective in curbing forest loss. Carbon payments, however, would effectively reduce forest clearing. In the context studied, a carbon payment of €30 per ton of carbon would limit deforestation to 10% of existing forest cover. A reversible carbon crediting system, in which a forestholder can redeem a credited forest, seems to substantially increase, at least in the short run, the effectiveness of carbon payments. Carbon payments could also complement the tax on cash-crop income in curbing tropical forest loss. An effective policy to combat tropical deforestation should, therefore, jointly consider forestry and cash-crop sectors.

Prosocial behavior and incentives: Evidence from field experiments in rural Mexico and Tanzania

- Ecological Economics---2012---John Kerr, Mamta Vardhan, Rohit Jindal

Incentive-based schemes for natural resource conservation are based on the premise that offering payments to groups of land users will motivate them to organize collectively to provide environmental services. In contrast, research from behavioral economics shows that introducing monetary incentives can undermine collective action that is motivated by social norms. In such a case payment could have perverse impacts. In view of this dichotomy, we conducted choice and field experiments in rural Mexico and Tanzania to test the response of prosocial behavior to incentives. The field experiments involved voluntary participation in real communal tasks under different incentive structures. Findings suggest that payments help raise participation where people are otherwise uninterested, but that participation in communal tasks can be high irrespective of the incentive if social norms favoring participation

are present. In Tanzania, high individual payments do not undermine participation although they appear to reduce people's satisfaction from the task relative to when there is no payment. In Mexico, group payments made through village authorities yield lower participation where people distrust leaders.

Sustainability economics, ontology and the capability approach

- Ecological Economics---2011---Nuno Martins

The relationship between sustainability economics and the capability approach has recently been explored. Here I shall discuss this relationship, and argue that a study of the ontology underlying the capability approach can help us to see more clearly the interconnections between sustainability economics and the capability approach. In particular, the interpretations of the capability approach as an ontological exercise, which have recently emerged in the literature, enable us to have a better understanding of the essential categories used in the capability approach, and to establish a clearer connection between the capability approach and sustainability economics.

Evolution of population-resource dynamics models

- Ecological Economics---2011---Yoko Nagase, Takuro Uehara

This paper provides a comprehensive analysis of Brander and Taylor's (1998) model and its descendants from the following perspectives: population growth, substitutability, innovation, capital accumulation, property rights and institutional designs, and modeling approach. This survey aims to contribute to a better understanding of population and resource dynamics models in general and facilitate further application of the model framework to relevant circumstances.

Modeling the bio-refinery industry in rural areas: A participatory approach for policy options comparison

- Ecological Economics---2011---Antonio Lopolito, Gianluca Nardone, Maurizio Proserpi, Roberta Sisto, Antonio Stasi

The development of bio-refineries has become a relevant topic in the EU's agenda. However, the promotion of a new industry in rural areas is typically hindered by the scarcity of human capital, lack of information, infrastructures, and competing interests. In this context, public support is unavoidable to assist promotion of this innovative sector. The various policy options reveal some strengths and drawbacks, posing the problem of finding the best trade-off to public decision makers. In this paper we aim at developing a methodology to support policy decision making within the biorefinery framework, with the purpose of determining a way to identify the most suitable policy option given the actual uncertainty in developing the bio-refinery industry in rural areas. The empirical experiment, based on a simulation of the enforcement of four identified policy instruments, highlights that, although subsidies and incentives to profitability of dedicated crops appear to have the greatest effects on the development of bio-refinery, the best performances are exhibited by technological innovation and information options.

The innovation effects of environmental policy instruments — A typical case of the blind men and the elephant?

- Ecological Economics---2011---Rene Kemp, Serena Pontoglio

In this paper we examine the innovation effects of environmental policy instruments in four literatures: theoretical models on incentives for eco-innovation, econometric studies based on observed data, survey analysis based on stated information and technology case studies. The aim of this paper is to critically examine the methods and the results. We argue that the case studies literature, even when its results are specific and difficult to generalise, is a necessary source

of empirical evidence about policy impacts and the factors responsible for these impacts, pointing to issues that are neglected in the theoretical and econometric literature such as the specifics of the innovation context and policy interaction effects. The paper states five synthesised findings and makes a plea for multi-method analysis. One other important synthesised finding is that the influence of market-based instruments on innovation (such as emission trading and taxes) is far weaker than assumed.

Reducing protest responses by deliberative monetary valuation: Improving the validity of biodiversity valuation

- Ecological Economics---2011---Zoltán Szabó

This paper focuses on examining the validity of biodiversity valuation methodologies. The results of a group deliberation technique (deliberative monetary valuation) are compared to those derived from a contingent valuation (CV) survey using the same environmental topic. Evidence is here presented that DMV can address some of the limitations of CV; namely a prevalence for lexicographic preference ordering due to psychological reasons and the lack of a priori or well-formed preferences. Both of these methodological shortcomings can result in protest responses which decrease the external validity of results. It is common environmental valuation methodology practice to exclude protest responses from the analysis on the grounds that they are illegitimate choices, thus the sample and consequently the environmental valuation analysis may become less representative of the population. An advantage of the DMV methodology is that it was found to significantly reduce the rate of protest responses to less than half (from 29% to 13%). Furthermore, DMV significantly increased the proportion of positive bids but not the amounts contributed. In relation to preference formation issues, we suggest rethinking the current practice of the DMV method, and propose dedicating the entire initial discussion session to introducing the good outside of a valuation context.

Climate change economics and discounted utilitarianism

- Ecological Economics---2011---Ulrich Hampicke

In the recent debate on climate change economics triggered by the Stern Review and his opponents, fundamental methodological issues emerge. It becomes obvious that different choices for some variables in the models applied lead to vastly different conclusions. Specifically, the choice of the pure time discount rate δ decides on whether immediate strong action (in the Stern Review) or a more moderate response (as in Nordhaus' writings) is the right strategy facing the climate change challenge. This contribution critically comments the use of both δ and η , the elasticity of marginal utility with respect to income, as "adjustment screws" in models of climate economics. Often, the models remain ambiguous as to whether they apply empirical or normative variables; facts and value judgments are not sufficiently distinguished. Furthermore, Discounted Utilitarianism appears to be a questionable fundament for climate change economics. From a non-utilitarian, specifically a Rawlsian point of view, it is pointless to maximize the utility an abstract, eternally-long lived phantasm "humanity" where no human individuals are distinguished. The more persuading position in climate economics is to postulate a duty to do everything in order to avoid serious evil for future generations.

Using an adapted HEP to assess environmental cost

- Ecological Economics---2011---Nathalie Dumas, Anne Rozan

The situation regarding the loss of biodiversity and ecosystem services is now critical. Consequently, environmental targets have been determined and environmental legislations at every level tend to be more demanding. The result at local scale is that land planners have to take more rigorous account of the environmental damage stemming from their infrastructure development plans. Several economic valuation methods can be used to perform a monetary valuation

of losses of natural areas. However, existing valuation methods have reached their limits when dealing with land planning in complex natural areas (i.e. unfamiliar goods). We propose to use a method based on the American Habitat Evaluation Procedure (HEP) to assess the environmental cost of infrastructure development plans. The “adapted” HEP is an equivalence-based valuation method that bases the valuation of environmental cost on the environmental damage itself rather than willingness to pay. We find that compared to more conventional methods, the “adapted” HEP gives a higher value to lost environmental assets, which is rather promising.

Examining the drivers of total factor productivity change with an illustrative example of 14 EU countries

- Ecological Economics---2011---Bernhard Mahlberg, Mikulas Luptacik, Biresh Sahoo

Based on the different models developed by Korhonen and Luptacik [Korhonen, P., Luptacik, M., 2004. Eco-efficiency analysis of power plants: An extension of data envelopment analysis. *European Journal of Operational Research* 154, 437–46], this contribution centers on the development of an intertemporal comparison in order to analyze eco-efficiency change over time. In this setup two model variants by Korhonen and Luptacik (2004) are used in order to provide deeper insights concerning the driving forces for the change in the eco-efficiency. Which bias in technical change can be observed? Is it more input-saving or pollution-reducing? For illustration purposes the proposed approach is used to analyze the performance of 14 countries of the European Union for the period 1995–2004. An average eco-productivity growth of 22% is observed. The estimated contribution of improved use of input is 20% and that of reduced relation of greenhouse gas emissions is 23%. Therefore it is concluded that, on average, the eco-productivity growth is more driven by improved environmental conditions.

What STIRPAT tells about effects of population and affluence on the environment?

- Ecological Economics---2011---Taoyuan Wei

In the literature on the application of STIRPAT to environmental impacts of population and affluence, the parameter estimates differ from study to study. One example is the effect of population size on CO₂ emissions, which is concluded to be very close to 1 in some studies (e.g., York et al., 2003) while far from 1 in others (e.g., Shi, 2003). What can explain these differences in results? In the present paper, I offer an alternative model equivalent to STIRPAT, which explicitly specifies the different role of technology (T) in STIRPAT from IPAT. By the alternative model, I conclude that different functional forms of STIRPAT can be one explanation for the difference among estimates in the studies on environmental impacts of population and affluence. The alternative model can also help to determine which factors to be added in STIRPAT.

Are pro-environmental consumption choices utility-maximizing? Evidence from subjective well-being data

- Ecological Economics---2011---Heinz Welsch, Jan Kühling

This paper studies whether pro-environmental consumption choices are consistent with utility maximization and what role the consumption behavior of reference persons and one's own past behavior play in this context. By combining data on individuals' pro-environmental consumption from a unique data set with data on subjective well-being, we find that people could attain higher well-being (utility) by unilaterally consuming more environmentally friendly while at the same time reducing the quantity consumed. The distortions identified are smaller when people's reference persons consume more environmentally friendly and when the individual has a longer environmental friendly consumption history. We therefore conclude that learning from the behavior of others and from one's own past experience may help alleviate decision error in environment-friendly consumption.

Trophically balanced sustainable agriculture

- Ecological Economics---2011---J.R. Schramski,Z.J. Rutz,D.K. Gattie,K. Li

Considering an economy without fossil fuels, literally built from the ground, then up, we developed several interactive research models of biointensive farms that use no fossil fuels. Quantifying and summarizing total human labor-energy input and total caloric energy output, we demonstrate that a successfully designed farm can produce a positive energy-return-on-investment (EROI) leaving excess caloric energy available for building economic-community structures (e.g., schools and hospitals). Farm products with negative EROI must be coupled with other products with positive EROI to assure nutritionally balanced diets are maintained while still achieving an overall positive EROI for the total agroecological operation. We show that similar to the ecosystem, energy budgets are tight which makes for difficult decisions on diet, farm plot diversity, and energy profitability for future growth. Considering the totality of this low energy agro-system based economy, we simplify many operational variables into a unique graphical solution space, which reveals both reasonable expectations of agroecological EROI performance, and extreme asymptotes, beyond which indicate regions of system failure.

Economic development and losses due to natural disasters: The role of hazard exposure

- Ecological Economics---2011---Ingmar Schumacher,Eric Strobl

Our contribution is to show that the relationship between wealth and disasters is mainly formed by the exposure to disaster hazard. We first build a simple analytical model that demonstrates how countries that face a low hazard of disasters are likely to see first increasing losses and then decreasing ones with increasing economic development. At the same time, countries that face a high hazard of disasters are likely to experience first decreasing losses and then increasing ones with increasing economic development. We then use a cross-country panel dataset in conjunction with a

hazard exposure index to investigate whether the data is consistent with the predictions from the model. In line with our model, we find that the relationship of losses with wealth crucially depends on the level of hazard of natural disasters faced by countries.

Valuing scenic amenity using life satisfaction data

- Ecological Economics---2011---Christopher L. Ambrey,Christopher Fleming

The life satisfaction approach has recently emerged as a new technique in the suite of options available to non-market valuation practitioners. Employing data from the Household, Income and Labour Dynamics in Australia (HILDA) survey and Geographic Information Systems (GIS), this paper examines the influence of scenic amenity on the life satisfaction of residents of South East Queensland (SEQ), Australia. Measuring scenic amenity on a 10-point scale, it is found that, on average, a respondent is willing-to-pay approximately AUD\$14,000 in household income per annum to obtain a one-unit improvement in scenic amenity. However, on closer inspection, we find that the relationship between willingness-to-pay and the level of scenic amenity is not linear. To our knowledge, this is the first paper to value scenic amenity using the life satisfaction approach and is the first paper to use this approach to value any type of environmental good or service in SEQ. As such, this paper represents a genuine contribution to a small, yet growing, body of literature.

Distributing water's bounty

- Ecological Economics---2011---Ronald C. Griffin,James W. Mjelde

Following an investigation of theoretical issues and an inventory of modeling requirements, support for increasing block rates is examined empirically, through comparison to a uniform rate that includes scarce water value. Using a single-year, monthly simulation model, it is found that under conditions of scarcity, households using smaller amounts of water are better off with a uniform rate than an increasing block.

Large water users have opposing preferences. Similar results arise for those household characteristics which are correlated with water use, such as income, property value, number of residents, and outdoor area of the property. For example, low-income households prefer scarcity-inclusive uniform rates over increasing block rates when scarcity is present. Therefore, in contrast to popularized opinion, increasing block rates do not place the welfare burden of conservation on large water users, nor do such rates favor low-income people in scarce-water circumstances.

Evaluation of welfare functions of environmental amenities: A case of forest biomass fuels in Mount Kilimanjaro, Tanzania

- Ecological Economics---2011---Martin Herbert Kijazi, Shashi Kant

This study is an empirical investigation of welfare functions of forest biomass fuels in Mount Kilimanjaro, Tanzania. The want parameter of welfare function was found to vary with household's current fuel consumption which reflects people's amenity aspirations shift with the amenity level attained. Furthermore, current wood consumption and welfare sensitivity parameter are also influenced by individual's environmental entitlements rather than economic entitlements. Resource scarcity induced by physical scarcity or institutional-legal constraints leads to resource conserving attitude, but not without loss in perceived well-being. Communal conservation of energy is also observed whereby large households are more energy conserving than small households. Regarding biomass use and consumption, monetary income does not guarantee satisfaction, but heightens people's wants. Thus, rural development programs should not focus on economic empowerment only but also on environmental sustainability and fair resource use rules.

The willingness to adopt agro-ecological innovations: Application of choice modelling to Caribbean banana planters

- Ecological Economics---2011---Jean-Marc Blazy, Alain Carpentier, Alban Thomas

This paper proposes an ex ante evaluation of the willingness to adopt agro-ecological innovations aimed at reducing pesticide use for banana production in the French West Indies. Four innovative systems, including intercropping, improved fallow and new pest-tolerant varieties, are proposed to a sample of 607 planters, with innovation and policy attributes calibrated from a bio-economic farm model. The model interacts technological and economic innovation attributes with farmer individual factors, and allows for a dual source of unobserved heterogeneity. We estimate a system of random coefficient Logit models, to obtain marginal values of innovation traits that can be useful for targeting farm types with appropriate innovations and designing policies for securing agricultural revenue.

The paradox of growth critique: Narrative analysis of the Finnish sustainable consumption and production debate

- Ecological Economics---2011---Annukka Berg, Janne I. Hukkinen

Academic discussion on economic growth and the environment has made a comeback under the auspices of the degrowth debate. To date, however, literature on the topic has been mainly theoretical and empirical studies of actual policy discussions have received less attention. This article contributes to the debate with a narrative policy analysis of interviews with members of Finland's Committee on sustainable consumption and production. Narrative policy analysis is suitable for complex policy cases. By tracing and comparing the different stories, non-stories and counterstories in the debate, the analysis clarifies the issue and paves the way for solutions. We found that it is common even among business and ministry representatives to criticize the current growth-bound economic system. From the perspective of narrative policy analysis, however, this critique only increases uncertainty and complexity in the policy field which, paradoxically, leads to a strengthening of the dominant growth stories. We suggest that constructing a complete degrowth story is essential for supporting democratic deliberation on sustainability. Robust institutional support for degrowth

work together with research and experimentation are important milestones on the way.

Landscape aesthetics: Assessing the general publics' preferences towards rural landscapes

- Ecological Economics---2011---Peter Howley

The central aim of this study was to gain greater insights into the factors that affect individuals' preferences for a variety of landscape settings. Using a nationally representative survey conducted in the summer of 2010 of 430 individuals living in Ireland, this paper derived dependent variables (based on a factor analysis of respondents mean ratings of 47 landscape images) representing 5 different landscape categories. These variables were then utilised in separate OLS regression models to examine the effect of personal characteristics, residential location and environmental value orientations on landscape preferences. First in terms of visual amenity the results suggest that the general public have the strongest preference for landscapes with water related features as its dominant attribute which was followed by cultural landscapes. Second the results also demonstrate how there is significant heterogeneity in landscape preferences as both personal characteristics and environmental value orientations were found to strongly influence preferences for all the landscape types examined. Moreover the effect of these variables often differed significantly across the various landscape groupings. In terms of land use policy, given the diversity of preferences a one size fits all approach will not meet the general publics' needs and desires.

Humans, environment and economies: From vicious relationships to virtuous responsibility

- Ecological Economics---2011---Olivia Bina,Sofia Guedes Vaz

The debates questioning the meaning of growth point to a need for a more holistic understanding of human beings and of the economic actor, fundamental to economic theory and practice. This contribution turns to virtue ethics in order to reframe the self in more

reflexive, relational and environmental terms. We explore the significance of understanding humans' sense of responsibility that is quintessentially relational, and of their capacity and need to relate to nature as well as community and society. We begin by reviewing the main arguments in the thriving debate in ecological economics, around what the characteristics of the human being can contribute to implement an ecologically sustainable development. Our aim is then to draw a link between this debate and that of virtue ethics, that leads to a different understanding of the human being, of what can contribute to individual wellbeing (and a good life): responsibility, we argue, is not only a value but a virtue, that enables individuals to find meaning in acting responsibly towards the environment, emphasising the multiple benefits that arise from framing good lives in active terms. We conclude reflecting on the challenges to, and implications of our proposition for government institutions, particularly education.

Historical iron and steel recovery in times of raw material shortage: The case of Austria during World War I

- Ecological Economics---2011---Manfred Klinglmair,Johann Fellner

This paper investigates, by means of material flow analysis, the supply management of iron during a historical period of increased demand and induced shortage. The Austrian economy during World War I, when numerous raw materials had to be substituted by secondary sources, is analyzed as an example.

Contribution of wetland agriculture to farmers' livelihood in Rwanda

- Ecological Economics---2011---N.L. Nabahungu,S.M. Visser

This study analyzes factors that contribute to the livelihood of smallholder farmers living in the vicinity of the Cyabayaga and Rugeramigozi wetlands. Three tools were used: 1) focus group discussion 2) formal surveys and 3) Monitoring for Quality Improvement

(MONQI). Farming systems in wetlands and on hill-sides differ. Level of education, resource availability, land ownership and location have an important impact on the location and type of farming systems practiced by households. The dependency of households on wetlands varies between sites. Field size, status of soil fertility and input use are also key factors determining the level of contribution that wetland agriculture makes to farmers' livelihood. In Cyabayaga, the per household per year contribution of wetland cultivation to gross margin (GM) was 74% (\$1901) compared to 24% (\$84) in Rugeramigozi. The rice in Cyabayaga was the largest contributor to household income providing on average \$1045 per household per season. Vegetables cultivated in the dry season in Rugeramigozi have high potential as cash crops. Poor maintenance of drainage and irrigation channels as well as inappropriate cropping systems in wetlands can undermine sustainability and have repercussions for the livelihoods of farmers dependent on agricultural wetlands.

Is agriculture compatible with free trade?

- Ecological Economics---2011---Wanki Moon

This article examines the relationship of free trade with agriculture in view of agriculture's distinctive features in the following three ways. First, agriculture produces a wide array of local and national nonmarket goods and services (in addition to market commodities) collectively known as multifunctionality of agriculture. Second, agriculture is intimately associated with global public goods of grave importance to humanity such as climate change, sustainability, and food security (poverty/hunger) in developing countries that require transnational cooperation to minimize free-rider and consequent under-provision problems. Third, embodying the first and second problems, agriculture plays distinctively different roles across countries. Specifically, this article views the global agriculture as consisting of four broad groups of countries with widely divergent needs from agriculture. This article concludes that the above agriculture-related problems are too diverse and complex to be left to free trade. When the global community is too much preoccupied with the illusive

mission of agricultural trade liberalization, the great danger is that such preoccupation may distract it from effectively addressing the agriculture-related problems of the 21st century in a timely manner that pose imperative challenges to humanity. The governance for global agriculture should prioritize managing/taming such global problems rather than squandering time for unworkable liberalization of agricultural trade.

Compensation for environmental services from artisanal fisheries in SE Brazil: Policy and technical strategies

- Ecological Economics---2011---Alpina Begossi, Peter H. May, Priscila F. Lopes, Luiz E.C. Oliveira, Valéria da Vinha, Renato A.M. Silvano

Artisanal fisheries are of great importance in Brazil, as they are responsible for more than 50% of national fish production. This importance, associated with the necessity of conserving marine environments threatened by multiple competing uses, leads us to propose mechanisms for co-management of fisheries by users and public authorities. This proposal takes into account: a) local conflicts between artisanal and industrial fishers; b) local rules over the use of fishing areas established by artisanal fishers; c) the advent of protected areas that close access to some fishing areas used by artisanal fisheries; and d) co-management options being explored between government and fishers. This study suggests policy and technical alternatives under consideration to manage the artisanal fisheries of south-eastern Brazil with a focus on Ilha Grande bay in Rio de Janeiro. In our case study, based on field research conducted in 2009, we show that artisanal fishers are squeezed into a marine space between protected areas and industrial fishing. We suggest that a combination of fishing agreements (FAs), based on experience in Amazonian fisheries and extractive reserves, and payment for environmental services (PES), based on forest and related water resource experience, could improve management and livelihoods for local artisanal fisheries by stimulating and rewarding fishers who participate in conservation efforts. The two instruments (FAs and PES) are the subject of considerable research and prac-

tical experience. Their integration in an instrument mix represents a contribution from transdisciplinary fields of human ecology and ecological economics.

The evolution of environmentally responsible investment: An Adam Smith perspective

- Ecological Economics---2011---Julie Whittaker

This paper demonstrates that Adam Smith has common ground with contemporary social scientists who study the management of the common pool resources from an evolutionary perspective. Contrary to the caricature of Smith, presented by neoliberals, as a promoter of self-interest, he recognized the value of other-regarding behavior. Specifically focus is given to how such behavior can contribute to constructing institutional arrangements that can help to avoid damaging market excesses. A study of the development of a process to encourage investment behavior that is environmentally responsible, establishes that Smith's work has relevance for addressing environmental issues in our contemporary complex market system.

Multi-region input–output analysis of CO2 emissions embodied in trade: The feedback effects

- Ecological Economics---2011---Bin Su,B.W. Ang

Energy-related CO2 emissions embodied in international trade have been widely studied by researchers using the environmental input–output framework. Despite the increasing interest in using the multi-regional input–output (MRIO) model by researchers, few studies have looked into the mechanism of feedback effects. We introduce a method called the stepwise distribution of emissions embodied in trade (SWD-EET) to reveal how the emissions embodied in trade are absorbed by a country's final demands through a series of allocation steps. A country's indirect absorption patterns and its indirect trade balance of emissions from bilateral trade with other countries are also studied based on the proposed method. An empirical study using the data of Asian economies shows significant differences in the “consumption-based” emission estimates for

some economies due to feedback effects through international trade. The differences can be largely captured by the first step or the first two steps of the adjustment procedure in the SWD-EET analysis. Other findings and some recommendations are also presented.

Allocating biosecurity resources between preventing, detecting, and eradicating island invasions

- Ecological Economics---2011---Tracy M. Rout,Joslin L. Moore,Hugh P. Possingham,Michael A. McCarthy

Finding efficient ways to manage the threat of invasive species helps make the most of limited resources. Different management actions reduce the impact of invasions differently: preventing invasion eliminates impacts entirely, surveillance can facilitate early detection and eradication, and removing individuals can reduce future impact. Few studies have examined the trade-off between all three facets of invasion management. Using a simple model of island invasion, we find how resources should be allocated to each action to minimise the total cost of management and impact. We use a case study of black rat (*Rattus rattus*) invasion on Barrow Island, Western Australia. The optimal amount to invest in each management action depends on the effectiveness of each action, and the magnitude of impact caused by different stages of invasion. If the pest is currently absent, it is more cost-effective to prevent impacts through prevention or surveillance. If the pest is already widespread, it can sometimes be cost-effective to give up rather than attempting eradication. This model of invasion can provide useful decision support by identifying the trade-offs inherent in each candidate management strategy, the thresholds that alter optimal strategies, and the parameters for which we need more information.

Bio-economic modeling of water quality improvements using a dynamic applied general equilibrium approach

- Ecological Economics---2011---Rob Dellink,Roy Brouwer,Vincent Linderhof,Karin Stone

An integrated bio-economic model is developed to assess the impacts of pollution reduction policies on water quality and the economy. Emission levels of economic activities to water are determined based on existing environmental accounts. These emission levels are built into a dynamic economic model for the Dutch economy and subsequently coupled to a national water quality model. The modular approach has the advantage that the impacts on the economy and water quality are evaluated simultaneously, but each within their own domain based on the appropriate scale and level of detail. The dynamic nature of the economic model allows us to also evaluate a derogated water policy as foreseen in the European Water Framework Directive. The indirect costs of different water quality improvement policy scenarios are at least as high as the direct costs related to investments in pollution abatement technology. The stricter the policy scenario, the more important the role of economic adjustment and restructuring mechanisms at the macro-economic level. Significant water quality improvements can be achieved through stringent domestic emission reductions. However, reaching water quality standards is highly dependent on water quality improvement policy in surrounding river basin countries and climate change.

Valuing pollination services to agriculture

- Ecological Economics---2011---Rachael Winfree,Brian Gross,Claire Kremen

Crop pollination by animal pollinators is an important ecosystem service for which there is no generally accepted valuation method. Here, we show that two existing valuation methods, previously thought to be unrelated, are each a special case of a more general equation. We then present a new method, termed attributable net income, for valuing insect pollination of crops. The attributable net income method improves upon previous methods in three ways: (1) it subtracts the cost of inputs to crop production from the value of pollination, thereby not attributing the value of these inputs to pollinators; (2) it values only the pollination that would be utilized by the crop plant for fruit production, thereby not valuing pollen deposited in

excess of the plants' requirements; and (3) it can attribute value separately to different pollinator taxa, for example to native vs. managed pollinators. We demonstrate all three methods using a data set on watermelon pollination by native bees and honey bees in New Jersey and Pennsylvania, USA. We discuss the reasons why different methods produce disparate values, and why the attributable net income method most accurately reflects the actual ecosystem service that is being valued, marketable fruit production.

Community conservation and a two-stage approach to payments for ecosystem services

- Ecological Economics---2011---Matthew Cranford,Susana Mourato

Recent revisions to the theory and definition of payments for ecosystem services (PES) challenge the generally accepted dominance of direct incentives provided in a buyer-seller relationship. The revisionist thinking insists indirect incentives and a cooperative, reciprocal relationship are often more appropriate. Those characteristics, however, hark back to the indirect, cooperative interventions that constitute "community conservation", which PES was originally designed as an improvement over. In that context, this study revisits the criticisms and potential benefits of community conservation. We analyze a case study of community conservation in Peru and find that it supported an uptake of forest-friendly behaviors. We take up the suggestion of a two-stage approach to PES, but refine it based on our results that indicate an important role for cognitive (e.g. education) alongside structural interventions (e.g. provision of alternatives), and a strong role for social consensus to support conservationist behavior. Community conservation can provide these elements in a first-stage of PES to create a social context conducive to conservation. Without creating that context first, PES could destabilize local resource management norms rather than improve on them. With the social context established, however, a market mechanism can be implemented in the second stage to reinforce the new conservationist behavior.

An aggregate resource efficiency perspective on sustainability: A Sustainable Value application to the EU-15 countries

- Ecological Economics---2011---Frederic Ang,Steven Van Passel,Erik Mathijs

The Sustainable Value approach integrates the efficiency with regard to environmental, social and economic resources into a monetary indicator. It gained significant popularity as evidenced by diverse applications at the corporate level. However, its introduction as a measure adhering to the strong sustainability paradigm sparked an ardent debate. This study explores its validity as a macroeconomic strong sustainability measure by applying the Sustainable Value approach to the EU-15 countries. Concretely, we assessed environmental, social and economic resources in combination with the GDP for all EU-15 countries from 1995 to 2006 for three benchmark alternatives. The results show that several countries manage to adequately delink resource use from GDP growth. Furthermore, the remarkable difference in outcome between the national and EU-15 benchmark indicates a possible inefficiency of the current allocation of national resource ceilings imposed by the European institutions. Additionally, by using an effects model we argue that the service degree of the economy and governmental expenditures on social protection and research and development are important determinants of overall resource efficiency. Finally, we sketch out three necessary conditions to link the Sustainable Value approach to the strong sustainability paradigm.

Assessing the compatibility of farmland biodiversity and habitats to the specifications of agri-environmental schemes using a multinomial logit approach

- Ecological Economics---2011---Geraldine Murphy,Stephen Hynes,Eithne Murphy,Cathal O'Donoghue,Stuart Green

Farmers participating in agri-environmental schemes (AESs) that are aimed at protecting biodiversity should

ideally make decisions relating to the ecological management of their farms based on the habitat types found on their farms. In reality, a variety of economic, demographic, farm and farmer characteristics influence all the management decisions made by farmers, including those relating to AESs. In Ireland, the Rural Environment Protection Scheme (REPS) requires that farmers choose at least 2 biodiversity undertakings (BUs) from a menu as part of their AES contract. Using a multinomial logit model, the likelihood of farmers choosing different BUs was estimated using data from the 2007 National Farm Survey as a function of geo-referenced habitat data. A comparison was then made between the probable selection of BUs with what would be considered the optimal selection from an ecological perspective. The results indicate that farmers' most likely choices of BUs only sometimes equates with the optimal ecological choices. This highlights deficiencies in the design of REPS, knowledge of which is very timely, given the imminent replacement of REPS by a new AES.

Performance of an agro-forestry based Payments-for-Environmental-Services project in Mozambique: A household level analysis

- Ecological Economics---2011---Ravi Hegde,Gary Q. Bull

There has been a paucity of research on the impacts of small scale Payments-for-Environmental-Services (PES) projects in developing countries. The aim of this paper is to evaluate the household level impacts of a small scale agro-forestry based carbon sequestration project in rural Mozambique. In 2006, questionnaire based interviews were conducted quarterly of 290 randomly selected households in the buffer zone of the Gorongosa National Park in Mozambique. We used the propensity score matching technique to assess the PES-project impacts on household cash income, consumption expenditure, forest resource use and crop yields. We found that, in contrast to nonparticipant households, PES-participant households earned more cash income, incurred more consumption expenditure, collected less forest products and, harvested lower quanti-

ties of agriculture crops. In addition, we found, through decomposition analysis, that there was a differential in PES income. Both male-headed and high-income households were being favoured as project benefit recipients. Future PES-projects should focus on a payment scheme that can better ensure the benefit to all the participant households and also pay extra attention on the benefits distribution to the vulnerable households.

Ecosystem services in agriculture: Determining suitability for provision by collective management

- Ecological Economics---2011---Heidi R. Stallman

Agricultural ecosystems provide many ecosystem services (ES) which are essential to human health and well-being. In turn, some ES affect agricultural productivity. Managing agricultural lands to provide more ES and higher quality ES may be essential for the long-term sustainability of agricultural ecosystems. Most agricultural lands, however, are managed for the short-term production of food, fiber, and fuel, often at the expense of other ES. Proposed solutions to the under-provision of ES often involve government regulation or market incentives. A growing number of scholars, however, recognize the potential for a third approach—cooperative solutions. One important element in determining if an ES is a suitable candidate for cooperative solutions is its resource characteristics. Accordingly, this paper: 1.) provides a framework for determining an ES's suitability for collective management based on its resource characteristics, 2.) provides an in-depth analysis of three agricultural-based ES to show how the framework differentiates between ES and 3.) uses the framework to analyze fourteen agricultural-based ES for their suitability for collective management. Ten out of the fourteen ES analyzed may be well suited (e.g. pollination), suited (e.g. flood control), or moderately suited (e.g. nature recreation) for collective management under current incentive systems in agricultural ecosystems.

Controlling households' drilling fever in France: An economic modeling approach

- Ecological Economics---2011---Marielle Montginoul, Jean-Daniel Rinaudo

Using primary data collected at the national and local levels in France, this paper shows how water price increase, initially intended to generate environmental benefits through reducing water use, has produced economic incentives for households to drill their own garden boreholes. The paper first presents the results of a national survey which identifies the increasing number of garden boreholes as an issue of concern in a majority of the French counties. It then presents a microeconomic model which represents the households' decision to construct a borehole. The model is used to simulate the impact of various water pricing scenarios on tube well development and residential water demand at regional level. The paper ends with a discussion of the social impact of emerging independent supply strategies.

Incentives for cooperation: The effects of institutional controls on common pool resource extraction in Cambodia

- Ecological Economics---2011---Henry Travers, Tom Clements, Aidan Keane, E.J. Milner-Gulland

Cooperation among humans is highly dependent on social and institutional conditions, with individual incentives playing a key role in determining the level of cooperation achieved. Understanding the conditions under which cooperation can emerge has important implications for the design of resource management and wildlife conservation interventions. Incentive-based conservation approaches are being widely implemented, yet very few studies test the role of incentives in promoting cooperation in relevant developing country contexts. Using a common pool resource game, in four villages in Cambodia, we investigated how the level of within-group cooperation varies under different institutional arrangements, including opportunities for social approval, external enforcement of rules and individual and collective incentive payments. Our results

demonstrate the significance of self-organisation, the ability to devise, monitor and enforce a set of rules, among resource users. Treatments which promoted self-organisation had the greatest effect in reducing individual extraction, achieved the greatest efficiencies and had the strongest interaction with group decision-making in reducing extraction. The effects of these treatments carried over to reduce extraction in subsequent treatments, irrespective of their institutional arrangements. These results suggest that policies designed to incentivise certain behaviour in local stakeholder groups may be more successful if they create opportunities for local decision-making.

Low-income fishermen's willingness-to-pay for fisheries and watershed management: An application of choice experiment to Lake Tana, Ethiopia

- Ecological Economics---2011---Fitalew Agimass,Alemu Mekonnen

In this paper, choice experiment was applied for valuation of Lake Tana's fishery and watershed. Two attributes — fishing control and lake side plantation — were identified as relevant attributes for the choice experiment. A monetary attribute — payment for fishing permit was also included. Multinomial and random parameter logit models were used for estimation. All the attributes included were significant factors in affecting the probability of choosing an alternative scenario. The results suggest that fishermen were more concerned about fishing control as reflected by the higher value they give to fishing control than lake side plantation. Household income, years of education, and family size were found to be significant. The economic welfare measures we calculated for two scenarios show that fishermen were willing to pay 57 birr (US\$5.3) per month for a moderate improvement scenario and 93 birr (US\$8.6) per month for an aggressive scenario for the two attributes.

How does consumer behavior influence regional ecological footprints? An empirical analysis for Chinese regions based on the multi-region input-output model

- Ecological Economics---2011---Xin Zhou,Hidefumi Imura

The calculation of national ecological footprints using world average productivities can lead to biased results due to the neglect of spatial variation in in-situ ecological impacts. To address this issue, we apply a regional approach to generate ecological footprints based on the multi-region input-output model. This method enables us to trace the origin of regional consumption and to systematically account for the ecological impacts embodied in interregional trade. By using decomposition analysis, we attribute regional differences in ecological footprints to three behavioral factors associated with consumption: the selection of production origins, the structure of consumption and the level of expenditure. An empirical study for China's eight regions shows substantial cross-regional variation in terms of the amount of land appropriation and the mix of land types. The empirical study also confirms that not only how much is being consumed and what is being consumed, but also geographical origins (and, by implication, regionally specific production processes and methods) influence consumption-induced ecological impacts. This paper therefore sheds light on the importance of accounting for interregional variation in consumer behaviors and recommends customized solutions to achieve effective reductions in regional ecological footprints.

Barriers to Massachusetts forest landowner participation in carbon markets

- Ecological Economics---2011---Marla Markowski-Lindsay,Thomas Stevens,David B. Kittredge,Brett J. Butler,Paul Catanzaro,Brenton J. Dickinson

U.S. forests, including family-owned forests, are important carbon sinks and sources for carbon sequestration. Family forest owners constitute a significant portion of the overall forestland in the U.S., but little is known

about their preferences for participating in carbon sequestration programs. The goal of this research is to understand what motivates Massachusetts family forest owners to participate in carbon markets. The study estimates the probability these landowners would engage in carbon sequestration programs using data from a survey of 930 Massachusetts family forest owners. Results from a random effects ordered probit indicate that under a carbon scenario similar to the current voluntary scheme, very few of these landowners would be interested in participating. Supply analysis indicates these landowners are more influenced to participate by factors other than price. Regression analysis results suggest that survey respondents are concerned about early withdrawal penalties, additionality requirements, and contract length. Forest owner harvesting plans, opinions about forest usage, and beliefs about climate change all play a significant role in the decision to participate. The study suggests that policy makers should consider the reasons behind these low participation rates, because private forest owners could play a pivotal role in the carbon sequestration potential of forests.

Measuring and locating footprints: A case study of Taiwan's rice and wheat consumption footprint

- Ecological Economics---2011---Jiun-Jiun Ferng

Ecological footprint (EF) has been used widely to examine the overall dependence of human society on bioproductive land. However, the recent literature regarding EF analysis has focused increasingly on presenting the different components inherent in an aggregated EF estimate, including consumption, land, and location categories. Analyzing the EF of a particular consumption category within its socioeconomic and environmental contexts reveals information relevant to sustainability issues. Examining results according to land category and location reference is also useful toward this end. Following the emerging disaggregating trend in EF analysis, this study measures Taiwan's rice and wheat consumption footprints in terms of cropland and energy land from 1989 to 2008. It also identifies the cropland location by source country. The results

indicate that Taiwan has continuously enlarged and dispersed the cropland for its rice and wheat consumption footprints in foreign countries, but it has decreased its footprint in domestic territories. By examining these findings within their local context, this study identifies and discusses related sustainability challenges that the Taiwanese government faces, such as preventing excess cropland from being developed for non-agricultural purposes.

Access to benefits from forest commons in the Western Himalayas

- Ecological Economics---2011---Sirisha Naidu

Little statistical evidence exists on the effects of forest management regimes and wealth on forest access rates in South Asia. To determine the magnitude and significance of these effects, this paper analyzes a dataset of communities from Himachal Pradesh, India, with a fractional logit model. The investigation considers three specific forest management regimes including a regime under complete state control, traditional community regime and a co-management regime known as Joint Forest Management. Communities with higher incidence of land poverty have lower forest access rates for grazing and fodder extraction, whereas communities with a higher incidence of land-rich households have higher forest access rates for fodder extraction. Forest access rates for fuelwood collection are lower under traditional and co-management regimes. However, the interaction between land-poverty and co-management regime increases forest access rates for fodder collection and livestock grazing.

Do people habituate to air pollution? Evidence from international life satisfaction data

- Ecological Economics---2011---Tobias Menz

Air pollution constitutes one of the main environmental problems in many countries. This paper uses the life satisfaction approach to environmental valuation (LSA) to investigate whether individuals habituate to air pollution and if a potential habituation effect influences the marginal rate of substitution between air quality

and income. My estimation results, based on a data set of 48 countries spanning the period 1990 to 2006, indicate that individuals do not habituate to pollution with particulate matter. Rather, I find that even past pollution levels reduce current utility. This effect tends to increase the value of pollution abatement.

Amenity driven price effects and conservation reserve site selection: A dynamic linear integer programming approach

- Ecological Economics---2011---Sahan Dis-sanayake, Hayri Önal

Most conservation reserve design models presented in the literature are static and ignore the dynamic economic aspects of site selection. Typically conservation programs operate under time-related (e.g. annual) budgets and purchase land over time in a sequential manner. The uncertainty of land development has been incorporated in a few dynamic reserve selection formulations using stochastic dynamic programming. However, the existing formulations do not explicitly deal with inter-temporal price and location linkages. We address this issue here and present a two-period linear integer programming model for conservation reserve design that incorporates amenity driven price feedback effects inherent in the reserve development problem. In addition, the model includes spatial and ecological criteria. We then use this model to answer the question “How suboptimal is ignoring amenity driven price effects in reserve design models?” We apply the model to artificially generated data sets and compare the results with the results of an iterated static model that considers only one period at a time. We find that the dynamic model with price feedback effects selects sites at a lower per-site cost. The policy implication of this finding is that conservation programs should avoid purchasing land in the same neighborhood over multiple time periods.

Accounting for the ecosystem services of migratory species: Quantifying migration support and spatial subsidies

- Ecological Economics---2011---Darius J. Semmens, James E. Diffendorfer, Laura López-Hoffman, Carl D. Shapiro

Migratory species support ecosystem process and function in multiple areas, establishing ecological linkages between their different habitats. As they travel, migratory species also provide ecosystem services to people in many different locations. Previous research suggests there may be spatial mismatches between locations where humans use services and the ecosystems that produce them. This occurs with migratory species, between the areas that most support the species' population viability – and hence their long-term ability to provide services – and the locations where species provide the most ecosystem services. This paper presents a conceptual framework for estimating how much a particular location supports the provision of ecosystem services in other locations, and for estimating the extent to which local benefits are dependent upon other locations. We also describe a method for estimating the net payment, or subsidy, owed by or to a location that balances benefits received and support provided by locations throughout the migratory range of multiple species. The ability to quantify these spatial subsidies could provide a foundation for the establishment of markets that incentivize cross-jurisdictional cooperative management of migratory species. It could also provide a mechanism for resolving conflicts over the sustainable and equitable allocation of exploited migratory species.

An operational structure for clarity in ecosystem service values

- Ecological Economics---2011---Robert Johnston, Marc Russell

Analyses used to value ecosystem services often confuse final ecosystem services with ecological functions that provide indirect benefit. Typologies of ecosystem services, such as that developed by the Millennium Ecosys-

tem Assessment, do not ameliorate these challenges. Among the causes of ambiguity in classifying values associated with intermediate versus final ecosystem services are (1) the lack of simple, broadly applicable guidelines to assist natural and social scientists in deriving consistent and replicable classifications, and (2) attempts to define universal typologies of final services that apply to all beneficiaries. This paper presents an operational mechanism for determining whether a biophysical feature, quantity, or quality represents a final ecosystem service for an inclusive suite of beneficiaries. It is designed for straightforward application by those without expertise in natural or social sciences, and can be used within existing typologies. Illustrations of the structure demonstrate how the resulting classifications avert double counting and other ambiguities.

The effect of individual ‘ability to choose’ (scale heterogeneity) on the valuation of environmental goods

- Ecological Economics---2011---Mike Christie,James Gibbons

Environmental valuation methods, such as choice experiments, are increasingly being used to value complex and often unfamiliar environmental goods. A potential risk is that some survey respondents may not be capable of developing and expressing preferences for such goods. The noise from these individuals may then conceal the well-defined preferences of other respondents and affect valuation estimates. We address this problem by estimating a range of models that accounts for scale heterogeneity (which we interpret as a respondent’s ability to choose: ATC) and taste heterogeneity. These models are applied to two case studies: amenity from coastal defence and biodiversity. In both case studies, model fit was improved in a scale-heterogeneity multinomial-logit (S-MNL) model (compared to a standard MNL model) suggesting the accounting for ATC (scale heterogeneity) improved preference revelation. A mixed multinomial-logit (MIXL) model outperformed the S-MNL model suggesting that accounting for taste heterogeneity was also important. However, a generalised multinomial-logit (G-MNL) model improved

model fit over the MIXL model only for the biodiversity data suggesting that for these data both taste heterogeneity and ATC were important. We conclude that accounting for ATC can improve the reliability and robustness of the results when valuing complex or unfamiliar environmental goods.

A coevolutionary framework for analysing a transition to a sustainable low carbon economy

- Ecological Economics---2011---Timothy Foxon

This paper proposes a coevolutionary framework for analysing a transition to a sustainable low-carbon economy, based on the coevolution of ecosystems, technologies, institutions, business strategies and user practices, within a multi-level micro–meso–macro perspective. This builds on and develops previous coevolutionary analyses of long-term technological and industrial change, and recent renewed interest within ecological economics on coevolutionary approaches. Previous work has analysed how the coevolution of technologies and institutions has led to the lock-in of current high-carbon energy systems; and how the coevolution of physical and social technologies and business strategies has brought significant material and welfare benefits to the minority of the world’s population living in industrialised countries. The coevolutionary framework proposed here may be used to undertake: (1) detailed empirical analyses at a micro–meso level of the challenges relating to the innovation and adoption of particularly low-carbon technologies; (2) as a framework for analysing the multi-level interaction of social and technological elements within potential transition pathways to a low carbon energy system; (3) to assess the implications for economic growth and prosperity of a transition to a low carbon economy; and (4) to assist in the development of more formal, multi-level evolutionary economic models.

Operationalising active involvement in the EU Water Framework Directive: Why, when and how?

- Ecological Economics---2011---Stuart A.L. Wright,Oliver Fritsch

We identify two key stages in the river basin planning process under the Water Framework Directive: the selection of instruments for a programme of measures to achieve the environmental targets, and disproportionate cost analysis to determine whether selected measures involve high costs. Some EU member states such as Denmark are operationalising these two key stages using cost effectiveness analysis and cost–benefit analysis. However, implementation guidelines encourage the active involvement of all interested parties in the implementation of the Directive. We discuss the potential benefits of actively involving non-state actors, which can be summarised as increasing the effectiveness of policy and improving its implementation. Criticising the emerging economic decision-making approach, we argue that economic analyses could result in a missed opportunity to capitalise on the potential benefits of involvement. The article discusses the appropriateness of actively involving the public during the two aforementioned decision-making stages and suggests concrete ways in which active involvement may be operationalised. We conclude that member states should not implement a minimum form of participation to comply with the statutory requirements of the Directive, but should strive for active involvement due to the potential for increasing the effectiveness of the Water Framework Directive and improving its implementation.

Biodiversity measures based on species-level dissimilarities: A methodology for assessment

- Ecological Economics---2011---Nicolas Gerber

Biodiversity is widely recognized as a valuable natural asset to conserve. Yet biodiversity is often reported to be declining worldwide. Biodiversity measures can help evaluating it and conserving it, but need to be clearly defined and assessed. In this paper, I review several biodiversity measures and develop a new one, all based on a matrix of species-level dissimilarity data. The data can be used in its raw form, regardless of its origin (e.g. studies of morphological traits, DNA hybridization experiments...) or of any graphical representation. Then, I propose a two-step assessment of

the measures. First, I assess them in terms of their deviation from a strict additive law determining the contribution of each species to the diversity of the set in an ideal setting. This setting refers to a case where the data exactly determines the hierarchical ordering of the species. Second, I assess the measures based on their compliance with a list of axioms. These axioms reflect basic mathematical properties regarded as desirable for diversity measures, such as their monotonicity in species and dissimilarities. Finally, I show the importance of applying the new quantitative assessment and the axiomatic approach together when selecting a dissimilarity-based diversity measure.

Will nonowners follow pioneer consumers in the adoption of solar thermal systems? Empirical evidence for northwestern Germany

- Ecological Economics---2011---Julia Sophie Woersdorfer, Wolfhard Kaus

In Germany, solar thermal systems (STSy) have only diffused to a minor extent as yet. This paper analyzes which demand side factors are decisive for the further proliferation of this environmentally benign technology. Making use of a consumer survey in northwestern Germany in 2007, we examine the following parameters: positive environmental attitude, knowledge of the applicability of STSy to satisfy consumer needs, and the presence of STSy among peer consumers. Drawing upon theoretical foundations from innovation economics and social psychology, we posit that these variables play a different role at distinct stages of the systems' diffusion process. Among nonowners, concrete plans to purchase such a system within the next two years are distinguished from the general interest to invest in this technology within the next five years. Probit models are estimated to test our hypotheses. Our results do not indicate a strong take-off of product diffusion within the next few years. By generating interest for the product, environmental attitude and knowledge as well as household income are important determinants of prospective adoption on the part of nonowners. However, it is only peer group behavior that appears to function as a trigger for the diffusion

of this technology.

The importance of the design of market-based instruments for CO2 mitigation: An AGE analysis for Spain

- Ecological Economics---2011---Mikel González-Eguino

In the past few decades, economists have defended the use of market-based instruments (MBI) in environmental and climate policy. There have been many papers which have compared the costs of attaining environmental objectives with MBIs and with command and control instruments. However very few have compared different MBIs in examining these costs. This paper seeks to analyse various MBIs for CO2 mitigation from the viewpoint of cost-effectiveness, using an AGE (applied general equilibrium) model for the case of Spain. A distinction is drawn between (1) quantity instruments, which represent different extents of a market for emission permits; and (2) price instruments, which represent different types of tax. Each instrument can affect different segments of the emission sources and therefore can have very different effects on the economy as a whole. We show how MBI can help to minimise mitigation costs, but also how taxes and tradable emission permits that are limited or constrained by many exemptions and distortions can raise costs considerably.

Anomalies in green national accounting

- Ecological Economics---2011---Geir Asheim, John Hartwick

We “extend” standard arguments for greening the product side of the national accounts to the income side of the accounts and turn up an anomaly. For an economy with oil use, no entry for oil income, a supposed primary factor, appears in the income side of the national accounts when the depletion of natural capital is accounted for on the product side of the accounts. We resolve this issue by applying an income definition developed in the theory of national accounting. This, however, leads to another anomaly on the income side of the national accounts.

Promise and shortcomings of a green turn in recent policy responses to the “double crisis”

- Ecological Economics---2011---Olivia Bina, Francesco La Camera

The paper analyses six international-scale responses to the financial and climate change ‘double crisis’ in order to: review how they define problems and solutions, analyse what underpins the policy choices revealed in these responses (the ‘green turn’), reflect on the implications of the proposed solutions in terms of sustainability and global environmental justice, and to suggest three elements for a paradigm shift towards an ‘alternative’ turn embedded in ecological economics theory. The analysis reveals that responses by leading international organisations continue to appeal to the precepts of neoclassical economy. We argue that from an ecological economics perspective, policy responses under the various labels of green economy, green growth, sustainable growth, green new deal, fall well short of what is needed to fight the environmental crisis and rising inequality across and within countries. The idea of justice and equity that underpins the mainstream approach seems inadequate in terms of sustaining our environmental base and global environmental justice. Based on this critical review, we propose an ‘alternative turn’, centred on three elements of a paradigm shift leading to a new economy where the environmental base and global environmental justice are at the centre of the discourse.

The effect of ambiguous risk, and coordination on farmers’ adaptation to climate change — A framed field experiment

- Ecological Economics---2011---Francisco Alpizar Rodriguez, Fredrik Carlsson, Maria A. Naranjo

The risk of losses of income and productive means due to adverse weather can differ significantly among farmers sharing a productive landscape, and is of course hard to estimate, or even “guesstimate” empirically. Moreover, the costs associated with investments in reduced vulnerability to climatic events are likely to exhibit economies of scope. We explore the implications

of these characteristics on farmer's decisions to adapt to climate change using a framed field experiment applied to coffee farmers in Costa Rica. As expected, we find high levels of risk aversion, but even using that as a baseline, we further find that farmers behave even more cautiously when the setting is characterized by unknown or ambiguous risk (i.e. poor or non-reliable risk information). Secondly, we find that farmers, to a large extent, coordinated their decisions to secure a lower adaptation cost, and that communication among farmers strongly facilitated coordination.

Woodsy the optimal owl: Environmental campaigns, norms, and implications for public goods policy

- Ecological Economics---2011---Matthew Interis,Tim Haab

Norms regarding private provision of a public good (e.g. cutting down on energy use, not littering) can affect the marginal gains from contributing to a public good and therefore people's decisions about contributing to the public good. A model is proposed in which norms of private contributions to a public good can be influenced by public policy, and these norms affect people's self-image, which derives from a comparison of one's own contribution with the norm contribution. In this context, we examine the conditions under which private contributions to a public good are efficient, and the conditions under which policy affecting these norms improves social welfare. We find that (1) a benevolent social planner who fails to account for private provision norms will underprovide the public good, and (2) public policy that attempts to raise the norm contribution of private provision can increase social welfare if the effect of raising the norm does not have an extreme negative effect – either extremely small or extremely large – on peoples' self-image.

Analysis of changes in Dutch emission trade balance(s) between 1996 and 2007

- Ecological Economics---2011---Bram Edens,Roel Delahaye,Maarten van Rossum,Sjoerd Schenau

In this paper we construct bilateral emission trade balances (ETB) for The Netherlands with 17 regions and compare results for 1996 and 2007 for three different greenhouse gasses. We establish a cross-sectional analysis of bilateral ETBs into a volume of trade, composition and technology effect. In order to analyze the driving forces of changes over time we perform a structural decomposition analysis of embodied import and export emissions. The main findings are that the embodied import emissions have increased by 37% whereas export emissions increased by only 3%, which is primarily driven by CO₂. The 2007 bilateral balances are positive with OECD countries but negative with economies such as Russia, Africa and China. The analyses demonstrate that the worsening of the ETB is to a large extent caused by the changing composition of trade: the Dutch economy increasingly exports clean products and imports dirty products.

EE-IO modeling of the environmental impacts of Finnish imports using different data sources

- Ecological Economics---2011---Sirkka Koskela,Ilmo Mäenpää,Jyri Seppälä,Tuomas Mattila,Marja-Riitta Korhonen

The environmental impacts of Finnish imports were modeled using alternative emission datasets. The first dataset was based on domestic technology assumptions from the Finnish environmentally extended input-output (EE-IO) model. In the second dataset, emissions of the largest volumes of imported goods were substituted for EIOLCA (USA) data and in the third option for data from Ecoinvent and the Danish LCA Food Database. Comparative results show that the environmental impacts of imports based on domestic emission intensities are mostly lower than the alternative approaches. Considering the high level of Finnish environmental protection we concluded that the impacts of imports are underestimated using domestic emission intensities. Additionally, we concluded that hybrid IO modeling will increase the accuracy of IO modeling by using process-based data for the most relevant material flows until a multi-regional IO model for Finland has been developed.

Tourists and traditional divers in a common fishing ground

- Ecological Economics---2011---Joung-Hun Lee, Yoh Iwasa

We study socio-ecological models for a fishing ground open to tourists. On Jeju Island, Korea, women traditional divers called “Haenyeo” harvest resources in a common fishing ground. To investigate the impact of introducing tourists on the benefit to the fishing association and the resource level, we examine two models that differ in the way the number of tourists is controlled. In the first model, the fishing association charges an entrance fee to tourists and the level of the fee is chosen to regulate tourist number. In the second, only a part of the fishing ground is made open to tourists, and the fraction of the ground open is chosen to control the tourist number. In both models, the fishing association seeks to maximize its total benefit. Analysis shows that the way the number of tourists increases with the availability of resources strongly influences the distribution of benefits among the fishing ground stakeholders. Finally, we discuss policy implications of our results and how local government can reduce the risk of introducing tourism.

Efficiency of Payments for Environmental Services: Equity and additionality in a case study from a Biosphere Reserve in Chiapas, Mexico

- Ecological Economics---2011---Luis Rico García-Amado, Manuel Ruiz Pérez, Felipe Reyes Escutia, Sara Barrasa García, Elsa Contreras Mejía

Payments for Environmental Services (PES) have been claimed as a more efficient way of accomplishing conservation and development goals than other indirect strategies, reaching their optimum when the buyer pays the opportunity costs of the foregone benefits. Different inefficient situations have been described, like lack of additionality, where payments are given for practices that would have been adopted anyway. Trade-offs between efficiency and equity of PES have usually emerged as well. In this paper we assess the equity, additionality and stakeholders’ perceptions of a PES

scheme in a Mexican community inside a Biosphere Reserve. We applied structured interviews to all adults, a total of 66 people from 31 households. Our results show a dual response in equity and additionality, depending on land tenure. PES have an egalitarian effect within landowners and landless groups, but it broadens the gap between them. Additionality is low for landowners and high for the landless people in the community, even though the former are the ones with full decision over the land. Although the scheme does not seem efficient under the classical PES paradigm, it is perceived as a reward, reinforcing conservation attitudes even though most of the interviewees claim it to be insufficient.

Productivity growth and environmental regulations - accounting for undesirable outputs: Analysis of China’s thirty provincial regions using the Malmquist–Luenberger index

- Ecological Economics---2011---Chunhong Zhang, Haiying Liu, Hans Th.A. Bressers, Karen S. Buchanan

This paper employs the Malmquist–Luenberger (ML) productivity index to evaluate China’s growth in total factor productivity (TFP), incorporating undesirable outputs, during the period from 1989 to 2008. The ML productivity index and its components (technical and efficiency changes) are derived from the directional distance function which gives credit for an increase in good outputs and for reductions in undesirable outputs. The average annual ML productivity growth, accounting for undesirable outputs, is 2.46%, whereas the value of the traditional Malmquist productivity index is 4.84%, showing that the true TFP growth in China is overestimated if undesirable outputs are ignored. We explore the strictness in enforcing environmental regulations and its impact on improvements in ML productivity. The results show that, the enforcement of environmental regulations in China is, in general, far below the levels achieved in the best performing regions, and that the more stringent enforcement of environmental regulations would help to improve ML productivity growth in China.

Long run trends in energy-related external costs

- Ecological Economics---2011---Roger Fouquet

This paper considers how energy-related external costs change through time. It focuses on one of the key periods in the history of energy. After a period of declining coal prices and soaring consumption which fuelled the Second Industrial Revolution, the nineteenth century British economy was externalising the social costs of energy production and consumption on a massive scale. Rising from 25% in the 1820s, an estimated 60%–70% of the average social costs of coal were externalised in the 1880s, imposing damages close to 20% of GDP. The eventual decline in air pollution concentration (around 1900) occurred fifty years later than was broadly socially optimal. This experience highlights the evolution of the demand for and supply of environmental quality in the context of economic growth, and the nature of related market and government failures, implying the necessity for adaptation rather than encouraging mitigation. This experience may offer lessons for climate analysis and policy-making.

Negative externalities on property values resulting from water impairment: The case of the Pigeon River Watershed

- Ecological Economics---2011---Seong-Hoon Cho,Roland Roberts,SeungGyu Kim

The objective of this research was to determine whether willingness to bear the negative externality from water quality impairment differs between those who do and those who do not receive economic benefit from the impairment source. Differences were tested using a hedonic analysis of ambient water quality in two discrete housing markets in the Pigeon River Watershed, which have been polluted by the operation of a paper mill. The results suggest that North Carolina residents residing in subwatersheds with impaired portions of the Pigeon River, who experience economic benefit from the paper mill in addition to its harmful effects on water quality, do perceive the pollution as a negative externality. In contrast, the effects of both the degraded river and its contributing streams on

property values are perceived as negative externalities by watershed residents in Tennessee who experience only harmful effects from the pollution. Differences in willingness to bear the water-impairment externality were not indicated by variables representing view of and proximity to impaired water bodies. The results suggest that the perception of water quality to which property owners implicitly apply value should be considered when establishing water-quality regulations.

When does a carbon tax on fossil fuels stimulate biofuels?

- Ecological Economics---2011---Govinda Tilmsina,Stefan Csordas,Simon Mevel

A carbon tax is an efficient economic instrument to reduce emissions of carbon dioxide released from fossil fuel burning. If designed properly, it could also help significantly to promote renewable energy. Using a multi-sector, multi-country computable general equilibrium model this study investigates under what circumstances a carbon tax would help stimulate penetration of biofuels into the energy supply mix for road transportation in various countries and regions around the world. This study shows that a carbon tax cum biofuel subsidy policy, where a carbon tax is introduced to fossil fuels and part of the tax revenue is used to finance the biofuel subsidy, would significantly help stimulate market penetration of biofuels. On the other hand, a carbon tax alone policy, where the entire tax revenue is recycled to households through a lump-sum transfer, does not help stimulate biofuels significantly even at higher tax rates. Although the carbon tax cum subsidy policy would cause higher loss in economic output at the global level as compared to the carbon tax alone policy, the incremental loss is relatively small. The key policy insight drawn from the study is that if a carbon tax were to be implemented in an economy for the purpose of climate change mitigation, recycling part of its revenue to finance biofuel subsidies would significantly help stimulate biofuels.

Water valuation at basin scale with application to western India

- Ecological Economics---2011---Saket Pande,Bart van den Boom,Hubert H.G. Savenije,Ashvani K. Gosain

A parsimonious hydro-economic model for a data scarce dryland area is presented. It features a basin level decentralized water allocation mechanism which is adapted to incorporate sustainable water use and to deal with the externalities from upstream–downstream linkages. We formulate the profit maximization problem of various agents in a basin, each identifying a sub-basin, who operate within the boundaries of a spatially explicit model that describes the dominant hydrological processes. We address issues of non-convexities and non-steady state conditions and elicit the dependence of a decentralized water allocation on geophysical properties of the basin. In particular, the approach describes how the competition between the drying and drainage functions of sub-basins in dryland areas manifests itself in the optimal valuation of water. The application to an area of over 500,000km² and 34 sub-basins in western India indicates that intra-basin cooperation could be beneficial; valuation of inter basin flows as a percentage of respective sub-basin income is on an average around 30% when each sub-basin includes downstream valuation as well.

Comparative costs and conservation of wild species in situ, e.g. orangutans

- Ecological Economics---2011---Clement Tisdell,Hemanath Swarna Nantha

The extent to which conservation is feasible is constrained by budgets and the financial sacrifice stakeholders are willing to bear. Therefore a possible objective for conserving a species is to minimise the cost of achieving that stated aim. For example, if a minimum viable population (MVP) of a species is to be conserved, the size and type of habitats reserved for this could be selected to minimise cost. This requires consideration of the comparative (relative) opportunity costs of reserving different land types for conservation. A general

model is developed to demonstrate this and is applied to the case of the orangutan. In the ecological literature, recommendations for reserving different types of land for conservation have been based on comparisons of either the absolute economic returns they generate if converted to commercial use or on differences in the density of a species they support. These approaches are shown to be deficient because they ignore relative trade-offs between species population and economic conversion gains at alternative sites. The proposed model is illustrated for orangutan conservation.

The impact of climate on life satisfaction

- Ecological Economics---2011---David Maddison,Katrin Rehdanz

We analyse the influence of climate on average life satisfaction in 79 countries using data from the World Values Survey. Climate is described in terms of ‘degree-months’ calculated as the cumulated monthly deviations from a base temperature of 65°F (18.3°C). Our results suggest that countries with climates characterised by a large number of degree-months enjoy significantly lower levels of life satisfaction. This finding is robust to a wide variety of model specifications. Using our results to analyse a particular climate change scenario associated with the IPCC A2 emissions scenario points to major losses for African countries, but modest gains for Northern Europe.

The economic and environmental performances of rural districts in Italy: Are competitiveness and sustainability compatible targets?

- Ecological Economics---2011---Luca Salvati,Margherita Carlucci

This paper analyses the economic performances of the rural system and the level of land sensitivity to degradation in Italy. Three indicators (district value added, share of agriculture on total product, and a composite index of land sensitivity) were used to classify 784 Italian local districts into eight performance classes. Four classes share a combination of high environmental quality (in terms of land degradation), high (or

low) economic performances, and high (or low) productivity of the primary sector. The remaining four are characterised by a combination of low (and declining) environmental quality, high (or low) economic performances, and high (or low) productivity of the primary sector. The eight classes were grouped into four ‘environmental quality’ types and four ‘target performance’ categories to discriminate among high- and low-performance districts by considering twelve additional variables within a Discriminant Function Analysis (DFA). 148 high environmental performance districts (18% of total) were identified mainly across the Alps and Apennine while 314 districts (41%) were classified in the lowest performance class and concentrated in flat areas of southern Italy. The districts with high environmental performances were characterised, on average, by medium to low district value added, moderately low economic weight of the primary sector, and tourism specialisation. Districts with high economic performances and low environmental performances were characterised by high sensitivity to LD, low district value added, high share of agriculture in total product, and the lowest productivity of labour in all economic sectors. In these districts the risk of entering a downward spiral of rural poverty and environmental degradation is potentially high.

Optimal environmental taxes and standards: Implications of the materials balance

- Ecological Economics---2011---Udo Ebert,Heinz Welsch

This paper investigates the implications of the materials balance for optimal environmental policy. We find that neglecting the materials–emissions relationship – as is common in models of optimal environmental regulation – implies biases, whose sign depends on the regulatory instrument chosen. When emissions are regulated through an emission tax, the seemingly optimal tax is too high. When regulation proceeds through the use of an emission standard, the seemingly optimal standard is too lax.

Forests, biomass use and poverty in Malawi

- Ecological Economics---2011---Sushenjit Bandyopadhyay,Priya Shyamsundar,Alessandro Baccini

Malawi is one of the poorest countries in Africa and has faced significant deforestation over the years. This paper seeks to examine the nature of the relationship between poverty and forests in Malawi. We try to answer three sets of questions: a) what is the extent of biomass available for meeting the energy needs of the poor in Malawi and how is this distributed? b) To what extent does fuelwood scarcity affect the welfare of the poor? And c) do households spend more time in fuelwood collection in response to scarcity? We answer these questions by matching household surveys with remote-sensing data.

The implications for households of environmental tax reform (ETR) in Europe

- Ecological Economics---2011---Paul Ekins,Hector Pollitt,Jennifer Barton,Daniel Blobel

The paper discusses the distributional implications of environmental tax reform (ETR) for households, and presents new results from modelling the impacts of a major ETR for the European Union. The distributional effects arise from the new environmental taxes, any tax reductions made as part of the ETR, the wider macroeconomic impacts from the ETR, any special provisions in the ETR, and the environmental benefits from the ETR. The paper’s literature review makes clear that while the impacts from taxes on the household use of energy are very often regressive, transport taxes tend not to be, although the impacts differ between urban and rural households. Moreover, the net distributional impact is often less regressive, or not at all, once the wider distributional effects are taken into account. Residual regressive effects can in principle be removed by further adjustments in the tax or benefits system. The modelling results suggest that an ETR in Europe will actually increase real incomes across the EU as a whole, and will not be generally regressive, although the results differ by country and for different socio-economic groups. The political acceptability of

ETR may depend on the worst effects on these groups being mitigated in some way.

Coexistence of GM and non-GM crops with endogenously determined separation

- Ecological Economics---2011---Emily Gray,Tiho Ancev,Ross Drynan

The possibility that genetically modified (GM) crops may contaminate non-GM crops through pollen-mediated gene flow presents a challenge to coexistence of GM agriculture with conventional and organic farming systems. In this paper an analytical model of coexistence is developed that allows for endogenous derivation of efficient widths and allocation of pollen barriers to limit contamination of non-GM crops. To reflect the uncertainty that surrounds pollen dispersal mechanisms the model contains a stochastic contamination function and safety rule decision mechanism, constraining the level of contamination to remain below a tolerated adventitious presence with a given probability. Two policies are considered and their performance is tested: the tolerance level of adventitious presence, and the allocation of responsibility for implementing coexistence measures to either GM or non-GM farmers. The relative size of GM rents (the value of productivity gains and the non-pecuniary benefits from GM crops), rents for identity preserved non-GM crops (price premiums realised over the GM crop price), characteristics of farms, and possible variation in agricultural landscapes are also taken into account. The findings indicate that conventional adventitious presence tolerances can be met without ex ante mandating large widths of pollen barriers. At the policy level, the findings of this paper are relevant for setting region-specific pollen barriers widths, and/or for establishing institutions that facilitate cooperative coexistence.

Analyses of water footprint of Beijing in an interregional input–output framework

- Ecological Economics---2011---Zhuoying Zhang,Hong Yang,Minjun Shi

Beijing is under severe water resource pressure due to

the rapid economic development and growing population. This study quantitatively evaluates the water footprint of Beijing in an interregional input–output framework with a focus on blue water resources and uses. The inter-connections of water resources between Beijing and other provinces are analyzed with a sectoral specification. The results show that the total water footprint of Beijing is 4498.4 106m³/year, of which 51% is from the external water footprint acquired through virtual water import. Agriculture has the highest water footprint of 1524.5 106m³/year with 56% coming from external sources. The main virtual water provider for Beijing is Hebei, another water scarce region, from which Beijing receives virtual water of 373.3 106m³/year with 40% from agriculture. The results of this study suggest that the interregional trade coordination, especially for the main sectors with high water use intensity, is important for enhancing the efficiency of regional and national water resource utilization.

Economic cost of deforestation in semi-deciduous forests — A case of two forest districts in Ghana

- Ecological Economics---2011---Lawrence Damnyag,Tapani Tyynelä,Mark Appiah,Olli Saastamoinen,Ari Pappinen

The ecological, economic and socio-cultural roles of forests are under threat in Ghana due to the high rate of deforestation. Efforts are being made to combat this problem through rehabilitation measures. However, the costs of deforestation and restoration benefits are not adequately estimated. This paper fills in the gap in knowledge by providing an empirical estimation of the cost of deforestation in monetary terms. Primary data collected regarding timber, non-timber forest products and soils in semi-deciduous forests were analyzed using opportunity cost and replacement cost techniques. The results emphasize differences in the value of these forest goods and services lost annually. The largest losses were in stumpage fees, edible fruits, and avoided carbon emissions values. The results show that US\$133,650,000 gross revenue, equivalent to 2.6%

of the 2008 agricultural sector Gross Domestic Product, is lost annually. It can be concluded that restoring the degraded forest lands would bring benefits particularly to the local communities through increased stumpage revenues and harvest of non-timber forest products, as well as additional funds from carbon credits. It is recommended that stakeholders of forest resources are made aware of these costs in order to raise awareness of what they are losing through deforestation.

Biodiversity conservation, loss of natural capital and interest rates

- Ecological Economics---2011---Clement Tisdell

It is argued that there is neither regular relationship between changes in the level of the market rate of interest and variations in the rate of biodiversity loss nor does such a regular relationship occur between alterations in the market rate of interest and changes in the rate of natural resource extraction. However, some texts suggest otherwise. Microeconomic examples are given in which a rise in the market rate of interest results in increased biodiversity loss and others in which it does not. It is also posited that the rate of biodiversity loss (as well as the rate of natural resource extraction) tends to rise with the level of aggregate investment and aggregate economic activity. It is demonstrated, using macroeconomic models, that the market rate of interest can increase or decrease with a rise in aggregate investment and also with an increase in the level of aggregate economic activity. Therefore, changes in biodiversity loss (and in the rate of natural resource extraction) are independent of variations in the market rate of interest in macroeconomic models.

Local environmental regulation and plant-level productivity

- Ecological Economics---2011---Randy Becker

This paper examines the impact of environmental regulation on the productivity of manufacturing plants in the United States. Establishment-level data from three Censuses of Manufactures are used to estimate 3-factor Cobb–Douglas production functions that include

a measure of the stringency of environmental regulation faced by manufacturing plants. In contrast to previous studies, this paper examines effects on plants in all manufacturing industries, not just those in “dirty” industries. Further, this paper employs spatial–temporal variation in environmental compliance costs to identify effects, using a time-varying county-level index that is based on multiple years of establishment-level data from the Pollution Abatement Costs and Expenditures survey and the Annual Survey of Manufactures. Results suggest that, for the average manufacturing plant, there is no statistically significant effect on productivity of being in a county with higher environmental compliance costs. For the average plant, the main effect of environmental regulation may not be in the spatial and temporal dimensions.

Provided and perceived status quo in choice experiments: Implications for valuing the outputs of multifunctional rural areas

- Ecological Economics---2011---Marcos Domínguez-Torreiro, Mario Soliño

This article presents a choice experiment analyzing multifunctional rural development policies targeting conservation and recovery of environmental, social and cultural assets. In choice experiments a base alternative is usually included in order to estimate the welfare change associated to policy proposals. This study is concerned with the much neglected issue of the impact on policy analysis of the definition of a ‘status quo’ alternative either as an objective assessment by experts, or as a self-reported perception by respondents. Convergent validity analysis and prospective policy scenarios show a significant impact of different status quo specifications on individuals’ preferences and related welfare measures when complex and unfamiliar biophysical systems are involved in policy analysis and evaluation.

A note on sustainability economics and the capability approach

- Ecological Economics---2011---Jerome Ballet, Damien Bazin, Jean-Luc Dubois, François-Régis

2011

Assets and drawbacks of the CA as a foundation for sustainability economics

- Ecological Economics---2011---Felix Rauschmayer, Ortrud Leßmann

2011

Payments for agrobiodiversity conservation services for sustained on-farm utilization of plant and animal genetic resources

- Ecological Economics---2011---Ulf Narloch, Adam G. Drucker, Unai Pascual

This paper discusses the potential application of Payment for Ecosystem Services-like schemes to tackle market failures associated with the public good characteristics of agrobiodiversity conservation services. So called payments for agrobiodiversity conservation services (PACS) would increase the private benefits from utilizing local plant and animal genetic resources on-farm through voluntary reward mechanisms, so as to sustain their on-farm conservation. Theoretical and applied insights about PACS are discussed and attention drawn to some of the challenges to be overcome in implementing PACS. In particular, these relate to the identification of potential buyers, the complex institutional setting in which PACS might operate and the articulation of a meaningful conservation goal based on a safe minimum standard approach. The latter is urgently needed, so as to ensure that additional agrobiodiversity services are generated. Relative to a fixed pricing approach, PACS schemes that seek to overcome information asymmetries through the use of conservation auctions may be associated with significant efficiency gains. However, potential trade-offs between ecological effectiveness, economic efficiency, and social equity considerations need to be carefully evaluated.

Issues in environmental justice within the European Union

- Ecological Economics---2011---Éloi Laurent

This paper surveys pressing issues facing current and future social policies in the European Union (EU) at the juncture of social justice demands and environmental concerns. European policy-makers have in fact only recently acknowledged the notions of environmental justice and environmental inequalities, which have been part of the US policy arsenal for almost two decades. Yet, challenges to equality and fairness in the environmental domain are many and growing within the European Union. After having defined environmental justice and environmental inequalities in the European context, the paper addresses two contemporary dimensions of those challenges for EU social policies: vulnerability and exposure to environmental disaster and risk; and fairness in environmental taxation and the related issue of fuel poverty.

Accountability and legitimacy: An analytical challenge for earth system governance

- Ecological Economics---2011---Frank Biermann, Aarti Gupta

2011

Accountability and legitimacy in earth system governance: A research framework

- Ecological Economics---2011---Frank Biermann, Aarti Gupta

Along with concerns over the effectiveness of earth system governance, ways of enhancing its accountability and legitimacy are increasingly coming to the fore in both scholarly debate and political practice. Concerns over accountability and legitimacy pertain to all levels of governance, from the local to the global, and cover the spectrum of public and private governance arrangements. This conceptual article elaborates on the sources, mechanisms and reform options relating to more accountable, legitimate and democratic earth system governance. We proceed in four steps. First, we

conceptualize accountability and legitimacy in earth system governance. Second, we place questions of accountability and legitimacy within the larger context of earth system transformation, which, we argue, poses special challenges to the pursuit of accountability and legitimacy. Third, drawing on the contributions to this special section, we analyze different sources and mechanisms of accountability and legitimacy and their effects on the democratic potential and effectiveness of governance. Fourth, in concluding, we outline reform options that may help alleviate persisting deficits in the democratic potential of earth system governance.

Global democracy and earth system governance

- Ecological Economics---2011---John S. Dryzek, Hayley Stevenson

The issue of climate change confirms the global reach of earth system governance, whose legitimacy and effectiveness could gain from democratisation. While electoral democracy as practised in states provides no model for global democracy, lessons drawn from the performance and history of states prove helpful in identifying the elements that a well functioning ecological democracy ought to strive for. We capture these elements through reference to the idea of a deliberative system, and show how the idea of such a system can be used to analyse, evaluate, and provide prescriptions for the global governance of climate change.

Diversity and pluralism in earth system governance: Contemplating the role for global administrative law

- Ecological Economics---2011---Francesca Spagnuolo

This article aims to explore whether procedural rights and administrative law mechanisms - such as, for example, the right to a hearing, the duties to provide a reasoned decision and to disclose relevant information - can enhance the accountability and democratic legitimacy of earth system governance. The democracy-enhancing potential of such mechanisms and rights -

which in the national context have proved to be beneficial in strengthening citizens' participation and the acceptance of decisions - can be limited in the global arena, by a number of factors. One of these factors is "legal imperialism", understood as the grafting onto the global level rules and institutions that impose the hegemony of western values. In fact, administrative law mechanisms, being a construct of a certain type of western, liberal model of the state (and its capitalist model of development), could be perceived, in developing countries as an instrument to reproduce the dominant position of advanced industrialized countries and their economic actors. The analysis suggests that in order to realize their democracy-enhancing potential, these mechanisms should draw, as far as possible, on cross-cultural principles, and be supported by financial and technical instruments enabling "developing countries" and marginalized groups to engage in dialog with the most powerful actors.

Transparency for governance: The mechanisms and effectiveness of disclosure-based and education-based transparency policies

- Ecological Economics---2011---Ronald B. Mitchell

When transparency is used as a tool for global environmental governance - i.e., to induce targeted actors to reduce environmentally-harmful behaviors, it can operate via disclosure or education. Disclosure-based policies improve the information the public has about targeted actors' behaviors while education-based policies improve the information targeted actors have about their own behaviors, whether that is information about consequences, alternatives, or social norms. Various social and political forces shape whether and what type of transparency policies are adopted. Disclosure-based and education-based transparency policies are effective under different conditions and operate through different mechanisms. Both often operate through mechanisms that reflect an instrumental logic of consequences but also can and do operate through mechanisms that reflect a normative logic of appropriateness, by increasing the legitimacy accorded to global environmental norms and the social accountability targeted actors

feel regarding their behaviors. Understanding the differences in the mechanisms by which disclosure-based and education-based transparency policies operate suggests that both scholars and practitioners should use caution in understanding why, and predicting when, such policies will work.

Creating legitimacy in global private governance: The case of the Roundtable on Sustainable Palm Oil

- Ecological Economics---2011---Greetje Schouten, Pieter Glasbergen

This article suggests that understanding legitimization processes of private governance initiatives requires a multi-dimensional approach. This suggestion has been operationalized in three aspects that can be used to better understand such processes: legality, moral justifications, and consent/acceptance. These aspects are based on different theoretical traditions and are applied in an analysis of the process of creating legitimacy of the Roundtable on Sustainable Palm Oil (RSPO). This empirical research reveals the characteristics of the legitimization process of the RSPO and shows the value of a multi-dimensional approach. The three perspectives complement each other and deepen our insights in legitimization processes by revealing tensions and trade-offs in the different ways in which non-state market driven governance arrangements can create legitimacy.

From CDM to REDD+ -- What do we know for setting up effective and legitimate carbon governance?

- Ecological Economics---2011---Markus Lederer

This article compares two carbon governance instruments - the Clean Development Mechanism (CDM) and Reducing Emissions from Deforestation and Degradation (REDD+) - to assess lessons from the former for the latter regarding effectiveness and legitimacy of such instruments. The article argues that the CDM has a relatively high degree of output-oriented legitimacy

resulting in effectiveness and some input-oriented legitimacy, with few discernible tradeoffs between them. In contrasting this to REDD+, the hypotheses are advanced that (i) output-oriented legitimacy/effectiveness can again be achieved but that (ii) a higher degree of input-oriented legitimacy is necessary for REDD+ and thus also a certain trade-off between the two forms of legitimacy can be expected. This is shown through comparing the technologies and methodologies, economic rationales, political support, regulatory structures, and environmental impacts of both instruments.

Institutional design for improved forest governance through REDD: Lessons from the global environment facility

- Ecological Economics---2011---G. Kristin Rosendal, Steinar Andresen

This contribution focuses on carbon mitigation and biodiversity conservation in the context of the UN initiative for Reduced Emissions from Deforestation and forest Degradation in Developing countries (REDD). The design of REDD is important as it may channel much of the international funding that will potentially be made available for future environmental problem-solving in developing countries. The most important multilateral environmental funding mechanism is the Global Environment Facility (GEF). With its basic structural similarity to the emerging REDD, it provides a good starting point for drawing lessons relevant to the design of REDD. In explaining GEF priorities and performance we discuss the role of key actors as well as the organizational and institutional structure of GEF. These factors do not encourage coalitions for addressing environmental problems in the poorest countries. The institutional setting of REDD in the Convention on Climate Change may further exacerbate this trend, as neither conservation nor socioeconomic concerns like the rights and well-being of indigenous peoples and local communities are addressed. Factors that favour utilizing a similar organization structure include scope for donor trust, for bringing in established competence and a comprehensive approach. REDD must be wary of catering solely to a Northern environmental agenda.

CSD water partnerships: Privatization, participation and legitimacy

- Ecological Economics---2011---Eleni Dellas

Public-private partnerships have been presented as an opportunity to improve the input and output legitimacy of global environmental governance, and they were endorsed by intergovernmental agreement at the Johannesburg Summit in 2002. However, their potential to contribute substantially to these aims has also been questioned. For partnerships working in the water sector, the implications of private sector participation for legitimate water governance have been disputed, for example regarding whether public-private partnerships can provide water that is affordable and accessible to all, and whether they provide opportunities for local stakeholder participation. In this article, these discussions are examined with respect to several examples of public-private partnerships registered with the UN Commission on Sustainable Development. The analysis indicates that these partnerships partially address these criticisms, but also have their own shortcomings.

An integrated decision-support approach in prioritizing risks of non-indigenous species in the face of high uncertainty

- Ecological Economics---2011---Shuang Liu, Michael Hurley, Kim E. Lowell, Abu-Baker M. Siddique, Art Diggle, David C. Cook

When evaluating the risks of future invasions, we often have sparse information on the likelihood that a species will arrive, establish and spread in a new environment, and on the potential impacts should this occur. Conventional risk assessment, therefore, is limited in providing guidance in managing the risk of non-indigenous species (NIS). However, risk management decisions must be made facing these uncertainties to avoid high and irreversible impacts. We develop an integrated ecological economic modeling and deliberative multi-criteria evaluation (DMCE) approach to support group decision-making in risk prioritization, using an example of ten NIS that could potentially impact Australian plant industries. This innovative

approach seeks to combine the advantages of dynamic modeling with the benefits of DMCE in assessing and communicating uncertainty. The model unveils the complexity of the socio-ecological system of biological invasion, with a scenario analysis designed to interactively communicate scientific uncertainty to decision-makers. The DMCE provides a structured approach to identifying stakeholders' key concerns in addressing economic, social, and environmental dimensions of NIS risk explicitly. Functioning as a platform for risk communication, the DMCE also offers an opportunity for diverse views to enter the decision-making process and for the negotiation of consensus consensus.

Thermodynamics on Main Street: When entropy really counts in economics

- Ecological Economics---2011---David Fisk

The implications of thermodynamics for economic theory have been a source of debate for 40 years. Adopting the framing used in modern engineering rather than physics suggests that the market place has already recognised most of these thermodynamic truths as self-evident rather than challenging basic concepts. The exception is the relatively small market for heat where the idea of thermodynamic grade, conveniently represented by the exergy or available work content of a heat source, exposes inconsistencies especially in monopoly supply and economic instruments. Earlier commentators were not wrong in the thrust of their criticisms of economic theory but may have been overly elaborate in their attack.

Quo Vadis MRIO? Methodological, data and institutional requirements for multi-region input-output analysis

- Ecological Economics---2011---Thomas Wiedmann, Harry C. Wilting, Manfred Lenzen, Stephan Lutter, Viveka Palm

In order to understand wider sustainability impacts of consumption and to successfully promote and implement sustainable consumption and production policies, there is a need to capture the whole life-cycle impact

of products and services across international supply chains. Multi-region input-output (MRIO) databases are a well described and suitable foundation for global sustainability analyses addressing a wide range of policy and research questions. In this paper we reflect on the reasons for the recent boom in MRIO compilation, summarise the current state of development and discuss future options for MRIO analysis. We list in detail the requirements for efficient and effective MRIO research and propose systemic and institutional changes. We deliberately try to go beyond existing ambitions for MRIO compilation and thus intend to stimulate discussion and to lay out the options for the future of MRIO research.

Indices of biotic integrity in stated preference valuation of aquatic ecosystem services

- Ecological Economics---2011---Robert Johnston,Kathleen Segerson,Eric T. Schultz,Elena Y. Besedin,Mahesh Ramachandran

Stated preference surveys often give minimal attention to distinctions between intermediate and final ecosystem services, leading to the potential for welfare estimates that overlook, misrepresent or double count associated values. This paper illustrates potential mechanisms through which multimetric indexes of the type developed in the ecological literature, here an index of biotic integrity, can be used within stated preference survey scenarios to both improve the validity of survey responses and provide otherwise unavailable information on willingness to pay for intermediate and final ecosystem services. We illustrate the approach using a choice experiment application to the restoration of migratory fish in a Rhode Island watershed. Where assumptions of the model hold, results can allow transparent disentanglement and estimation of marginal values for both intermediate and final ecosystem services.

Addressing leakage in the EU ETS: Border adjustment or output-based allocation?

- Ecological Economics---2011---Stéphanie Monjon,Philippe Quirion

The EU ETS has been criticised for threatening the competitiveness of European industry and generating carbon leakage, i.e. increasing foreign greenhouse gas emissions. Two main options have been put forward to tackle these concerns: border adjustments and output-based allocation, i.e. allocation of free allowances in proportion to current production. We compare various configurations of these two options, as well as a scenario with full auctioning and no border adjustment. Against this background, we develop a model of the main sectors covered by the EU ETS: electricity, steel, cement and aluminium. We conclude that the most efficient way to tackle leakage is auctioning with border adjustment, which generally induces a negative leakage (a spillover). This holds even if the border adjustment does not include indirect emissions, if it is based on EU (rather than foreign) specific emissions, or (for some values of the parameters) if it covers only imports. Another relatively efficient policy is to combine auctioning in the electricity sector and output-based allocation in exposed industries, especially if free allowances are given both for direct and indirect emissions, i.e. those generated by the generation of the electricity consumed. Although output-based allocation is generally less effective than border adjustment to tackle leakage, it is more effective to mitigate production losses in the sectors affected by the ETS, which may ease climate policy adoption.

A summary of ISEW and GPI studies at multiple scales and new estimates for Baltimore City, Baltimore County, and the State of Maryland

- Ecological Economics---2011---Stephen M. Posner,Robert Costanza

This paper (1) summarizes a number of previous Index of Sustainable Economic Welfare (ISEW) and Genuine Progress Indicator (GPI) studies at various scales; (2) estimates the GPI for Baltimore, Baltimore County, and the State of Maryland; and (3) compares these results with previous and parallel studies. GPI incorporates environmental, social, and economic information into a single metric to represent economic well-being. At all three scales, GPI was found to grow at a slower

rate than the conventional economic measure of gross domestic product (GDP), while at the US national scale GPI has been relatively flat since 1975. State-level results match an independently calculated Maryland GPI, confirming that GPI methods are robust and reproducible. In addition, the State of Maryland has recently made GPI one of their official State statistics, reported annually. State-level GPI results were also compared with studies for the states of Ohio and Vermont to explore regional differences. We recommend that the GPI research community develop consensus on a standardized measurement approach and seek common ground for advancing the use of improved indicators and accounting systems in official policy settings.

On the North-South trade in the Americas and its ecological asymmetries

- Ecological Economics---2011---Pablo Muñoz,Rita Strohmaier,Jordi Roca

There has been a long and intensive debate within the scientific community about the role of international trade in the development of countries. During the last decades, the focus of attention has moved from the pure economic level to the environmental aspects of international trade. Establishing a simplified system of North-South trade for one reference period (2003), this paper attempts to test empirically the extent of potential asymmetries with regard to extracted material flows, and contrasts the results with the economic benefits from trade (in terms of value-added). The South is thereby represented by a selection of Latin American countries (Brazil, Chile, Colombia, Ecuador and Mexico), the North comprises one of their main commercial partners, the United States. At the methodological level, a multi-regional input-output analysis is used as the tool of investigation. Results generally support the hypothesis that the South was feeding the North's societal metabolism. South-North material exports were 1.6 times larger than North-South material exports, resulting in a net deficit for the South of 324 million tons. Moreover, material intensity of exported commodities from the South was twice as high as that from

the North. It is worth highlighting, however, that part of the North-South hypothesis fails for the sample of countries since the larger part of the economic surplus has remained in the South, contrarily to what would have been expected.

The economic importance of non-timber forest products (NTFPs) for livelihood maintenance of rural west African communities: A case study from northern Benin

- Ecological Economics---2011---Katja Heubach,Rüdiger Wittig,Ernst-August Nuppenau,Karen Hahn

Non-timber forest products (NTFPs) contribute significantly to a rural household's livelihood in the African semi-arid tropics. This study examines the income from NTFPs and the dependency on these of different socio-economic groups in Northern Benin. Using survey data from 230 households of two villages, we firstly compared incomes of five different ethnic groups being differentiated by their traditional source of livelihood and regional provenance. Secondly, we investigated disparities between three income groups. On average, income from NTFPs accounted for 39% of total household income and had a strong equalizing effect on it. However, the economic relevance of NTFPs differs between households: Poorer households are relatively more dependent on NTFPs in order to fulfill basic needs than wealthier households. However, the latter extract more NTFPs in quantitative terms and have significantly higher cash returns than poorer ones. This is mainly due to a significant greater land holding. Moreover, our study revealed that net income from NTFPs reflects traditional sources of livelihoods of different ethnic groups. In conclusion, both conservation and development strategies should take into consideration the socio-economic context of different beneficiaries of savanna woodland resources in order to apply appropriate measures to poverty reduction.

Forest management under fire risk when forest carbon sequestration has value

- Ecological Economics---2011---Stéphane Courture, Arnaud Reynaud

We develop a multiple forest use model to determine the optimal harvest date for a forest stand producing both timber and carbon benefits under a risk of fire. An empirical application is provided for a forest owner producing maritime pine in Southwest of France. Our results indicate that a higher risk of fire will decrease the optimal rotation period. On the contrary, higher carbon prices increase the optimal harvesting age. To investigate the contradictory effects of fire risk and carbon price on forest rotation, we identify the set of carbon prices and fire risks that lead to a given rotation age. We also show that forest owner's willingness to pay for a risk reduction can be substantial (37.33€ euros by ha and by year to reduce the annual fire risk from 1.26% to 0.07%).

Structural decomposition analysis and input-output subsystems: Changes in CO2 emissions of Spanish service sectors (2000-2005)

- Ecological Economics---2011---Isabela Butnar, Maria Llop

The analysis of gas emissions by an input-output subsystem approach provides detailed insight into pollution generation in an economy. Structural decomposition analysis, on the other hand, identifies the factors behind the changes in key variables over time. Extending the input-output subsystem model to account for the changes in these variables reveals the channels by which environmental burdens are caused and transmitted throughout the production system. In this paper we propose a decomposition of the changes in the components of CO2 emissions captured by an input-output subsystems representation. The empirical application is for the Spanish service sector, and the economic and environmental data are for years 2000 and 2005. Our results show that services increased their CO2 emissions mainly because of a rise in the emissions

generated by non-services to cover the final demand for services. The decomposed effects show a decrease in CO2 emissions due to technological changes between 2000 and 2005 compensated by an increase in emissions caused by the rise in final demand of services. Finally, large asymmetries exist not only in the quantitative changes in the CO2 emissions of the various services but also in the decomposed effects of these changes.

IT for green and green IT: A proposed typology of eco-innovation

- Ecological Economics---2011---S. Faucheux, I. Nicolai

This article is in support of the development of an ecological economic framework. It discusses, from an interdisciplinary perspective, the increasing use of green IT and their applications (IT for green). IT and sustainable development have had a concomitant rise and reach. The future world emerging from their respective interpretations enables, in both cases, a shift from today's questionable industrial capitalism towards post-industrial capitalism. This paper addresses the following questions: What is known about green IT and IT for green? Are smart solutions (buildings, energy grids, transport) always beneficial to an ecological economy? And, if so, in what ways? In the first part of this article, we analyse the economic, social and environmental impact of IT and argue for the need for green applications of green IT in order to achieve sustainable outcomes. The second part focuses on the managerial dimension of eco-innovation theory and presents one of the distinctive features of green applications of green IT: the collective organisation of innovation. A typology of eco-innovation aimed at reconciling IT development and green growth is then proposed explicitly addressing four kinds of changes towards sustainable development: technological, social, institutional and organisational innovation.

Multi-scale integrated assessment of soybean biodiesel in Brazil

- Ecological Economics---2011---Matteo Borzoni

Developing countries are often believed to have excellent conditions for biofuel production, however studies aimed at assessing the sustainability of large scale biofuel programs have generally focused on a few variables related to one scientific domain and one scale. Contrary to this approach, this paper analyzes soybean biodiesel in Brazil using a parallel biophysical and economic assessment at different scales. A Multi-Scale Integrated Analysis of Societal and Ecosystem Metabolism (MuSI-ASEM) approach is applied as a scenario analysis tool. A soybean biodiesel energy balance for the specific conditions of Brazil is included and the energy ratio turns out to be 1.09. This means that the energy delivered is higher than the energy invested, however the net energy is very low. The economic impacts are analyzed through input-output analysis. The results show that soybean biodiesel increases energy consumption per hour of work without a corresponding increase in economic labor productivity. Consequently the already low energy efficiency of Brazilian production could get worse. Although Brazil has large expanses of land, the substitution of 20% fossil diesel (i.e. just 3.3% of the country's primary energy consumption) with fully renewable biodiesel might destroy protected areas and forests and increase the GHGs emitted.

Dynamic sustainability assessment: The case of Russia in the period of transition (1985-2008)

- Ecological Economics---2011---Stanislav Shmelev

Russia has experienced twenty years of economic and social change, which had a substantial impact on the regional and sectoral patterns of the development of its economy, infrastructure, the quality of the environment and the well-being of its people. The current economic revival offers new opportunities and presents new challenges for the sustainable development of Russia. The paper employs the UN Sustainable Development framework of indicators and assesses sustainability of Russia using multi-criteria evaluation methods, namely the uncertainty randomization multi-criteria evaluation method "Analysis and Synthesis of Parameters under Information Deficiency" (ASPID). The analysis covers economic, environmental and social trends in Russia's

development in 1985-2008 and assesses sustainability of this development from the point of view of multiple criteria. The results show the potential of employment of multi-criteria methods for the sustainability assessment at the macro level and offer useful insights into multidimensional nature of sustainability and the role of priority setting in the evaluation process. Such an analysis reveals the degree of harmoniousness of sustainable development policy. It shows how different sets of priorities determine the outcome of multidimensional analysis of sustainability and could potentially help in assessing progress and designing new policy instruments. This paper is one of the first to apply multi-criteria methods to the macro sustainability analysis in the dynamic setting.

An options based bioeconomic model for biological and chemical control of invasive species

- Ecological Economics---2011---Alex Marten, Christopher C. Moore

The management of non-native invasive species is a complex but crucial task given the potential for economic and environmental damages. For many invasions the development of socially optimal control strategies requires more than is offered by the single-species, single-control models that have dominated this area of research. We develop a general stochastic optimal control framework that accommodates multiple interacting species while accounting for uncertainty in the temporal population dynamics. This extension to the current line of bioeconomic control models allows for the design of optimal integrated pest management strategies that utilize both chemical and biological controls in an environment of uncertainty and irreversibility. We demonstrate the benefits of combining chemical and biological controls in long term management strategies through a case study of the hemlock wooly adelgid (*Adelges tsugae*) infestation in the eastern United States. In this application we find that the introduction of natural predators is usually sufficient to manage the infestation, though chemical insecticides can play an important role when detection of the infestation is

delayed or when the biological control agent does not sufficiently increase mortality of the invasive species.

Groundwater and ecosystems damages: Questioning the Gisser-Sánchez effect

- Ecological Economics---2011---Encarna Esteban, José Albiac

Gisser and Sánchez (1980a) state the conditions under which welfare gains from policy intervention are negligible in aquifer management, when compared with non-regulation or "free market" outcomes. This is the so-called Gisser-Sánchez effect (GSE), which has been supported by the ensuing literature during recent decades. The GSE requires a number of assumptions, among which is the disregard for aquatic ecosystems linked and dependent on aquifer systems. The depletion of aquifer systems in arid and semiarid regions worldwide is causing acute water scarcity and quality degradation, and leading to extensive ecosystem damages. This study shows that by including environmental damages into the analytical model, results can change substantially. The analysis highlights both theoretically and empirically the importance of policies in groundwater management, as well as the potential role for stakeholders' cooperation. The empirical application deals with two large aquifers in Spain, the Western La Mancha aquifer which is grossly mismanaged, and the Eastern La Mancha aquifer, which is moving towards sustainable management. Western and Eastern La Mancha aquifers illustrate that policies and institutions are essential to avoid the current global aquifer mismanagement.

International transmission of environmental policy: A New Keynesian perspective

- Ecological Economics---2011---Giovanni Ganelli, Juha Tervala

In this paper we examine the international transmission of environmental policy using a New Keynesian model of the global economy. We first consider the case in which the quality of the environment affects utility, but not productivity. This allows us to look at the

trade-off between environmental quality and output. We then consider the case in which the quality of the environment increases productivity but does not affect utility. Our main results show that in both cases a unilateral implementation of a more stringent environmental policy by the domestic country raises foreign welfare under a benchmark parameterization. Our modeling strategy allows an analysis of how nominal rigidities interact with the implementation of environmental reforms, by allowing the domestic country to shift, through exchange rate depreciation, parts of the costs of more stringent environmental policies to the foreign one.

Motivation crowding in environmental protection: Evidence from an artefactual field experiment

- Ecological Economics---2011---d'Adda, Giovanna

This paper examines how motivation, crowding and social image affect environmental conservation decisions. An artefactual field experiment conducted in Bolivia is used to reproduce the trade-off between individual and social benefits in natural resource use and test the effect of non-monetary and non-regulatory incentives on pro-social behavior for environmental conservation. The results show the presence of a social norm prescribing positive contribution towards environmental protection, and that external incentives have heterogeneous effects on pro-social behavior depending on how they influence reputation and self-image. The experimental results differ from those of analogous experiments conducted in the laboratory, and are instead consistent with those from field experiments on common-pool resource management. This fact suggests caution in generalizing conclusions, reached in the laboratory, to different settings and populations.

Markets of concentration permits: The case of manure policy

- Ecological Economics---2011---Bart Van der Straeten, Jeroen Buysse, Stephan Nolte, Ludwig Lauwers, Dakerlia Claeys, Guido Van Huylenbroeck

Concentration permits are regarded as an interesting

policy tool for regulating emissions where, besides absolute amounts, also local concentration is important. However, effects of governance structure, trading system and possible policy interventions in the permits' allocation are not yet well analysed and understood. This paper explores in how far tradable fertilisation standards can be seen as a concentration permit trading (CPT) system which can be fine-tuned for further policy intervention. Indeed fertilisation standards such as obliged by the EU Nitrate Directive can be regarded as local nitrate emissions limits, and thus concentration permits. A multi-agent spatial allocation model is used to simulate the impact of defining the manure problem in terms of concentration permits rather than conventional emission permits. Impacts are simulated in terms of environmental performance and increased reallocation costs. The model is applied on the Flemish manure problem.

Impact of Bt cotton on pesticide poisoning in smallholder agriculture: A panel data analysis

- Ecological Economics---2011---Shahzad Kouser,Matin Qaim

While substantial research on the productivity and profit effects of Bt cotton has been carried out recently, the economic evaluation of positive and negative externalities has received much less attention. Here, we focus on farmer health impacts resulting from Bt-related changes in chemical pesticide use. Previous studies have documented that Bt cotton has reduced the problem of pesticide poisoning in developing countries, but they have failed to account for unobserved heterogeneity between technology adopters and non-adopters. We use unique panel survey data from India to estimate unbiased effects and their developments over time. Bt cotton has reduced pesticide applications by 50%, with the largest reductions of 70% occurring in the most toxic types of chemicals. Results of fixed-effects Poisson models confirm that Bt has notably reduced the incidence of acute pesticide poisoning among cotton growers. These effects have become more pronounced with increasing technology adoption rates. Bt cotton now helps to avoid several million cases of pesticide poi-

soning in India every year, which also entails sizeable health cost savings.

Assessing fishers' empowerment in inland openwater fisheries in Bangladesh

- Ecological Economics---2011---G.M. Shamsul Kabir,Tai Shzee Yew,Kusairi Mohd. Noh,Law Siong Hook

The Community Based Fisheries Management (CBFM) approach has made a significant contribution towards improvement of fishers' empowerment of inland openwater fisheries in Bangladesh aiming to manage their resources efficiently. This arrangement introduced CBFM approaches named fisher-led, community-led and women-led approach. A wider range of local institutional arrangements as community based organizations (CBOs) have been established through participatory process with legal entity. Now, the CBOs as local institutions and fishers are more empowered in participation of fishery management under co-management arrangement. The study reveals that there is still lack of institutional arrangement to be achieved at optimum level. This paper presents and assesses the empowerment status of the fisher communities in inland openwater fisheries under co-management arrangement in Bangladesh through Factor analysis and regression model. This study might have policy implication to replicate the community based fishery management approach to promote empowerment for better management.

An indicator-based integrated assessment of ecosystem change and human-well-being: Selected case studies from Indonesia, China and Japan

- Ecological Economics---2011---M.S. Suneetha,Joeni S. Rahajoe,Kikuko Shoyama,Xing Lu,Shubhechha Thapa,Ademola K. Braimoh

The paper highlights the findings of a study from selected ecosystems in Indonesia, China and Japan. The study sought to trace changes to productive resources of ecosystems over a period of 50 years; and trace

the dependence of well-being of local populations on the ecosystems for the same time period. Data was collected from land-use maps, records and participatory rapid/rural appraisal (PRA) surveys in multistakeholder forums. To illustrate the changes, an indicator-based assessment framework was developed that integrates data from biophysical and socio-economic parameters. We observed that the approach (1) provides a better representation of the preferences of different stakeholders of ecosystem services, (2) fosters validation of data between the different stakeholders and (3) enables a communication and planning process among the stakeholders to sustainably utilize and manage their ecosystems. The use of spatial maps validates the relevance and utility of diachronic observations of communities and other stakeholders directly dependent on ecosystems. At the same time, they can be used to strengthen local planning processes for the development of services in the ecosystem. Such research thereby also acts as a catalyst to a social process of coordinated action to address local issues of global relevance.

Pitfalls and potential of institutional change: Rain-index insurance and the sustainability of rangeland management

- Ecological Economics---2011---Birgit Müller,Martin Quaas,Karin Frank,Stefan Baumgärtner

Rain-index insurance is strongly advocated in many parts of the developing world to help farmers to cope with climatic risk that prevails in (semi-)arid rangelands due to low and highly uncertain rainfall. We present a modeling analysis of how the availability of rain-index insurance affects the sustainability of rangeland management. We show that a rain-index insurance with frequent payoffs, i.e. a high strike level, leads to the choice of less sustainable grazing management than without insurance available. However, rain-index insurance with a low to medium strike level enhances the farmer's well-being while not impairing the sustainability of rangeland management.

The value of nonindigenous species risk assessment in international trade

- Ecological Economics---2011---Michael Springborn,Christina M. Romagosa,Reuben P. Keller

Managing the introduction of nonindigenous species is becoming a major goal of policy-makers at regional, national and international scales. Here we investigate, at the national level, the ideal design and expected net benefits of a risk assessment program for evaluating the desirability of nonindigenous species imports. We show how to enhance the statistical rigor of such a system by correcting a common non-random sampling problem encountered in the data. This correction enables model output to be interpreted in an economically relevant way and facilitates a theoretically rigorous characterization of the balance between trade and non-indigenous species establishment risk. Using reptiles and amphibians imported to the U.S. as a case study, we characterize economic outcomes over a range of cases and demonstrate substantial expected returns to such a screening program, relative to the current effectively open-door policy. Our results are informative for the current debate in the U.S. about whether to require federal agencies to apply risk assessment before allowing a species for import. The framework presented decomposes a complex argument about risk management into component economic and statistical parts, allowing for debate and improved understanding over each element to inform the overall program in a transparent fashion.

Emergy evaluation perspectives of an irrigation improvement project proposal in China

- Ecological Economics---2011---Dan Chen,Michael Webber,Jing Chen,Zhaohui Luo

Emergy theory and method are used to evaluate the feasibility of an irrigation improvement project in China and its contribution to local agricultural development. An emergy method for evaluating the costs and benefits of the project and a composite index named the emergy cost-benefit ratio (EmCBR) were developed.

The emergy evaluation shows that the major costs associated with the proposed project come from earthwork (77.4% of the total cost) and concrete work (15.4%), and that water saving (43.0% of the total benefit) and agricultural yield increase (56.9%) are the most important contributions. The calculated EmCBR is 0.97 (the lowest value for a feasible project is 1.0) which indicates that this project would not be feasible in emergy terms. The regional agricultural system could not benefit from the proposed project, according to several emergy indices: emergy yield ratio (EYR), emergy investment ratio (EIR), environmental load ratio (ELR) and environmental sustainability index (ESI). The results show that conventional cost-benefit analysis could fail to provide an adequate decision-making framework because it is unable to value resources and environmental impacts properly. More additional emergy evaluations should be completed on other alternatives to the proposed project to provide adequate guidelines for selecting the best alternative that contributes most to agricultural development with limited environmental impact.

Towards a unified scheme for environmental and social protection: Learning from PES and CCT experiences in developing countries

- Ecological Economics---2011---Luis C. Rodríguez, Unai Pascual, Roldan Muradian, Nathalie Pazmino, Stuart Whitten

Environmental protection and poverty alleviation in the developing world are usually heralded as joint objectives. However, these two goals are often associated with different sectoral policy instruments. While so-called payments for environmental services (PES) are increasingly being promoted for environmental protection, poverty alleviation is increasingly addressed by conditional cash transfers (CCT) program. These instruments although aimed to achieve distinct objectives have a number of similarities and challenges in their design and implementation phases. This paper elaborates on these similarities and develops a unifying generic framework that is used to discuss the extent to which both approaches could be unified.

Modeling farmer participation in agri-environmental nitrate pollution reducing schemes

- Ecological Economics---2011---Eirini Giovanopoulou, Stefanos Nastis, Evangelos Papanagiotou

Why do farmers choose to participate in agri-environmental programmes and how do they choose the amount of land they allocate to such programmes? This paper examines the determinant factors influencing farmers' adoption of the EU-financed agri-environmental Nitrate Reduction Programme (NRP) in Greece and the extent of the programme's adoption, in terms of land allocation. The decision to adopt the NRP is modeled as a two-step procedure. First, farmers decide whether to participate in the agri-environmental programme and second, the extent of participation is determined. We employ Heckman's self-selection bias correction model to derive unbiased estimates. Based on farm level data, we develop the profile of farmers who choose to adopt the agri-environmental programme and the characteristics of their farms. The results of the analysis provide valuable policy insights decomposed into the main factors determining first, the adoption of the agri-environmental programme and second, the extent of adoption. By decomposing the determining factors, policy makers can employ this information to design effective agri-environmental programmes, desirable to farmers and more targeted towards specific environmental and agricultural development goals.

A choice experiment on fuel taxation and earmarking in Norway

- Ecological Economics---2011---Håkon Sclen, Steffen Kallbekken

Pigouvian taxes are efficient -- but unpopular among voters -- and hence often politically infeasible. Earmarking of revenues has been widely reported to increase public support for taxes, but earmarking is generally not the most efficient use of the revenues. This trade-off between efficiency and political feasibility is the motivation for our primary research objective: to

quantify the effect of earmarking on support for fuel tax rises. Our secondary research objective is to investigate why earmarking increases support. Using data from a representative sample of the Norwegian voter population ($N = 1147$), we estimate models of voter preferences for fuel taxes using logistic regression models. Our results show that, in the absence of earmarking, the majority of voters would like to reduce fuel taxes, but earmarking the revenues for environmental measures has a substantial effect on voter support for fuel tax increases, garnering a majority for increases of up to 15% above present levels. Further analysis indicates that a prime reason why earmarking for environmental measures is popular is that it increases the perceived environmental effectiveness of the tax, and hence its legitimacy as an environmental rather than a fiscal policy instrument.

Do environmental benefits matter? Evidence from a choice experiment among house owners in Germany

- Ecological Economics---2011---Martin Achtnicht

Residential buildings strongly contribute to global CO₂ emissions due to the high energy demand for electricity and heating, particularly in industrialised countries. Within the EU, decentralised heat generation is of particular relevance for future climate policy, as its emissions are not covered by the EU ETS. We conducted a choice experiment concerning energy retrofits for existing houses in Germany. In the experiment, the approximately 400 sampled house owners could either choose a modern heating system or an improved thermal insulation for their home. We used standard and mixed logit specifications to analyse the choice data. We found environmental benefits to have a significant impact on choices of heating systems. However, they played no role in terms of insulation choices. Based on the estimated mixed logit model, we further obtained willingness-to-pay (WTP) measures for CO₂ savings.

Income inequality and the development of environmental technologies

- Ecological Economics---2011---Francesco Vona, Fabrizio Patriarca

Within rich countries, a large dispersion in the capacity of generating environmental innovations appears correlated to the level of inequality. Previous works analyze the relationship between inequality and environmental quality in a static setting. This paper builds a dynamic model more suitable to analyze technological externalities driven by the emergence of a new demand for green products. Under fairly general assumptions on technology and preferences, we show that: 1. the relationship between inequality and environmental innovation is highly non-linear and crucially depends on per-capita income; 2. an excessive inequality harms the development of environmental technologies especially in rich countries. Key to our results is the fact that externalities generated by pioneer consumers of green products benefit the entire population only for relatively low income distances. The empirical analysis robustly confirms our theoretical results, that is: whereas for rich countries inequality negatively affects the diffusion of innovations, per-capita income is paramount in poorer ones.

Explaining the variation in household recycling rates across the UK

- Ecological Economics---2011---Andrew Abbott, Shasikanta Nandeibam, Lucy O'Shea

Household waste recycling rates vary significantly both across and within regions of the UK. This paper attempts to explain the variation by using a new data set of waste recycling rates and policy determinants for all of the UK's 434 local authorities over the period 2006Q2 to 2008Q4. Our results suggest that the method of recycling collection chosen by policy makers is an important factor influencing the recycling rate. We also find an inverse relationship between the frequency of the residual waste collection and the recycling rate.

Sustainability and externalities: Is the internalization of externalities a sufficient condition for sustainability?

- Ecological Economics---2011---Kostas Bithas

In an important contribution in Ecological Economics, van de Bergh (2010) correctly concludes that sustainability does not imply zero externalities. However, he continues with the Delphic statement "(Delphic statements were uttered by the renowned oracle of ancient Greece at Delphi. They were phrased in such a way as to be self-fulfilling because alternative interpretations covered every possibility.)" "Without externalities the problem of sustainability vanishes". If this statement refers to an impossible economic process that produces no externalities then he is right. However, it might be interpreted as stating that whenever environmental policy internalizes environmental externalities then sustainability will be ensured. In this note, I assert that in the real world where externalities prevail, their internalization or neutralization in the traditional way cannot lead to sustainability. Only if internalization takes a very specific form that results in the inviolable preservation of environmental rights of future generations in pure biological terms can sustainability be ensured. After revised the original commentary I re-submit it. The issues raised by the editor have been carefully considered.

The economic valuation of biodiversity as an abstract good

- Ecological Economics---2011---Yves Meinard,Philippe Grill

The notion of an economic valuation of biodiversity raises major philosophical and practical challenges, especially due to the fact that biodiversity is an abstract good. Insights from political philosophy and philosophy of language can help to clarify the reliability and scope of the current economic methods that can be used for the purpose of valuing it. The analogy with another abstract good, justice, indeed shows that thinking about abstract goods is a very specific exercise. If

they do not take account of this specificity, applications of hedonic and contingent valuation methods can hardly claim to be relevant to value biodiversity. Rawls' theory of justice provides for the conceptual tools to overcome this problem. A reinterpretation, based on the theory of counterfactuals, allows generalizing this account of justice to outline a theory of thinking about abstract goods. This new framework emphasizes the importance of the institutional context in determining the reliability of thinking about abstract goods. It points toward substantial reforms of the methodology of economic valuation. Specifically, it suggests reinterpreting valuation as a dynamic expressive process, where initial steps aim at reinforcing the reliability of later steps through an institutional transformation and stabilization of preferences for abstract goods.

Valuing ecosystem and economic services across land-use scenarios in the Prairie Pothole Region of the Dakotas, USA

- Ecological Economics---2011---William R. Gascoigne,Dana Hoag,Lynne Koontz,Brian A. Tangen,Terry L. Shaffer,Robert A. Gleason

This study uses biophysical values derived for the Prairie Pothole Region (PPR) of North and South Dakota, in conjunction with value transfer methods, to assess environmental and economic tradeoffs under different policy-relevant land-use scenarios over a 20-year period. The ecosystem service valuation is carried out by comparing the biophysical and economic values of three focal services (i.e. carbon sequestration, reduction in sedimentation, and waterfowl production) across three focal land uses in the region [i.e. native prairie grasslands, lands enrolled in the Conservation Reserve and Wetlands Reserve Programs (CRP/WRP), and cropland]. This study finds that CRP/WRP lands cannot mitigate (hectare for hectare) the loss of native prairie from a social welfare standpoint. Land use scenarios where native prairie loss was minimized, and CRP/WRP lands were increased, provided the most societal benefit. The scenario modeling projected native prairie conversion to cropland over the next 20 years would result in a social welfare loss valued at over

\$4 billion when considering the study's three ecosystem services, and a net loss of about \$3.4 billion when reductions in commodity production are accounted for.

Intertemporal choice of marine ecosystem exploitation

- Ecological Economics---2011---Lars Ravn-Jonsen

Exploitation of the marine ecosystem brings with it an intertemporal choice: there is a choice of catching the fish today, or restrain from fishing with the option of an increase in the benefit from future harvest. In a marine ecosystem under common pool management regime the contribution margin from catching the fish belongs to the fisher, while the benefit from the investment of leaving the fish in the sea will be shared in the common pool. The intertemporal choice therefore creates a driver for short sighted use of the ecosystem. The intertemporal balance of the exploitation is analyzed by applying capital theory to a size-based ecosystem model. The model reveals a need for intertemporal balance with respect to both fish size and harvest volume. The management therefore is, at an ecosystem level, to set target and regulate not only harvest volume but also size.

Evaluating the effects of area closure for recreational fishing in a coral reef ecosystem: The benefits of an integrated economic and biophysical modeling

- Ecological Economics---2011---Lei Gao,Atakelty Hailu

This paper presents an integrated agent-based model of recreational fishing behavior within a reef ecosystem as a platform for the evaluation of recreational fishing management strategies. Angler behavior is described using econometrically estimated site choice models, with site choice among anglers driven by site attributes and angler characteristics. The biophysical model represents the marine reef environment as a system with different trophic levels identifying algal and coral growth as well as two types of fish (piscivores and

herbivores). Ecosystem dynamics are driven by interactions within the trophic levels and interaction between fish populations and fishing activities. The model is used to simulate recreational fishing activities and their interactions with the environment. Recreational fishing sites from the Ningaloo Marine Park, an iconic coral reef system in Western Australia, are used as a case study. A set of management strategies, including "business-as-usual" and different site closure durations, are assessed for two different levels of fishing pressures. The results show that not only the effectiveness but also the distribution of management impacts across space and over time can be very different from what one would expect without the benefit of integrated modeling.

Potential ecological and economic impacts of sea lice from farmed salmon on wild salmon fisheries

- Ecological Economics---2011---Yajie Liu,Ussif Sumaila,John Paul Volpe

This paper examines the possible ecological and economic effects of sea lice from salmon farms on wild salmon populations and fisheries. A bioeconomic model is developed incorporating an age-structured population dynamics model of wild pink and chum salmon with mortality caused by farm-derived sea lice. Our model incorporates capture fisheries under two management policy scenarios. Results suggest that the ecological and economic effects are minor when the sea lice induced mortality rate is below 20%, while they can be severe if the mortality is greater than 30%. Sea lice have greater ecological and economic impacts on pink salmon than on chum salmon. The impact of farm lice epizootics on wild salmon is greater under a fixed exploitation rate than under a target escapement policy. As a result, a precautionary principle should be adopted, and appropriate management schemes and policy strategies should be developed to minimize these effects.

Complementarity between water pricing, water rights and local water governance: A Bayesian analysis of choice behaviour of farmers in the Krishna river basin, India

- Ecological Economics---2011---Prakashan Chellattan Veettil,Stijn Speelman,Aymen Frija,Jeroen Buysse,Guido van Huylenbroeck

To ensure efficient water allocation and use, policy designers have adopted various strategies, including price setting, decentralising irrigation water management or improving water rights. Most of these strategies have been applied individually, without considering the complementary relationships between them. This paper uses a discrete choice model to analyse the scope for combinations of tools for irrigation water demand management and farmers' acceptance of these. In terms of local irrigation water governance, the presence or absence of collective irrigation water management, in the form of a Water Users Association, is considered. Water rights are specified in terms of the duration and quality of the entitlement and its transferability. Finally, four types of water pricing methods (area, crop, block and volumetric pricing) are considered. Using a choice experiment, we elicit the most preferred water pricing method, under different water rights situations, at different price levels and under various contexts for local irrigation water governance. Our results indicated that under conditions of improved water rights, preference for volumetric pricing increases, whilst the presence of a Water Users Association reduces this preference. Furthermore, it was found that using an appropriate combination of water demand management tools considerably increases the willingness to pay for a change in scenario.

Organic food consumption in Europe: International segmentation based on value system differences

- Ecological Economics---2011---Salvador Ruiz de Maya,Inés López-López,José Luis Munuera

In this paper, we analyze the market for organic products in eight European countries, based on differences

in their respective value systems. With a significant sample of 8014 consumers, we first identify international segments in the European organic products market using the Values Theory. Then we apply the Theory of Planned Behavior to examine how European consumers use attitudes, subjective norms and perceived behavioral control to form their purchase intention for organic products. Results show that subjective norms are the main underlying factor driving consumer behavior concerning these products. This effect is higher for the group of countries whose citizens score higher on Schwartz's value scale. In this segment of countries, people are more likely to be affected by what others think, which means that the best approach is to increase social awareness of the relevance of purchasing organic products. Organic products represent a potentially profitable opportunity for companies with an international horizon. Results are also useful for consumers and public administrations.

Environmental impacts of changes to healthier diets in Europe

- Ecological Economics---2011---Arnold Tukker,R. Alexandra Goldbohm,Arjan de Koning,Marieke Verheijden,René Kleijn,Oliver Wolf,Ignacio Pérez-Domínguez,José Rueda-Cantuche,Ignacio Perez Dominguez

Food consumption causes, together with mobility, shelter and the use of electrical products, most life cycle impacts of consumption. Meat and dairy are among the highest contributors to environmental impacts from food consumption. A healthier diet might have less environmental impacts. Using the E3IOT environmentally extended input output database developed in an EU study on Environmental Impacts of Products (EIPRO), this paper estimates the difference in impacts between the European status quo and three simulated diet baskets, i.e. a pattern according to universal dietary recommendations, the same pattern with reduced meat consumption, and a 'Mediterranean' pattern with reduced meat consumption. Production technologies, protein and energy intake were kept constant. Though this implies just moderate dietary shifts,

impact reductions of up to 8% were possible in reduced meat scenarios. The slightly changed food costs do not lead to significant first order rebound effects. Second order rebounds were estimated by applying the CAPRI partial equilibrium model. This analysis showed that European meat production sector will most likely respond by higher exports to compensate for losses on the domestic meat market. Higher impact reductions probably would need more drastic diet changes.

Evaluating the effectiveness and efficiency of biodiversity conservation spending

- Ecological Economics---2011---Helen F. Laycock, Dominic Moran, James C.R. Smart, David G. Raffaelli, Piran C.L. White

Evaluation of effectiveness and efficiency should be an integral component of biodiversity conservation strategies. We used Cost-Utility Analysis (CUA) and Threat Reduction Assessment (TRA) to evaluate the effectiveness and efficiency of individual Species Action Plans (SAPs) with regard to improving conservation status and reducing threats within the UK Biodiversity Action Plan. Spending was highly biased towards vertebrates, in particular mammals and birds. Of 38 fully-costed SAPs, the top five most expensive SAPs accounted for almost 80% of the total money spent. Just over half of the SAPs studied had improved the conservation status of the species concerned, and one third of SAPs achieved at least a 50% reduction in threats. SAP cost was significantly positively related to improvement in conservation status but unrelated to threat reduction for that species. Effectiveness and efficiency were significantly correlated with one another in terms of threat reduction for different species, but there was no correlation between effectiveness and efficiency in terms of improving conservation status. Although conservation decisions should not be made solely on the outcome of such analyses, CUA and TRA can provide an important contribution to the evidence base to inform the development of more effective and efficient conservation strategies.

Could society's willingness to reduce pesticide use be aligned with farmers' economic self-interest?

- Ecological Economics---2011---Jean-Philippe Boussemart, Hervé Leleu, Oluwaseun Ojo

In the context of approximately 50% reduction in pesticide treatment according to the agreement of the "Grenelle de l'environnement" in France, the main part of this study involves the assessment of intensification or extensification of pesticide use in crop activities. This is done with reference to its use per ha thereby helping to proffer a solution to the persistent questions of farmers with regard to the use of inputs in an intensified manner or otherwise. With respect to this, a sample of 600 farms in the Meuse department was observed over a 12-year period. The analysis is essentially to assess cost efficiency dominance between technologies using non-parametric cost-functions which involves different levels of pesticide use per ha. Our empirical application shows that less intensive processes in terms of pesticide level per ha are a better option not only for the society but also for the producers who could significantly reduce their costs in 80% of cases.

The Asian clam *Corbicula fluminea* in the European freshwater-dependent industry: A latent threat or a friendly enemy?

- Ecological Economics---2011---Inês C. Rosa, Joana L. Pereira, João Gomes, Pedro M. Saraiva, Fernando Gonçalves, Raquel Costa

While the biofouler *Corbicula fluminea* (Müller, 1774) is known to cause great economic losses in North America, studies reporting the problem in Europe are much scarcer. This paper explores the industrial effects of the species in Portugal, the gateway by which the bi-valve entered Europe around 30 years ago. National waterworks, major power stations, cement plants, pulp and paper mills and irrigation systems were surveyed. The industrial impacts of the pest were shown to remain relatively mild; irrigation systems are those that seem to be facing more significant economic losses due

to infestation. Possible reasons for the apparent discrepancy between this result and the species dispersal in natural ecosystems are discussed, and recommendations on adequate responses to the latent threat are provided. This study may assist the implementation of integrated pest management policies in countries at risk of invasion or recently invaded, and contribute to an understanding of the species' progression in industrial environments.

Estimating and communicating food system impacts: A case study in Montreal, Quebec

- Ecological Economics---2011---Joël Thibert, Madhav G. Badami

Modern food systems are characterized by a range of resource use, environmental, and socioeconomic impacts, resulting from choices made by various actors, including the public, who are "distanced" from these impacts, with important implications for sustainability. In order to make ecologically responsible food choices, the public will need information that is reliable, easily comprehensible, and that allows them to discriminate between these choices in terms of the range of impacts, and their trade-offs with factors such as market price. We illustrate, by means of a case study involving nine variations of two meals of similar nutritional energy content, some challenges and issues associated with estimating and integrating the diverse impacts of food systems, and explore the implications of our results for communicating these impacts in a manner that balances epistemic adequacy with heuristic usefulness in enabling ecologically responsible food choices.

Estimating the impacts of eliminating fisheries subsidies on the small island economy of the Azores

- Ecological Economics---2011---Natacha Carvalho, Sameer Rege, Mário Fortuna, Eduardo Isidro, Gareth Edwards-Jones

A major problem affecting world fisheries today is over-capacity of which overfishing is both a cause and a

consequence. There is a general consensus that fisheries subsidies cause great harm to the resource by exacerbating the problems resulting from the common resource issues of fisheries leading to overexploitation of the resource through a new set of perverse incentives. Many now advocate that subsidies should gradually be terminated, and that capacity enhancing and fuel subsidies should be terminated immediately. On account of the global fisheries crises, highly subsidised fisheries and the anticipated reforms of the European Union's Common Fisheries Policy this study aimed to estimate the impact of eliminating fisheries subsidies on various macro and micro economic variables pertaining to the regional economy of the Azores using a dynamic computable general equilibrium model based on a social accounting matrix. The simulation results suggest that reduction, and in particular, elimination of fisheries subsidies would have a substantial effect on the region, however, the negative social and economic effects would be largely confined to the fishing sector. Conversely, the augmentation of fishery subsidies would benefit the fishing sector with an overall adverse effect on the rest of the economy.

Smallholder timber sales along the Transamazon Highway: a comment

- Ecological Economics---2011---Robert Walker, Eugenio Arima

Reply to Walker and Arima

- Ecological Economics---2011---Gregory S. Amacher, Frank Merry, Maria S. Bowman

2011

Governing the commons: Learning from field and laboratory experiments

- Ecological Economics---2011---Marco A. Janssen, John M. Anderies

2011

The challenge of understanding decisions in experimental studies of common pool resource governance

- Ecological Economics---2011---John M. Anderies,Marco A. Janssen,François Bousquet,Juan-Camilo Cardenas,Daniel Castillo,Maria Claudia Lopez,Robert Tobias,Björn Volla,Amber Wutich

Common pool resource experiments in the laboratory and the field have provided insights that have contrasted to those derived from conventional non-cooperative game theory. Contrary to predictions from non-cooperative game theory, participants are sometimes willing to restrain voluntarily from over extracting resources and use costly punishment to sanction other participants. Something as simple as face-to-face communication has been shown to increase average earnings significantly. In the next generation of experiments, both in the laboratory and in the field, we need to extract more information that provides insight concerning why people make the decisions they make. More information is needed concerning attributes of individuals as well as the social and social-ecological context in which they interact that may give rise to such deviations from theoretical predictions. In the process of extracting more information from participants and the contexts in which they interact, we face several methodological and ethical challenges which we address in this paper.

Reprint of: A common-pool resource experiment with postgraduate subjects from 41 countries

- Ecological Economics---2011---T.K. Ahn,Elinor Ostrom,James Walker

This study reports results from a new series of experiments that examine the robustness of face-to-face communication as a cooperation-facilitating institution in common-pool resource settings. Results are reported from nine experiment sessions, initially designed for pedagogical purposes. The sessions were conducted between 1998 and 2007 as part of a series of summer institutes on institutional analysis and environmental change. Subjects were graduate students

and professionals from diverse disciplines, representing 41 countries of residence. The participants in this study stand in sharp contrast to most previous studies, which used undergraduates who self-select into experiments by volunteering to participate. Results from these experiments substantiate earlier findings that non-binding communication can serve as an effective mechanism for solving social dilemma problems, with subjects achieving near socially efficient outcomes.

Head-enders as stationary bandits in asymmetric commons: Comparing irrigation experiments in the laboratory and the field

- Ecological Economics---2011---Marco A. Janssen,John M. Anderies,Juan-Camilo Cardenas

The emergence of large-scale irrigation systems has puzzled generations of social scientists, since they are particularly vulnerable to selfish rational actors who might exploit inherent asymmetries in the system (e.g. simply being the head-ender) or who might free ride on the provision of public infrastructure. As part of two related research projects that focus on how subtle social and environmental contextual variables affect the evolution and performance of institutional rules, several sets of experiments have been performed in laboratory settings at Arizona State University and in field settings in rural villages in Thailand and Colombia. In these experiments, participants make both a decision about how much to invest in public infrastructure and how much to extract from the resources generated by that public infrastructure. With both studies we find that head-enders act as stationary bandits. They do take unequal shares of the common-pool resource but if their share is very large relative to downstream participants' shares, the latter will revolt. Therefore for groups to be successful, head-enders must restrain themselves in their use of their privileged access to the common-pool resource. The comparative approach shows that this result is robust across different social and ecological contexts.

The impact of culture and ecology on cooperation in a common-pool resource experiment

- Ecological Economics---2011---Sebastian Prediger,Björn Vollan,Markus Frölich

Context affects decision-making in many ways. In this paper we explore differences in cooperation behaviour between communal farmers in Namibia and South Africa, who share the same ethnic origin but have had different historical and ecological constraints. We report on a series of field experiments based on a common-pool resource model. Our experimental design is framed according to the grazing situation in semi-arid rangelands. Dependent on the behaviour in previous rounds, participants are facing different states of resource availability with varying need to cooperate, coordinate and to be patient. While only 4% of the grazing areas in South Africa remain in good quality, Namibians achieve a level of 42%. We analyse the different experimental states and find that Namibians behave in all states more cooperatively. We argue that the large difference between the two regions is due to a combination of different historical developments and ecological preconditions: Namibian resource users have a longer experience in cooperative resource management and intact traditional norms. Moreover, the real-life payoffs to cooperation are higher in Namibia stemming from ecological factors.

Context matters to explain field experiments: Results from Colombian and Thai fishing villages

- Ecological Economics---2011---Daniel Castillo,François Bousquet,Marco A. Janssen,Kobchai Worrapimphong,Juan-Camilo Cardenas

During the last decade, field experiments regarding the study of common pool resource governance have been performed that replicated earlier findings of laboratory experiments. One of the questions is how the decisions made by participants in rural communities are influenced by their experience. This paper presents the results of field experiments in Colombia and Thailand

on fishery resources. Context information is derived from the communities via in-depth interviews, surveys and role playing exercises. The use of different methodological tools allowed to link decisions in field experiments with contextual variables for two fishery villages. Explanation of core variables in social dilemmas is given, the degree of cooperation levels, preferred rules, rule compliance and enforcement. Main findings include: i) fishermen made decisions in the field experiments that reflected their own experience and context, ii) agreements for rule crafting are possible only under specific conditions that guarantees livelihoods and sustainability, iii) the broader context determines cooperation levels at a local level, iv) inequalities in the sanctioning of rule breakers decrease the possibilities of reaching cooperation agreements, and v) high levels of trust among local fishermen is not a sufficient condition for resource sustainability, when trust in external rule makers and enforcers is low.

Adapting auctions for the provision of ecosystem services at the landscape scale

- Ecological Economics---2011---Andrew Reeson,Luis C. Rodriguez,Stuart Whitten,Kristen Williams,Karel Nollés,Jill Windle,John Rolfe

Auctions, or competitive tenders, can overcome information asymmetries to efficiently allocate limited funding for ecosystem services. Most auctions focus on ecosystem services on individual properties to maximise the total amount provided. However, for many services it is not just the total quantity but their location in the landscape relative to other sites that matters. For example, biodiversity conservation may be much more effective if conserved sites are connected. Adapting auctions to address ecosystem services at the landscape scale requires an auction mechanism which can promote coordination while maintaining competition. Multi-round auctions, in which bidding is spread over a number of rounds with information provided between rounds on the location of other bids in the landscape, offer an approach to cost effectively deliver landscape-scale ecosystem services. Experimental economic testing shows these auctions deliver the most

cost effective environmental outcomes when the number of rounds is unknown in advance, which minimises rent-seeking behaviour. It also shows that a form of bid-improvement rule facilitates coordination and reduces rent seeking. Where the biophysical science is well developed, such auctions should be relatively straightforward to implement and participate in, and have the potential to provide significantly better outcomes than standard 'one-shot' tenders.

Are Internet surveys an alternative to face-to-face interviews in contingent valuation?

- Ecological Economics---2011---Henrik Lindhjem, Ståle Navrud

Internet is an increasingly popular data collection mode for stated preference research in environmental economics. However, little is known about how this survey mode may influence data quality and welfare estimates. As part of a national contingent valuation (CV) survey estimating willingness to pay (WTP) for biodiversity protection plans, we assign two groups of respondents either to an Internet or face-to-face (in-home) interview mode. Our design aims to better isolate measurement effects from sample composition effects by drawing both samples from the same sample frame. We find little evidence of social desirability bias in the interview setting or satisficing (shortcutting the response process) in the Internet survey. The share of "don't knows", zeros and protest responses to the WTP question with a payment card is very similar between modes and equality of mean WTP cannot be rejected. Results are fairly encouraging for the use of Internet in CV as stated preferences do not seem to be significantly different or biased compared to face-to-face interviews.

An economic analysis of the possibility of reducing pesticides in French field crops

- Ecological Economics---2011---Florence Jacquet, Jean-Pierre Butault, Laurence Guichard

The paper aims to study the effects of reducing pesticide use by farmers in the arable sector in France and the feasibility of a policy target of reducing pesticide

use by half. The originality of the approach is to combine statistical data and expert knowledge to describe low-input alternative techniques at the national level. These data are used in a mathematical programming model to simulate the effect on land use, production and farmers' income of achieving different levels of pesticide reduction. The results show that reducing pesticide use by 30% could be possible without reducing farmers' income. We also estimate the levels of tax on pesticides necessary to achieve different levels of reduction of pesticide use and the effect of an incentive mechanism combining a pesticide tax with subsidies for low-input techniques.

Valuation of ecosystem services from rural landscapes using agricultural land prices

- Ecological Economics---2011---Shan Ma, Scott Swinton

Agricultural lands, primarily managed for crops and livestock production, provide various ecosystem services (ES) to people. In theory, the economic value of the service flows that can be captured privately is capitalized into land prices. This study proposes an integrative framework to characterize the ecosystem services associated with agricultural lands. Using that framework, we demonstrate how hedonic analysis of agricultural land prices can be used to estimate the private values of land-based ES. The model is estimated with data from southwestern Michigan, USA. Results suggest that ES values are associated with lakes, rivers, wetlands, forests and conservation lands in rural landscapes. Ecosystem services that support direct use values, such as recreational and aesthetic services, are likely to be perceived by land owners and capitalized in land prices. Some regulating services that provide indirect use values may be partially capitalized in a land parcel's relationship to natural resources and landscapes. Other ES from the land parcel and its surroundings are unlikely to be capitalized due to lack of private incentives, unawareness, or small perceived value. The private ES values measured in this study highlight opportunities to design cost-effective public policies that factor in the value of private benefits from

Quantification of interdependencies between economic systems and ecosystem services: An input-output model applied to the Seine estuary

- Ecological Economics---2011---Mateo Cordier, José A. Pérez Agúndez, O'Connor, Martin, Sébastien Rochette, Walter Hecq

The aim of this paper is to assess the possible contribution of an input-output model towards two of the basic principles of the sustainability strategy of integrated coastal zone management (ICZM) and Post-Normal Science. According to these principles, decision-support tools should offer a holistic perspective and handle high uncertainty. The difficulties in reaching sustainability are due partly to the prevailing use of "narrow-system-boundary" tools that are non-holistic. Consequently, they fail to capture important ecosystem services and ignore interdependencies between them. To comply with the basic principles, our method allows environmental assets to be evaluated in multiple units and integrates results from recent researches in natural sciences. Both enable coverage of interdependencies between ecosystem services. Thereby, we enlarge input-output modelling from the two conventional ecosystem services of sink and provisioning to the most vital ones: the supporting services. An application to the Seine estuary addresses the impacts of maritime transportation infrastructures on nursery habitats for commercial fish. The ecosystem services covered are life support and resource provisioning. Our results show that the restoration of a total of 73.7 km² of nursery areas over the period 2004-2015 would result in a stock of sole in 2015 that exceeds the "business as usual" scenario by 44.2% (uncertainty range: 35.9%-69.9%). In spite of high restoration costs, the negative macro-economic impact is very low. However, on the sector level, a trade-off results between nurseries and three economic sectors. The quantification of such trade-offs in our model is particularly useful to public participation in decision-making.

Factors determining awareness and knowledge of aquatic invasive species

- Ecological Economics---2011---Mark E. Eiswerth, Steven T. Yen, Gerrit van Kooten

Public perceptions of invasive species may influence policies and programs initiated by public and private stakeholders. We investigate the determinants of the public's awareness and knowledge of invasive species as few studies have examined this relationship. We focus on aquatic invasive species (AIS) and employ survey data from property owners in a lake district. A major contribution is that we estimate a mixed trivariate binary-ordered probit regression model that accommodates correlations among unobserved characteristics, produces statistically more efficient estimates, and allows a more proper investigation of the probability of knowledge conditional on awareness. Our results provide insights for invasive species education and management programs. We find that individuals are more likely to be aware of AIS if they participate in water-based recreation, visit lakes outside their area, have a boat, belong to a lake association, or are college educated. This has a policy implication: Given high levels of AIS awareness by those most involved in activities around lakes and those with a higher education, it may be beneficial to target informational campaigns at those who do not display these characteristics, so that they can better make informed decisions about whether to support and expend money on invasive species management programs.

Marginal abatement costs of greenhouse gas emissions from European agriculture, cost effectiveness, and the EU non-ETS burden sharing agreement

- Ecological Economics---2011---Stéphane De Cara, Pierre-Alain Jayet

We propose a quantitative assessment of the marginal abatement costs (MAC) of greenhouse gas emissions from European agriculture and analyze the implications of the non-ETS burden-sharing agreement (BSA) for this sector. This assessment is based on MAC reduced

forms, the generic specification of which enables simple parameterization and numerical computations. Such MAC curves are parameterized for each Member State using the outputs of a detailed model of the European agricultural supply. They are then used to compute total and marginal abatement costs involved by the BSA targets, as well as the cost-effective effort sharing, the corresponding emission price and abatement costs. The main findings are: (i) flexibility mechanisms such as a cap-and-trade system for agricultural emissions could reduce the total costs of meeting the 10% EU abatement target by a factor two to three relative to the strict implementation of each country's target, (ii) the corresponding equilibrium emission price is found to be 32-42Â [euro]/tCO₂eq depending on the assumption regarding business-as-usual emissions, and (iii) a cap-and-trade system with allowances based on the BSA targets would involve substantial transfers from EU-15 countries to New Member States, an important share of which being made of 'hot air'.

How does environmental performance affect financial performance? Evidence from Japanese manufacturing firms

- Ecological Economics---2011---Hiroki Iwata,Keisuke Okada

This paper examines the effects of environmental performance on financial performance using the data of Japanese manufacturing firms from 2004 to 2008. As the environmental performance, our study considers the two different environmental issues of waste and greenhouse gas emissions in capturing the effects of corporate environmental management on financial performance. In addition, to clarify how each financial performance responds to a firm's effort in dealing with different environmental issues, we utilize many financial performance indices reflecting various market evaluations. Our estimation results show the different effects of each environmental performance on financial performance. Waste emissions do not generally have significant effects on financial performance. On the other hand, greenhouse gas reduction leads to an increase in financial performance in the whole sample and clean in-

dustries, although it does not have significant effects on financial performance in dirty industries. Furthermore, as the firm growth rate increases, the partial effects of waste emissions on financial performance decrease, whereas the partial effects of greenhouse gas emissions on financial performance increase.

,The Isis Agreement -- How Sustainability Can Improve Organizational Performance and Transform the World, Alan AtKisson, Earthscan (2008) ISBN 978-1-84407-415-0 322 pp

- Ecological Economics---2011---Sigrun Maria Kristinsdottir

2011

Felix Rauschmayer, Ines Omann and Johannes Fröhmann, Editors, Sustainable Development: Capabilities, Needs, and Well-Being, Routledge, London and New York (2011) ISBN 978-0-415-58652-8 167 pp

- Ecological Economics---2011---Dale S. Rothman

2011

Correcting for the endogeneity of pro-environment behavioral choices in contingent valuation

- Ecological Economics---2011---Roberto Martinez-Espineira,Nikita Lyssenko

In contingent valuation studies, observed behavioral choices often enter as independent variables in the willingness to pay function. However, these variables may be endogenously determined when the error term in the behavioral model is correlated with the error term in the willingness to pay model. We investigate the effects of correcting for the endogeneity of a variable, namely membership status in environmental organizations that proxies unobservable characteristics of the respondents. Jointly modeling the membership variable and the willingness to pay response yields an estimate for the effect of the former that contradicts previous findings but is intuitive and agrees with theoretical expectations.

An exercise in composite indicators construction: Assessing the sustainability of Italian regions

- Ecological Economics---2011---Matteo Floridi, Simone Pagni, Simone Falorni, Tommaso Luzzati

This paper presents a piece of research aimed at evaluating the relative sustainability of the Italian Regions. After selecting a core set of indicators, for which we referred to the EU Sustainable Development Strategy, we built a composite index and checked for its robustness. As a result we got 'many numbers', that is, a range of possible rankings for Italian Regions.

Coupled economic-ecological systems with slow and fast dynamics -- Modelling and analysis method

- Ecological Economics---2011---Anne-Sophie Crépin, Jon Norberg, Karl-Göran Mäler

The purpose of this article is to contribute to the exploration of non-convex dynamics in coupled human-nature systems. We study welfare issues associated with the management of a human-nature complex adaptive system with a threshold and a stochastic driver. We exemplify with a specific system where we link changes in the number and diversity of birds to the abundance of a pest (insects) that causes damages to goods and services valuable to human beings. We present a method that simplifies the analysis and helps us discuss different management models that combine direct and indirect controls of the pest. This allows us to show that 1) the choice of control method depends in a highly non-linear way on biodiversity characteristics and 2) the socially optimal outcome may not be reachable using price instruments. Hence the price vs. quantity debate needs to be revisited using a complex adaptive system lens.

Decomposing the decoupling of CO2 emissions and economic growth in Brazil

- Ecological Economics---2011---Luciano De Freitas, Shinji Kaneko

This paper examines the occurrence of a decoupling between the growth rates in economic activity and CO2 emissions from energy consumption in Brazil from 2004 to 2009. This decoupling was highlighted when economic activity and CO2 emissions moved in opposite directions in 2009. More generally, we observe several periods of relative decoupling in Brazil, but not to the extent witnessed in 2009. To identify the determinants of emissions change, we develop a decomposition model based on a log-mean Divisia index (LMDI) framework. The results indicate that the carbon intensity and energy mix are the main determinant of emissions reduction in Brazil between 2004 and 2009. Modifications in the economy structure are also associated to emission mitigation in the period. Such evidence demonstrates similarities with events of decoupling registered for the interval 1980-1994 in Brazil. Finds from Brazil differ from observations in other countries in which improvement in energy intensity has been the most common determinant of emissions reduction.

International support of climate change policies in developing countries: Strategic, moral and fairness aspects

- Ecological Economics---2011---Dirk Rübelke

International transfers in climate policy channeled from the industrialized to the developing world either support the mitigation of climate change or the adaptation to global warming. From a purely allocative point of view, transfers supporting mitigation tend to be Pareto-improving whereas this is not very likely in the case of adaptation support. We illustrate this by regarding transfer schemes currently applied under the UN Framework Convention on Climate Change (UNFCCC) and the Kyoto framework. However, if we enrich the analysis by integrating distributional aspects, we find that international adaptation funding may help both the developing and developed world. Interestingly this is not due to altruistic incentives, but due to follow-up effects on international negotiations on climate change mitigation. We argue that the lack of fairness perceived by developing countries in the international climate policy arena can be reduced by the support of adap-

tation in these countries. As we show - taking into account different fairness concepts - this might raise the prospects of success in international negotiations on climate change. Yet, we find that the influence of transfers may induce different fairness effects on climate change mitigation negotiations to run counter. We discuss whether current transfer schemes under the UNFCCC and the Kyoto framework adequately serve the distributive and allocative objectives pursued in international climate policy.

The conservation against development paradigm in protected areas: Valuation of ecosystem services in the Doñana social-ecological system (southwestern Spain)

- Ecological Economics---2011---Berta Martín-López,Marina García-Llorente,Ignacio Palomo,Carlos Montes

The ecosystems of the Doñana social-ecological system (southwestern Spain) provide numerous ecosystem services to society. We valued the most important ecosystem services through a market-based approach, revealed-preference and stated-preference methods to assess the conservation effectiveness of the Doñana Protected Area, with consideration of existing human activities in surrounding lands. We also analysed the spatial distribution of the ecosystem services beneficiaries and the scale of their related markets. We found a clear trade-off between the local and global market values of ecosystem services because landscape management outside of the Doñana Protected Area promotes the provision of ecosystem services associated with international markets. Our results suggest that a conservation against development model occurs in the Doñana social-ecological system, in which land use intensification takes place outside of the Protected Area borders as a result of promoting marketed ecosystem services, while biodiversity conservation is the main activity inside the Protected Area. We conclude that protected areas should be part of a larger-scale, adaptive landscape management strategy in which conservation planning should be the focal element in coordinating

sectoral policies in the context of social-ecological systems.

Spatial patterns and economic contributions of mining and tourism in biodiversity hotspots: A case study in China

- Ecological Economics---2011---Ganlin Huang,Weiqi Zhou,Saleem Ali

Mining activities and tourism are both growing fast in biodiversity intense areas globally. However, the dynamic and interactions between mining and tourism when they both occur in biodiversity hotspots, and how they together may impact the economy and environment in these biodiversity rich areas, remain unclear. This paper examined how the two industries interact in terms of their economic contributions and spatial patterns in a biodiversity hotspot, Yunnan, China. We used correlation analyses to measure the relationships between mining activities, tourism visits and local gross domestic productions. We also employed a distance-based technique to investigate the nature of any dependency between mining and tourism sites. Results showed that mining activities tend to be in relatively fluent areas while tourism tends to occur in less developed areas. Our results showed that the location of tourism and mining sites are likely to be close to one another but the two industries usually perform better economically when they are apart from each other. These findings can provide insights on how mining and tourism together may impact the economy and environment in biodiversity rich areas, and provide important information for managers and planners on balancing mining and tourism development in these areas.

Agriculture production versus biodiversity protection: The impact of North-South unconditional transfers

- Ecological Economics---2011---Stéphanie Aulong,Charles Figuières,Sophie Thoyer

The purpose of this paper is to explore whether international income transfers can improve or worsen the

global level of biodiversity and global social welfare by changing the relative contributions to biodiversity protection and to agricultural production. Because of the public good nature of biodiversity, Warr's neutrality theorem suggests that such transfers may have no effects at all (Warr, 1983). A model is developed, based on the simplifying assumption that northern countries have little biodiversity whereas southern countries are endowed with natural capital in the form of (generally unspoilt) biodiversity-rich land. Southern countries allocate optimally land and capital to two competing productive activities, agriculture and eco-tourism. When transfers are organized from the North to the South, we show that Warr's neutrality theorem collapses. Transfers can either reduce or increase the natural capital in the South, depending on some empirically verifiable hypotheses concerning the characteristics of the eco-tourism and agricultural production functions. In addition, we demonstrate that welfare improvements can be obtained even with reductions in the level of biodiversity.

Scope economies and technical efficiency of cocoa agroforestry systems in Ghana

- Ecological Economics---2011---Adeline Ofori-Bah, John Asafu-Adjaye

A number of studies have addressed issues relating to the physiological, environmental and economic values of trees in cocoa farming systems. However, to date, little has been done to quantitatively examine the effect of crop diversity on cocoa farming efficiency. This study therefore sets out to first investigate whether and to what extent crop diversity (defined as the mixing of cocoa with other crop species on farmers' plots) affects productivity on cocoa farms. Secondly, it sought to establish whether there are economies of scope (i.e., cost complementarities) from the sharing of farm inputs by crops on the same plots. Our results indicate that diversified (i.e., multi-crop) cocoa farms are more efficient than single (i.e., mono) crop farms. Furthermore, our estimate for the economies of scope parameter indicates possibilities for cost complementarities between production of cocoa and other crops on the same

plot. We advocate further investigation on the issue of scope economies to determine which crop combinations offer better cost complementarities and also meet biodiversity conservation objectives.

What will be the environmental effects of new free-floating car-sharing systems? The case of car2go in Ulm

- Ecological Economics---2011---Jörg Firnkorn, Martin Müller

The purpose of this paper is the discussion of the environmental effects of a free-floating car-sharing system operating in Ulm, Germany. The system, called car2go, allows users to take and leave vehicles at any point within the city limits. Thus opposed to traditional car-sharing, there are no fixed stations and in particular one-way trips of any length are possible without a booking requirement. Since this is the first free-floating system in operation, there is as yet no associated empirical research. Based on primary data from a survey, a model was developed to forecast the environmental impact of car2go. The prognosis considers the period of five years after the launch of car2go in 2009 and indicates a CO₂-reduction per average car2go-user. In addition, more than a quarter of the survey respondents stated that they may forgo a car purchase if car2go was offered permanently. By reaching a greater share of citizens than traditional systems, the results indicate that free-floating car-sharing systems could contribute to reducing private vehicle ownership in cities.

Is fairness blind?--The effect of framing on preferences for effort-sharing rules

- Ecological Economics---2011---Fredrik Carlsson, Mitesh Kataria, Elina Lampi, Åsa Löfgren, Thomas Sterner

This paper uses a choice experiment to study citizens' preferences for effort-sharing rules for reducing carbon dioxide emissions. For a given global cost and level of emission reduction, we study the willingness to pay for various rules that imply different distributions of the

cost between EU, the US, China and Africa. The focus of this paper is on the use of two different treatments, one where the respondents were informed about the country (or country group) names and one where the names were replaced with anonymous labels A-D. This allows us to test whether people's preferences for effort-sharing rules depend on the framing of the problem. We find that the ranking of the rules and the strength of the preferences are not significantly different between the two treatments, and hence we find no evidence of ingroup bias in preferences for effort-sharing rules.

Farmers adoption of integrated crop protection and organic farming: Do moral and social concerns matter?

- Ecological Economics---2011---Naoufel Mzoughi

We investigate empirically the role of moral and social concerns in farmers' decision to adopt integrated crop protection (IP) and organic farming (OF). A survey questionnaire has been sent to 1286 fruit-growers and vegetable producers located in the French areas of Alpes de Haute Provence, Hautes-Alpes and Vaucluse. Analysis of individual responses ($N = 243$) shows that, although economic concerns play a strong role, a significant number of respondents give high importance to moral and social ones. We also examine how these considerations matter according to different crop protection strategies, that is, conventional farming, IP and OF. Using a multinomial logistic regression, we find that (1) social concerns (e.g., showing to others one's environmental commitment) drive both IP and OF adoption, (2) moral concerns (e.g., do not feel guilty about one's choices) increase the probability of organic farming adoption only, and (3) farmers who give high importance to economic concerns (e.g., cutting production costs) are less likely to adopt OF.

Stimulating different types of eco-innovation in the UK: Government policies and firm motivations

- Ecological Economics---2011---Pelin Demirel, Effie Kesidou

In this paper, we adopt a recent OECD framework and examine the role of external policy tools and internal firm specific factors for stimulating three different types of eco-innovations that range on a spectrum of lower to higher technological and environmental impacts: End-of-Pipeline Pollution Control Technologies, Integrated Cleaner Production Technologies and Environmental R&D. Using a novel firm-level dataset from a DEFRA survey, we estimate a Tobit model, which provides empirical evidence showing that these eco-innovations are motivated by different external policy tools and internal firm specific factors. Our findings indicate that End of Pipeline Technologies and Integrated Cleaner Production Technologies are mainly driven by equipment upgrade motives with a view of improving efficiency while environmental regulations are effective in stimulating the End-of-Pipeline technologies and Environmental R&D. Interestingly, alongside government induced regulations, we find that market factors, mainly motivated by cost savings, are effective in driving Environmental R&D. Finally, ISO14001 certification is effective in strengthening the positive impact of environmental management systems on both End-of-Pipeline technologies and Environmental R&D while CSR policies have no significant impact on motivating any of the eco-innovations.

Determinants of farmers' willingness to participate in subsidy schemes for pesticide-free buffer zones--A choice experiment study

- Ecological Economics---2011---Tove Christensen, Anders Branth Pedersen, Helle Oersted Nielsen, Morten Mørkbak, Berit Hasler, Sigrid Denver

Danish farmers have been far less interested in agri-environmental subsidy schemes (AES) than anticipated. In order to examine how to improve the appeal of such schemes, a choice experiment was conducted concerning 444 Danish farmers' preferences for subsidy schemes for pesticide-free buffer zones. A random parameter logit framework was used to capture heterogeneity among farmers. Our results indicate that 1) the vast majority of farmers are willing to trade off the size of the

subsidy for less restrictive scheme requirements and that 2) the amount of the subsidy they are willing to trade off varies with specific scheme requirements, suggesting which features are most important for successful policy design. Our results suggest that farmers value flexible contract terms higher than reduced administrative burdens. Finally, we suggest a practical approach to estimating a monetary value of farmers' reluctance to participate in AES. While the trade off's that farmers are willing to make between subsidy size and individual scheme requirements are case specific, our results concerning increased use of farm advisors, farmers ability of valuing different types of flexibility, and our attempt to place a monetary value on farmers' reluctance to engage in regulatory subsidy schemes have a potentially broader application platform.

The economic impact of shale gas extraction: A review of existing studies

- Ecological Economics---2011---Thomas C. Kinnaman

Recent advances in drilling technology have allowed for the profitable extraction of natural gas from deep underground shale rock formations. Several reports sponsored by the gas industry have estimated the economic effects of the shale gas extraction on incomes, employment, and tax revenues. None of these reports has been published in an economics journal and therefore have not been subjected to the peer review process. Yet these reports may be influential to the formation of public policy. This commentary provides written reviews of several studies purporting to estimate the economic impact of gas extraction from shale beds. Due to questionable assumptions, the economic impacts estimated in these reports are very likely overstated.

Valuing water level changes in reservoirs using two stated preference approaches: An exploration of validity

- Ecological Economics---2011---Nele Lienhoop,Till Ansmann

The combination of travel cost (TCM) and contingent

behaviour (CB) methods is a relatively new research avenue in the recreational valuation community. Contrary to simple TCM applications, TCM-CB facilitates the ex ante valuation of marginal welfare effects resulting from environmental quality or quantity changes, similar to the contingent valuation method (CV). Even though TCM-CB is highly policy relevant, i.e. to inform changes in management regimes at recreational sites, the validity of estimates has hardly received any attention and little is known about the performance of TCM-CB compared to CV. In this paper, TCM-CB and CV are explored with respect to several validity tests in a case study on the recreational effects of water level changes in a reservoir. Overall, the findings reveal that TCM-CB and CV perform equally well in terms of theoretical validity, but that the marginal recreational value varies significantly between the two methods. We also observe that both methods face similar internal difficulties with respect to the stability of values when the order of a set of valuation questions is changed.

On the merits of plant-based proteins for global food security: Marrying macro and micro perspectives

- Ecological Economics---2011---Joop de Boer,Harry Aiking

This paper aims to demonstrate the importance of protein production for the global environment and to give insight into the way consumers frame the protein part of their meal. Using a macro perspective, it presents a review of the literature on current and future impacts of the nutritional transition that has made animals the chief source of protein in many countries. Protein-related environmental pressure is put into the perspective of a number of vital Earth-system processes whose boundaries have already been overstepped or are under threat of transgression. To inform policy-makers about these linkages a long-term global food security frame is proposed. Using a micro perspective, survey data on consumers reveal that their frames and habits are strongly adapted to the current meat system. Although this system has induced some pickiness about meat as well as uneasiness about meat's animal

origin, there is a large psychological distance between consumers and experts in their view of protein sources. It is suggested that a global food security frame may help to bridge this distance by creating overlapping frames, capturing both altruistic aspects and a reasonable measure of self-interest. This may enable a novel protein transition, featuring a greater share of plant-based protein.

Ecological Economics and Environmental History

- Ecological Economics---2011---Jouni Paavola,Evan D.G. Fraser

2011

Can economic, land use and climatic stresses lead to famine, disease, warfare and death? Using Europe's calamitous 14th century as a parable for the modern age

- Ecological Economics---2011---Evan D.G. Fraser

Although many of today's ecological, climatic and socio-economic problems seem unprecedented, similar events have occurred in the past. As such, historic periods of climatic and economic volatility can be used as a way of developing frameworks for analyzing today's predicament. Western Europe's "middle ages" (circa 11-14th century) may be one such case. By the 12th century, medieval Europe had shifted from the subsistence agrarian economy that emerged following the collapse of the Roman Empire to one where spatially dispersed trade in agricultural commodities helped support a complex society that devoted considerable resources to cultural works. This shift was facilitated by new institutional arrangements centred on monastic orders that provided access to both new agricultural and food processing technologies as well as trade routes. These institutional arrangements contributed to population growth and land clearing. All of these factors increased the wealth of society but also concentrated this wealth in a small number of communities that were dependent on an ever-increasing and exploited hinterland for resources. Ultimately, this created a tightly

coupled continent-wide subsistence system that was vulnerable to the weather, economic and disease shocks of the 14th century when Europe's population declined by perhaps 50%. In exploring this history, the goal of this paper is to draw on a diverse theoretical body of literature (that includes resiliency theory, landscape ecology, political science and ecological economics) to develop a series of hypotheses about how large-scale complex civilizations can become vulnerable to climate change.

Foreign trade and early industrialisation in the Habsburg Monarchy and the United Kingdom -- Two extremes in comparison

- Ecological Economics---2011---Simone Gingrich

The concept of socio-ecological transitions is used to analyse the quantitative importance of physical imports and exports for the Habsburg Empire and the United Kingdom in the 19th and early 20th centuries. For the Habsburg Empire, a new dataset of foreign trade and social metabolism is presented. For the United Kingdom, the analysis relies on previously published data. Foreign trade volumes increased in both countries in the long run. Total trade volumes were much higher in the United Kingdom throughout the entire time period, on average by around a factor four. Physical factors explaining the disparities in structure and volume of foreign trade in the two countries are differences in (1) the temporal patterns of the socio-ecological transition and (2) domestic resource endowments. In both countries, energy carrying materials, i.e. fossil fuels and biomass, were the dominant resources in physical foreign trade. The analysis focuses on the physically most important material groups: coal, wood and cereals, and discusses the role of imports and exports in relation to domestic resource provision and environmental pressures. Physical foreign trade increased at a faster pace than domestic resource extraction and consumption. The socio-ecological transition was thus accompanied by rising international integration of resource supply.

Reprint of: Sewage Pollution and Institutional and Technological Change in the United States, 1830-1915

- Ecological Economics---2011---Jouni Paavola

This article examines institutions for water pollution control and their interaction with water supply and sanitation technologies in the United States before the First World War. The article discusses how growth of settlements polluted waters and created pressure to adopt local institutional responses and networked water supply and sewerage technologies in the mid-19th century. However, the new urban technologies undermined local institutional responses and expanded the scale of water pollution problems they were expected to resolve. Water companies, households and local governments litigated their water pollution conflicts in the courts in the absence of other alternatives. In the end of the 19th century, many states adopted water pollution policies. At first, public health authorities enforced the new policies to protect public water supplies from sewage contamination. However, when the effectiveness of filtration and chlorination of drinking water was demonstrated in the early 20th century, public health authorities ceased to enforce discharge prohibitions and instead pressured water companies to adopt the new technological measures to protect public health.

Water scarcity, social power and the production of an elite suburb: The political ecology of water in Matadepera, Catalonia

- Ecological Economics---2011---Iago Otero, Giorgos Kallis, Raül Aguilar, Vicenç Ruiz

This article investigates the history of land and water transformations in Matadepera, a wealthy suburb of metropolitan Barcelona. Analysis is informed by theories of political ecology and methods of environmental history; although very relevant, these have received relatively little attention within ecological economics. Empirical material includes communications from the City Archives of Matadepera (1919-1979), 17 interviews with locals born between 1913 and 1958, and an

exhaustive review of grey historical literature. Existing water histories of Barcelona and its outskirts portray a battle against natural water scarcity, hard won by heroic engineers and politicians acting for the good of the community. Our research in Matadepera tells a very different story. We reveal the production of a highly uneven landscape and waterscape through fierce political and power struggles. The evolution of Matadepera from a small rural village to an elite suburb was anything but spontaneous or peaceful. It was a socio-environmental project well intended by landowning elites and heavily fought by others. The struggle for the control of water went hand in hand with the land and political struggles that culminated - and were violently resolved - in the Spanish Civil War. The displacement of the economic and environmental costs of water use from few to many continues to this day and is constitutive of Matadepera's uneven and unsustainable landscape. By unravelling the relations of power that are inscribed in the urbanization of nature (Swyngedouw, 2004), we question the perceived wisdoms of contemporary water policy debates, particularly the notion of a natural scarcity that merits a technical or economic response. We argue that the water question is fundamentally a political question of environmental justice; it is about negotiating alternative visions of the future and deciding whose visions will be produced.

Energy, property, and the industrial revolution narrative

- Ecological Economics---2011---Stefania Barca

The Industrial Revolution (IR) story is the core of a mainstream economic history narrative of energy/development relationships, celebrating Modern Economic Growth (MEG) as the increase in per capita energy consumption in the last two centuries. Such a narrative emphasizes mineral technology and private property as the key elements of growth processes. I will criticize the above narrative, from a socio-environmental history perspective, for its inability to account for two crucial aspects of energy history: 1. the role of social power as key determinant in how

energy sources are used and to what ends; 2. the socio-ecological costs associated with the increase of energy consumption. I will then review Environmental History studies on energy/industrialization and highlight possible future developments in the field. The article makes a strong point for the need to look at energy transitions as social processes, and to include the unequal distribution of environmental, health, and social costs of mineral energy into global history narratives.

Profits and poverty: Certification's troubled link for Nicaragua's organic and fairtrade coffee producers

- Ecological Economics---2011---Tina D. Beuchelt, Manfred Zeller

Governments, donors and NGOs have promoted environmental and social certification schemes for coffee producers as certified market channels are assumed to offer higher prices and better incomes. Additionally, it is presumed that these certifications contribute to poverty reduction of smallholders. Yet, gross margins, profits and poverty levels of certified smallholder coffee producers have not yet been quantitatively analyzed applying random sampling techniques. Our quantitative household survey of 327 randomly selected members of conventional, organic and organic-fairtrade certified cooperatives in Nicaragua is complemented by over a hundred qualitative in-depth interviews. The results show that although farm-gate prices of certified coffees are higher than of conventional coffees, the profitability of certified coffee production and its subsequent effect on poverty levels is not clear-cut. Per capita net coffee incomes are insufficient to cover basic needs of all coffee producing households. Certified producers are more often found below the absolute poverty line than conventional producers. Over a period of ten years, our analysis shows that organic and organic-fairtrade farmers have become poorer relative to conventional producers. We conclude that coffee yield levels, profitability and efficiency need to be increased, because prices for certified coffee cannot compensate for low productivity, land or labor constraints.

Willingness to pay for other species' well-being

- Ecological Economics---2011---Brian Vander Naald, Trudy Cameron

Benefit-cost analysis of environmental policies typically focuses on benefits to human health and well-being. For other species, economists have attempted to measure human WTP for changes in the numbers of individuals for different types of wildlife, and to preserve biodiversity. When it comes to humans' WTP for improvements in the quality-of-life for other species, however, the evidence is limited. Morbidity and quality-of-life considerations may be particularly important to the task of valuing non-fatal harm to wildlife in the wake of an environmental disaster. We argue that the other species morbidity-reduction component of WTP should be calculated net of any "outrage" component associated with the cause of the harm. This net WTP is likely to be correlated with the premium that people are willing to pay for chicken products from birds for which the quality-of-life has been enhanced by improved animal welfare measures. This paper uses a conjoint choice stated preference survey to reveal the nature of systematic heterogeneity in preferences for "humanely raised" versus "conventionally raised" chicken. We also use latent class analysis to distinguish between two classes of people--those who are willing to pay a premium for humanely raised chicken, and those who are not.

Species diversity, fishing induced change in carrying capacity and sustainable fisheries management

- Ecological Economics---2011---Wisdom Akpalu, Worku T. Bitew

It is well established in the fisheries management literature that marine ecosystems are complex and marine species depend on one another. As a result, it is important to account for species diversity to ensure sustainable management. In addition, recent research published in the marine sciences literature has provided unequivocal evidence that fishing activities destroy habitats and inhibit production of planktons. This paper illustrates that if a conventional bioeconomic model

is employed, an optimum effort policy as opposed to quota appears to result in sustainable management even if fishing impacts carrying capacity. However, the so-called optimum effort may collapse the stock if species diversity is not accounted for. Conversely, if species diversity and the impact of fishing on carrying capacity are considered, neither the equilibrium quota nor effort may guarantee sustainable yield.

The impact of urbanization on CO2 emissions: Evidence from developing countries

- Ecological Economics---2011---Inmaculada Martínez-Zarzoso, Antonello Maruotti

This paper analyzes the impact of urbanization on CO2 emissions in developing countries from 1975 to 2003. It contributes to the existing literature by examining the effect of urbanization, taking into account dynamics and the presence of heterogeneity in the sample of countries. The results show an inverted-U shaped relationship between urbanization and CO2 emissions. Indeed, the elasticity emission-urbanization is positive for low urbanization levels, which is in accordance with the higher environmental impact observed in less developed regions. Among our contributions is the estimation of a semi-parametric mixture model that allows for unknown distributional shapes and endogenously classifies countries into homogeneous groups. Three groups of countries are identified for which urbanization's impact differs considerably. For two of the groups, a threshold level is identified beyond which the emission-urbanization elasticity is negative and further increases in the urbanization rate do not contribute to higher emissions. However, for the third group only population and affluence, but not urbanization, contribute to explain emissions. The differential impact of urbanization on CO2 emissions should therefore be taken into account in future discussions of climate change policies.

Oil consumption and economic efficiency: A comparative analysis of advanced, developing and emerging economies

- Ecological Economics---2011---George Halkos, Nickolaos Tzeremes

This paper investigates the economic efficiency-oil consumption relationship in 42 countries during the period 1986-2006. In a first stage by using DEA window analysis countries' economic efficiencies are obtained. In a second stage an econometric analysis based on robust GMM estimators reveals an inverted 'U'-shape relationship between oil consumption and economic efficiency. In order to capture heterogeneities among countries' development stages the analysis has been separated into two groups (advanced economies and developing/emerging economies). The results show that advanced economies have much higher turning points compared to emerging and developing economies. It appears that oil consumption increases countries' economic efficiency. In addition the consumption patterns of oil products and its derivatives have changed through years and among countries. The different turning points from the econometric analysis indicate the dependence of oil consumption in advanced economies (higher turning points) is driven mainly by household purchasing activities and their standards of living (transport, housing and water, food, etc.). Finally, it appears that oil consumption is the main driver behind the progress of industrialization and urbanization regardless of the country's development stage.

A nonparametric analysis of the impact of agri-environmental advisory activities on best management practice adoption: A case study of Québec

- Ecological Economics---2011---Lota Tamini

This study investigates the factors that determine producers' participation in agri-environmental advisory activities and their adoption of best management practices (BMPs) in Québec (Canada). Data were collected from farmers via telephone interviews, and the impacts

of agri-environmental extension activities were analyzed using average treatment effect and local average treatment effect, estimated with non-parametric approaches. The average effects of agri-environmental extension activities are statistically significant for the majority of BMPs. We also find a statistically significant formal diffusion effect of producers' membership in an agri-environmental advisory club. The informal diffusion effect is statistically significant for BMPs that require advanced technical knowledge.

Is economic growth for the birds?

- Ecological Economics---2011---Aaron Strong,John Tschirhart,David Finnoff

The environment provides ecosystem services that support human wants. Economic growth is important for raising human living standards. But whether economic growth benefits the environment is unclear. Research into this relationship has focused on a U-shaped association known as the Environmental Kuznets Curve (EKC). As economies grow, environmental quality initially declines but ultimately recovers and improves. However, environmental quality has been narrowly defined in the research, largely neglecting the availability and range of ecosystem services. Because these services derive from biodiversity, we use avian biodiversity as a proxy for environmental quality. Our results replace the U-shaped relationship with a lazy-S relationship. As economies grow, environmental quality initially declines, then improves over intermediate growth, but ultimately declines at higher growth. The EKC hypothesis has been used to forward economic growth as a means for improving environment quality. Our results call into question policies that rely solely on economic growth for reversing environmental decline.

Structuring stakeholder participation in New Zealand's water resource governance

- Ecological Economics---2011---James Lennox,Wendy Proctor,Shona Russell

International experience has shown that extensive, systematic and structured stakeholder engagement is im-

portant in modern water resource governance. Through two case studies in the Canterbury Region, we investigate the emergence of structured and deliberative participatory processes for decision-making in New Zealand. We particularly focus on the use of evaluative criteria and weightings in providing structure for stakeholder deliberations and clarity and transparency in decision-making processes. Some of the benefits of using criteria weightings to reflect individuals' priorities include their ability to bring out the various perspectives and preferences to start the deliberations and increase the understanding of other people's points of views and their knowledge to all of the stakeholders. We consider particular aspects of the New Zealand context, including the development of criteria specific to Maori interests. These case studies lead us to conclude that stakeholder participation in decision-making is beneficial and increasingly necessary to resolve the problems and tensions around the governance of Canterbury's water resources. They also demonstrate that there are numerous practical and systemic barriers that must be overcome if the potential is to be fully realised. We provide recommendations on how such participatory processes can be successfully implemented to produce meaningful and effective outcomes.

Hot spots regulation and environmental justice

- Ecological Economics---2011---Rama Mohana R. Turaga,Douglas Noonan,Ann Bostrom

This paper analyzes whether regulating "hot spots" of toxic air pollution by increasing the spatial resolution of regulation could address environmental justice (EJ) concerns. To examine this question, this paper develops a decision model of a regulator choosing emission controls within a net cost minimizing framework. An empirical application of the model using air toxic emission data for Escambia and Santa Rosa Counties in Florida estimates the emission standards and spatial distribution of risks at a coarse and a finer spatial resolutions. Implications for EJ are analyzed by combining the simulated spatial risk distributions at the two resolutions with the demographic data. Results

indicate that different measures of EJ point to different conclusions regarding the question of whether finer resolution regulation alleviates EJ concerns. The paper concludes with a discussion of the implications for EJ policy.

Adoption of organic farming: Are there differences between early and late adoption?

- Ecological Economics---2011---Doris Läßle, Tom Van Rensburg

Based on the fact that not all farmers adopt a technology at the same time, it is argued in this paper that the distinction between groups is important because early, medium and late adopters respond differently to economic and non-economic factors when they consider whether to take up organic farming or not. The individual effects on adoption between the groups are identified by the use of multinomial logit analysis. The results provide evidence that there are significant differences in the characteristics between the adopter groups. The findings also reveal that the factors that affect adoption play a different role for early, medium and late adopters, particularly with regard to farming intensity, age, information gathering as well as attitudes of the farmer. More specifically, early adopters were the youngest to adopt organic farming and their decisions were found to be less profit related compared to other groups. Late adoption is constrained by risk considerations, while environmental attitudes and social learning were identified to be important determinants for all adopter groups. Overall, the findings strongly suggest, that for policy measures to be effective, the current state of diffusion has to be taken into account.

Adoption of safer irrigation technologies and cropping patterns: Evidence from Southern Ghana

- Ecological Economics---2011---Awudu Abulai, Victor Owusu, John-Eudes A. Bakang

The new irrigation technologies introduced in sub-Saharan Africa aim at ensuring safer vegetable production when untreated waste water is used as irrigation

water. This paper examines the adoption of safer irrigation technologies and crop choices among vegetable farmers, using cross-section data from urban Kumasi in Ghana. The study employed a two-stage conditional maximum likelihood approach to examine the impact of crop choices and farm-level characteristics on the adoption of safer irrigation technologies. The empirical results indicate that apart from household and farm characteristics such as access to extension agents, belonging to a farmer's organization and education, cropping patterns tend to influence adoption of irrigation technologies for safer vegetable production.

Price discovery and intermediation in linked emissions trading markets: A laboratory study

- Ecological Economics---2011---Timothy Cason, Lata Gangadharan

Many new and proposed emissions trading systems involve multiple countries and regions. The introduction of interregional trading raises questions about how flexible state- or national-level authorities should be in allowing individual firms to trade with firms or authorities in other states or countries. This paper uses laboratory methods to evaluate the efficiency and pricing performance of linking trading across regions at the firm-to-firm level. In one treatment, individual firms trade directly with firms or authorities in other regions. We compare performance in this treatment to an intergovernmental trading treatment, where emissions trading is restricted to occur only between intermediaries. A baseline treatment of autarky, where firms only trade with other firms in their country or region, provides a benchmark to assess the efficiency benefits of allowing linking. Although efficiency and price discovery are both improved by allowing intermediation in linked permit markets, we find that further gains can be realized through direct firm to firm trading. Buyers in high cost regions and sellers in low cost regions benefit the greatest from linking.

Sustainability economics as a contested concept

- Ecological Economics---2011---Peter Söderbaum

A review on cost-effectiveness analysis of agri-environmental measures related to the EU WFD: Key issues, methods, and applications

- Ecological Economics---2011---Bedru Babulo Balana, Andy Vinten, Bill Slee

The European Water Framework Directive (WFD) explicitly integrates economics into water management and water policy in Europe. Specifically, Article 11 and Annex III of the Directive call for a cost-effectiveness analysis (CEA) of alternative mitigation measures as a requirement in formulating Programme of Measures (PoMs) to achieve 'good ecological status' for all waters in Europe. As agriculture is supposed to be the major contributor to diffuse water pollution, CEA of agri-environmental measures has been given paramount importance in establishing the PoMs. This paper summarises the status, significance, and methodological limitations of WFD-related CEA studies in Europe. Cases from the United Kingdom, countries surrounding the Baltic Sea and central and southern Europe were included in the review. Review results indicate that most WFD-related CEA studies: (1) were based on models of 'representative' farms without capturing the variability among real-world farms; (2) concentrate on a single ecological effect of measures or are based on cost estimates of the sectors directly involved in the pollutant-reduction programme (i.e., co-benefits, trade-offs, and external costs were not examined); and (3) did not incorporate uncertainties in both cost and effectiveness estimates. Based on the review results, the paper suggests policy implications and recommendations for future research in the field.

Tracing distant environmental impacts of agricultural products from a consumer perspective

- Ecological Economics---2011---Thomas Kastner, Michael Kastner, Sanderine Nonhebel

Globally, trade flows of agricultural products are increasing. While value is typically added along the

whole production chain, certain environmental impacts, such as land and water use, biomass appropriation, and soil degradation, are intrinsically linked to where the primary products originate from. When taking a consumer oriented approach on environmental problems, bilateral trade statistics can help in providing a clearer picture about the location of impacts caused by consumption elsewhere. However, in today's increasingly globalized world, consumer goods are often imported from countries other than where the primary product originated from. For instance, soybeans are transported from Brazil to the Netherlands, where they are processed into soy oil, which is shipped to Austria, where it is consumed. Utilizing bilateral trade matrices and matrix algebra, we present a method that allows to clearly link consumption patterns to the origin of primary products. In this, the method can help to provide information about consumption related, distant environmental impacts. We employ the case of land and water use linked to Austria's soy product consumption to demonstrate the approach's relevance. Finally, we outline some possible applications of this method to show its potential in enhancing understanding for informed consumer based environmental decision making.

Matching users' rights to available groundwater

- Ecological Economics---2011---John F. Rafter

The amount of available groundwater in a catchment changes quickly, and the amount of water that users can take sustainably depends on where and when it is taken. However, rights to water tend to be fixed, and obtaining rights to water incurs high transaction costs. As a result, water catchments are over-allocated worldwide. In this paper, I show how a catchment manager could match users' rights to the available water, in near real time, despite uncertain future inflows, while making effective use of all available hydrological data. The solution uses the framework of a smart market. A smart market is a periodic auction cleared with the help of an optimization model. In addition to market clearing, this model allows a convenient means to

adjust initial rights, and the auction revenue reflects the available water relative to users' rights. When the auction is revenue neutral, the catchment may be viewed as allocated perfectly. I suggest several ways in which a catchment manager can find this revenue-neutral allocation, assuming the manager has authority to adjust initial rights.

Application of PCA integrated with CA and GIS in eco-economic regionalization of Chinese Loess Plateau

- Ecological Economics---2011---Qing-feng Zhang,Fa-qi Wu,Li Wang,Lifeng Yuan,Long-shan Zhao

Eco-economic regionalization (EER) is to divide an area into geographical zones. Each zone is linked to the others based on the eco-economic similarity and disparity. In this study, models of EER of the Chinese Loess Plateau were constructed. Data on 22 selected indicators were gathered for the 282 administrative counties. Then they were analyzed through an approach of PCA integrated with CA and GIS. In the generated model, the plateau was assigned to 4 belts and 18 eco-economic zones. The relationship among the subdivisions was able to represent the real situation. It demonstrates the division scheme is very comprehensive, concise and applicable. The work has established a novel methodological framework for EER of large-scale area.

The rising culture and worldview of contemporary spirituality: A sociological study of potentials and pitfalls for sustainable development

- Ecological Economics---2011---Annick Hedlund-de Witt

Several social scientists claim that the rise of the culture of contemporary spirituality is a pivotal part of the gradual but profound change taking place in the Western worldview, both reflecting the larger cultural development, as well as giving shape and direction to it. Its emergence is therefore not to be neglected in

attempts to create a more sustainable society. The aim of this study is to generate insight into the culture and worldview of contemporary spirituality and explore its potentials and pitfalls for sustainable development. An investigation of the sociological literature on the so-called "New Age" phenomenon results in a delineation and overview of these and shows that this culture is both a potentially promising force, as well as a phenomenon posing specific risks. A structural-developmental understanding is introduced in order to be able to distinguish between regressive and progressive tendencies in this culture, and comprehend the deeper logic behind the observed potentials and pitfalls. This may serve to facilitate the actualization of the culture's potentials while mitigating its pitfalls, and in that way contribute to the timely challenge of creating a more sustainable society.

How well do tree plantations comply with the twin targets of the Clean Development Mechanism? -- The case of tree plantations in Tanzania

- Ecological Economics---2011---Solveig Glomsrød,Taoyuan Wei,Gang Liu,Jens B. Aune

The Clean Development Mechanism (CDM) of the Kyoto Protocol is supposed to provide both carbon mitigation and poverty reduction. This article reports from a model based study of market related carbon leakage and poverty reduction in the wake of a CDM tree-planting project in Tanzania. A tree plantation was incorporated in a computable general equilibrium (CGE) model with income differentiated household segments. The study focused on sensitivity of carbon leakage and income distribution to different project ownerships and carbon premium allocations. It turned out that the project value in terms of carbon premium has clear shortcomings as indicator of induced GDP growth and poverty alleviation. The non-poor rural and urban households benefit considerably more than the poor households. However, rising household income in all domestic project ownership arrangements increases demand for food, raises use of fertilizer and crop yields. A carbon cycle module for agricultural

land use was incorporated in the CGE model, showing an increased carbon sequestration in agricultural soil, representing a negative leakage through markets in the range of 60-120% of the certified emissions reductions as registered in the CDM tree plantation project.

The relative influences of land-owner and landscape heterogeneity in an agent-based model of land-use

- Ecological Economics---2011---Hugh Kelley, Tom Evans

The purpose of this work is to explore the extent to which landowners' land-use decisions are influenced by heterogeneous land-use preferences, spatial externalities, and unique suitability features? We develop and calibrate a heterogeneous-agent portfolio-theory model to the historical Southern Indiana land-use history. Calibration exercises demonstrate that our spatially-explicit approach provides an accurate description of landowners in our study area, with the most descriptive model explaining 70% of land-use variation across time and space. Comparative statics simulations indicate that landowners' heterogeneous calibrated preference parameters marginally influence the landscape more than suitability and externality parameters. Policy simulations demonstrate that weaker multi-policy management strategies simultaneously targeting heterogeneities and spatial interactions can provide 1-6% more forest that is 1-3% less fragmented compared to alternative strong single-policy approaches.

A new fuzzy multi-criteria framework for measuring sustainability performance of a supply chain

- Ecological Economics---2011---Ismail Erol, Safiye Sencer, Ramazan Sari

Sustainable supply chain performance measurement is aimed at addressing environmental, social and economic aspects of sustainable supply chain management. It can be argued that it is not easy to reduce all dimensions of sustainable supply chain to a single unit. Then, the issue is that all valuations should somehow be

reducible to a single one-dimensional standard. Multi-criteria evaluation introduces a framework to remedy this issue. As a consequence, multi-criteria evaluation seems to supply a proper and adequate assessment framework for sustainable supply chain assessment. In this study, a multi-criteria framework based on fuzzy entropy and fuzzy multi-attribute utility (FMAUT) is proposed in order to evaluate and compare the company performances in terms of sustainable supply chain. However, note that reducing all aspects of sustainable supply chain to a single unit using a multi-criteria framework may not be sufficient to satisfy all the needs of decision makers although it is used to evaluate sustainability performance of supply chains with respect to three aspects. Therefore, in this research, an alert management system is also developed to satisfy further requirements of users. The proposed frameworks are tested using data obtained from one of the middle sized Turkish grocery retailers.

Distal order effects in stated preference surveys

- Ecological Economics---2011---Beilei Cai, Trudy Cameron, Geoffrey Gerdes

Stated preference researchers have previously demonstrated that a good's placement among a sequence of goods in a set of valuation questions (i.e. proximal order effects) can have a substantial impact on people's valuations of these different goods. However, the economic consequences of potential order effects stemming from other questions in a survey, prior to the valuation tasks, have received surprisingly little attention. Using an online climate change survey, we identify order effects created by prior attitude-elicitation questions, and we assess the potential impact of these distal order effects on willingness to pay (WTP) estimates for stylized climate change policies. We find that the order used in prior questions may change people's opinions toward various attributes of the good to be valued, and thereby change WTP by a substantial amount. This paper emphasizes the significance of order effects stemming from preliminary survey questions, and supports a call for diligence in the random ordering of all potentially influential preliminary information in stated

preference surveys to minimize inadvertent effects from any single arbitrary ordering.

Macroeconomic conditions in the U.S. and congressional voting on environmental policy: 1970-2008

- Ecological Economics---2011---Shaun Tanger,Peng Zeng,Wayde Morse,David Laband

Using the Environmental Scorecard ratings of Congressmen and Senators published annually by the League of Conservation Voters, we explore empirically whether political support for pro-environment legislation, aggregated across each legislative body, is sensitive over time to changing economic conditions -- that is, whether there is a political trade-off between economic conditions and the environment. Using LCV scorecard ratings from 1970 to 2008, we find evidence, consistent across both the House and Senate, that political support for the environment is related to per capita income, but this general tendency can be decomposed into sharp differences by party.

The relationship between resilience and sustainability of ecological-economic systems

- Ecological Economics---2011---Sandra Derissen,Martin Quaas,Stefan Baumgärtner

Resilience as a descriptive concept gives insight into the dynamic properties of an ecological-economic system. Sustainability as a normative concept captures basic ideas of intergenerational justice when human well-being depends on natural capital and services. Thus, resilience and sustainability are independent concepts. In this paper, we discuss the relationship between resilience and sustainability of ecological-economic systems. We use a simple dynamic model where two natural capital stocks provide ecosystem services that are complements for human well-being, to illustrate different possible cases of the relationship between resilience and sustainability, and to identify the conditions under which each of those will hold: a) resilience of the system is necessary, but not sufficient, for sustainability;

b) resilience of the system is sufficient, but not necessary, for sustainability; c) resilience of the system is neither necessary nor sufficient for sustainability; and d) resilience is both necessary and sufficient for sustainability. We conclude that more criteria than just resilience have to be taken into account when designing policies for the sustainable development of ecological-economic systems, and, vice versa, the property of resilience should not be confused with the positive normative connotations of sustainability.

Optimal detection strategies for an established invasive pest

- Ecological Economics---2011---Frances Homans,Tetsuya Horie

We model optimal detection of sub-populations of invasive species that establish ahead of an advancing front. For many invaders, eradication of the main population is an untenable goal, yet it may be possible to treat and eradicate emerging sub-populations once these sub-populations are detected. We embed a dynamically optimal post-detection management plan of sub-populations into a model of optimal detection effort determination and find that optimal detection effort depends, in part, on the distance from the main front: locations closer to the front with shorter management horizons enjoy lower reductions in overall cost from intervention. The uninfested landscape is divided into two zones, characterized by different dynamically optimal management plans: a suppression zone and an eradication zone. In the suppression zone, optimal detection effort increases with distance from the front. At the distance where the suppression zone yields to the eradication zone, optimal detection effort plateaus at its maximum level.

Cost-effective compensation to avoid carbon emissions from forest loss: An approach to consider price-quantity effects and risk-aversion

- Ecological Economics---2011---Thomas Knoke,Otto-Emmanuel Steinbeis,Matthias Bösch,Rosa María Román-Cuesta,Thomas Burkhardt

Analyses were carried out on financial compensation to avoid loss of tropical forests and related carbon (C) emissions when marginal financial yield declined for land-use options with extended areas, and when a risk-averting perspective (modeled according to financial theory around the capital asset pricing model) is assumed. The approach in this study was to consider natural forest, forest plantation, pasture, and cropland simultaneously to investigate how an optimized land-use distribution may reduce the amount of compensation necessary to avoid C emissions from forest loss. The financial compensations derived were as high as US\$ 176 per hectare per year when comparing natural forests only with the most profitable alternative (croplands). However, compensation decreased to US\$ 124 for risk-neutral decision-makers, who would strive for optimized land-use allocation, and to only US\$ 47 per hectare per year for risk-avoiders, who would look to maximize the reward-to-variability ratio. Sensitivity analyses indicated that the compensation under risk-aversion increased much less than under risk-ignoring when increased productivity of agricultural land-use or growing demand for agricultural products was simulated. It was concluded that considering appropriate diversification strategies and the well documented human behavior to avoid risks is an important step in developing cost-effective compensation policies.

Analysing the profitability of the Spanish fleet after the anchovy moratorium using bootstrap techniques

- Ecological Economics---2011---M. Dolores Garza-Gil, Manuel Varela-Lafuente, Gonzalo Caballero-Miguez, Marcos Álvarez-Díaz, Gonzalo Caballero Miguez

Given the low biomass level of the anchovy, the European Commission agreed to establish a moratorium on this species in the Bay of Biscay in 2005. Although the effects of managing the fishing activity with TACs, fees, taxes and ITQs on the stocks and future net profits are well documented in the specialized literature, scarce attention has been paid to analyze the effects of moratoriums on fisheries and the profitability of the fleet.

This paper studies if the anchovy moratorium had a significant impact on the economic profitability of the fleet that fishes anchovy and other pelagic species in the North Atlantic waters. For this purpose, we compare the financial situations of the fleet before and after the moratorium from a statistical point of view using bootstrap, which is a flexible non-parametric and computationally intensive methodology. The results reveal the existence of a structural change in the financial performance of the fleet after the implementation of the moratorium.

The trade-off between agriculture and biodiversity in marginal areas: Can crofting and bumblebee conservation be reconciled?

- Ecological Economics---2011---Lynne M. Osgathorpe, Kirsty Park, Dave Goulson, Svetlana Acs, Nick Hanley

Crofting is a low intensity agricultural system restricted to the Highlands and Islands of northern Scotland typified by small scale mixed livestock production and rotational cropping activities. As with other low intensity farming systems across Europe, crofting is changing in response to a range of socio-economic factors. This is having a negative impact on the populations of rare bumblebees that are associated with this agricultural system. In this paper we use an ecological-economic modelling approach to examine the likely impacts of introducing two different management options for conserving bumblebees on croft land-use and income. Two linear programming models were constructed to represent the predominant crofting systems found in the Outer Hebrides, and varying constraints on bumblebee abundance were imposed to examine the trade-off between conservation and agricultural incomes. The model outputs illustrate that in some instances it is likely that both agricultural profits and bumblebee densities can be enhanced. We conclude that policy-makers should take into consideration the type of farming system when designing cost-effective agri-environment policies for low intensity farming systems, and that improvements in bee conservation are not necessarily in conflict with maintaining farm income.

Embedding effects in choice experiment valuations of environmental preservation projects

- Ecological Economics---2011---Jette Bredahl Jacobsen,Thomas Lundhede,Louise Martinsen,Berit Hasler,Bo Thorsen

This paper addresses the question, whether attribute values derived from a CE study of one nature restoration and preservation project depend on the overall scale of nature preservation activities in which it is embedded. A split-sample CE study was undertaken in which a particular nature preservation project was evaluated in three plausible and strictly different embedding contexts. Respondents' attention was drawn to a varying number of forthcoming substitute preservation projects to be implemented prior to the one in question. Results show that while WTP for the project in focus is sensitive to the presentation of substitute projects as such, there does not seem to be any clear and unidirectional relationship between WTP and the number of substitute projects. Furthermore, effects vary across the project's attributes.

One model fits all? -- On the moderating role of emotional engagement and confusion in the elicitation of preferences for climate change adaptation policies

- Ecological Economics---2011---Anke Fischer,Klaus Glenk

Environmental economic and psychological studies often implicitly assume homogeneity of respondents' decision strategies in questionnaire-based surveys. However, social psychology and behavioural research suggest that there is a wide variety of approaches that individuals use to make such choices. We explore this heterogeneity against the backdrop of so-called 'dual process models', analysing participants' responses in a survey of public beliefs about and preferences for climate change adaptation policies. We find that the postulate of two different types of decision-making, the systematic-analytical and the heuristic-holistic, does indeed help us to understand patterns in respondent

behaviour that are, in turn, underpinned by respondents' motivation and ability to process information. Participants who were motivated and able to process the information provided were more likely to express preferences in line with their beliefs about adaptation policies, whereas those less motivated and more confused were more likely to use generalised rules-of-thumb that were not specific to the policy issue at hand. Depending on the theoretical framework of a study, such heterogeneity in response consistency and use of generic rules-of-thumb might have implications for the usefulness of survey outcomes. We discuss the implications of our findings, and draw conclusions for survey-based environmental research.

Sustainability and the value of the 'regulating' services: Wetlands and water quality in Lake Victoria

- Ecological Economics---2011---Silvio Simonit,Charles Perrings

The regulating services provided by ecosystems are amongst the most important for the sustainability of resource use, and yet they are also amongst the least understood. This paper considers one set of regulating mechanisms - the buffering functions of wetlands - and considers the information needed to identify both the value of the services offered by wetlands, and their substitutes. Using data from a catchment discharging water and nutrients to the Kenyan segment of Lake Victoria, the Yala catchment, the paper models the interactions between agriculture and fisheries as mediated by wetlands at the lake margin. More particularly, it estimates the value of the forgone nutrient retention function involved in the conversion of the wetland to agriculture, and the scope for providing the same services through land use change elsewhere in the catchment. The total cost of the payments that would compensate farmers for on-farm nutrient buffering services is 3.86 M US\$ year⁻¹, or 35% of the total gains from wetland conversion to crop production. This finding contributes to an understanding of both the value of regulating services and how they might most effectively be delivered in alternative ways.

Cooperation and framing effects in provision point mechanisms: Experimental evidence

- Ecological Economics---2011---Douadia Boughera,Laurent Denant-Boèmont,David Masclet

Andreoni (1995) showed that pure framing effects may influence contribution in Voluntary Contribution Mechanisms (VCM) by comparing a standard public goods game, called the positive frame condition (giving to the public good), with a negative frame condition (taking from the public good) where the subjects' choice to purchase a private good makes the other subjects worse off. This paper aims at testing the robustness of such framing effects in the context of Provision Point Mechanisms (PPM). Our approach is original in that it combines both framing and provision point dimensions by comparing maintaining (taking from the public good) and creating (giving to the public good) contexts using Provision Point experiments. Consistent with previous findings, we find that individuals tend to be less cooperative in the maintaining frame than in the creating frame. Our results also show that the framing effects are stronger under a PPM than under a VCM and increase with the provision point level. These results may have important consequences for the management of environmental resources.

Unsustainable timber harvesting, deforestation and the role of certification

- Ecological Economics---2011---Olivier Damette,Philippe Delacote

Deforestation is a major environmental issue, while demand for timber products increases rapidly in the developing world. One can thus wonder whether forest harvesting is sustainable worldwide, or if demand for timber products is fulfilled with the products from deforestation. Our panel data analysis shows that countries where timber harvesting is more important tend to experience larger deforestation rates than others, giving the intuition that forest harvesting is generally not sustainable. We also show that timber certification is negatively related to deforestation and thus seems to be a good indicator of harvesting sustainability.

Eco-labeling in commercial office markets: Do LEED and Energy Star offices obtain multiple premiums?

- Ecological Economics---2011---Franz Fuerst,Pat McAllister

This paper investigates the effect of eco-labeling on rental rates, sale prices and occupancy rates. The consensus emerging from previous studies appears to be that investors in and occupiers of eco-labeled buildings obtain a bundle of benefits related to lower operating costs, reputation benefits and productivity higher. In this study, a hedonic model is used to test whether the presence of an eco-label has a significantly positive effect on rental rates, sale prices and occupancy rates of commercial office buildings in the US. The results suggest that office buildings with Energy Star or LEED eco-labels obtain rental premia of approximately 3-5%. Dual certification produces an additive effect with rental premia estimated at 9%. Respective sale price premia for Energy Star and LEED labeled office buildings are 18% and 25%. The sale price premium for dual certification is estimated at 28-29%. An occupancy premium could not be confirmed for LEED labeled office buildings and only a small positive occupancy premium was found for Energy Star.

Combining ecological and recreational aspects in national park management: A choice experiment application

- Ecological Economics---2011---Artti Juutinen,Yohei Mitani,Erkki Mäntymaa,Yasushi Shoji,Pirkko Siikamäki,Rauli Svento

Increasing pressure to diversify development of national parks emphasizes the need for new and relevant information for park management decisions. In this paper, we use choice experiment to value different tradeoffs that evolved in park development scenarios. Specifically, we examine which kind of development profiles are worth considering and which paths not to follow. We focus on biodiversity and recreational services provided by Oulanka National Park in Finland, which represents a popular recreation site attracting a large

number of visitors. The increase of biodiversity was the most highly valued feature by the respondent national park visitors. Thus, our results show that the protection of biodiversity and recreational and tourism use of national parks can cause conflicting welfare effects if managed in inappropriate ways. Increasing the number of visitors, expanding present resting places, constructing new resting places and an intense increase in information boards, especially if combined with shrinking biodiversity, are welfare reducing managerial actions in national parks.

Collier Paul, The Plundered Planet, Why We Must - and How We Can - Manage Nature for Global Prosperity, Oxford University Press (2010) ISBN 978-0-19-539525-9 271 pp

- Ecological Economics---2011---Peter Söderbaum

2011

Ernst von Weizsäcker, Karlson Hargroves, Michael H. Smith, Cheryl Desha and Peter Stasinopoulos, Factor Five: Transforming the Global Economy Through 80% Improvements in Resource Productivity, Earthscan (2009) 340 pp., ISBN 978-1844075911

- Ecological Economics---2011---John Polimeni

2011

A bibliometric account of the evolution of EE in the last two decades: Is ecological economics (becoming) a post-normal science?

- Ecological Economics---2011---Manuela Castro e Silva,Aurora Teixeira

In ecological economics the debate on formalism and formalization has been addressed in the context of a lively discussion on ecological economics as a 'post-normal' (versus 'normal') science. Using ecological economics (EE) as a 'seed' journal and applying bibliometric techniques to all (2533) the articles published in EE from January 1989 to December 2009, we analyze the evolution of the field of ecological economics aiming

to shed light on this debate. We observe the predominance (and increased relevance) of certain research topics: 'Methodological issues', 'Policies, governance and institutions' and 'Valuation'. Moreover, 'Collective action', 'Technical change and the environment' and 'Values' stand as emergent themes of research. Finally, we note that ecological economics experienced an 'empirical turn' reflected in a shift away from exclusively formalized papers towards exclusively empirical and, to a larger extent, 'formal and empirical' ones. The combination of the prominent and emergent topics and the 'empirical turn' mirrors the increasing awareness among researchers in the field of the need to address a key specificity of ecological economics -- the interdependence of the economic, biophysical and social spheres. On this basis, we argue that at least through the lens of EE, ecological economics has evolved towards a post-normal science.

Groundwater balance and conservation under different water pricing and agricultural policy scenarios: A case study of the Hamadan-Bahar plain

- Ecological Economics---2011---Hamid Balali,Sadegh Khalilian,Davide Viaggi,Fabio Bartolini,Majid Ahmadian

Government subsidies for agricultural activities in recent decades have encouraged farmers of Hamadan-Bahar plain to extend the number of wells and irrigated farms, with no consideration of groundwater resource conservation. As a result, the level of the groundwater table has decreased continuously in this area, threatening the life of groundwater aquifer. The objective of the study is to analyze the impacts of irrigation water pricing and agricultural policy scenarios on aquifer conservation by considering the dynamic relations between aquifer groundwater balance and the agriculture sector. For this purpose a combination of simulation and optimization techniques is considered in a dynamic framework. Firstly, dynamic treatments of groundwater and the main factors affecting the balance of studied aquifer are simulated. Then, optimization behaviour of agriculture sector related to farmers' decision-making

processes is defined on the time horizon. Thereafter all of the equations are used simultaneously by a non-linear dynamic programming method, which maximize present value of gross margins of agriculture sector subject to groundwater constraints and other input limitations. The analysis of the results indicates that water pricing by itself can considerably reduce the agricultural demand for aquifer groundwater in the Hamadan-Bahar plain.

In defence of degrowth

- Ecological Economics---2011---Giorgos Kallis

This article defends the proposal of sustainable degrowth. A starting premise is that resource and CO₂ limits render further growth of the economy unsustainable. If degrowth is inevitable, the question is how it can become socially sustainable, i.e. a prosperous and stable, rather than a catastrophic, descent. Pricing mechanisms alone are unlikely to secure smooth adaptation; a full ensemble of environmental and redistributive policies is required, including - among others - policies for a basic income, reduction of working hours, environmental and consumption taxes and controls on advertising. Policies like these, that threaten to "harm" the economy, are less and less likely to be implemented within existing market economies, whose basic institutions (financial, property, political, and redistributive) depend on and mandate continuous economic growth. An intertwined cultural and political change is needed that will embrace degrowth as a positive social development and reform those institutions that make growth an imperative. Sustainable degrowth is therefore not just a structuring concept; it is a radical political project that offers a new story and a rallying slogan for a social coalition built around the aspiration to construct a society that lives better with less.

Environment versus growth -- A criticism of "degrowth" and a plea for "a-growth"

- Ecological Economics---2011---Jeroen van den Bergh

In recent debates on environmental problems and policies, the strategy of "degrowth" has appeared as an alternative to the paradigm of economic growth. This new notion is critically evaluated by considering five common interpretations of it. One conclusion is that these multiple interpretations make it an ambiguous and rather confusing concept. Another is that degrowth may not be an effective, let alone an efficient strategy to reduce environmental pressure. It is subsequently argued that "a-growth," i.e. being indifferent about growth, is a more logical social aim to substitute for the current goal of economic growth, given that GDP (per capita) is a very imperfect indicator of social welfare. In addition, focusing ex ante on public policy is considered to be a strategy which ultimately is more likely to obtain the necessary democratic-political support than an ex ante, explicit degrowth strategy. In line with this, a policy package is proposed which consists of six elements, some of which relate to concerns raised by degrowth supporters.

Farming system modelling for agri-environmental policy design: The case of a spatially non-aggregated allocation of conservation measures

- Ecological Economics---2011---Laure Bamière, Peter Havlik, Florence Jacquet, Michel Lherm, Guy Millet, Vincent Bretagnolle

This paper addresses the issue of designing policies for habitat conservation on agricultural land. The case under study requires a non-aggregated spatial distribution of the fields to be enrolled in an agri-environmental programme. A spatially explicit mathematical programming farm-based model, which accounts for three spatial levels (field, farm and landscape), is coupled with a relevant spatial pattern index (the Ripley L-function) to analyse the design and implementation of an agri-environmental programme aimed to preserve the Tetrax tetrax in the Plaine de Niort, France. The model is run using a stylised map with heterogeneous soil types and both crop growing and mixed dairy farms. Results show that valuable insights into agri-environmental programme design are gained through

a detailed representation of farming system management. The suitable, non-aggregated spatial pattern for T. tetra conservation is more costly than less-suitable, more aggregated patterns, because it tends to require equal participation of all farms. The policy simulations reveal that the various spatial patterns can be obtained through relatively simple uniform contract structures. An effective contract structure entails a set of two degressive payments which encourages all farms to enrol at least a small share of their land in the program.

A dimensionally consistent aggregation framework for biophysical metrics

- Ecological Economics---2011---Deepak Malghan

We develop a formal representation of the economy-ecosystem interaction problem by distinguishing between stock-flow, and fund-flux spaces (Georgescu-Roegen, 1971). We then define dimensionless quantities in both the cardinal stock-flow space and the ordinal fund-flux space. This leads to analytic definitions of natural capital and natural income in the fund-flux space. We show that a stock-fund representation of the economy-ecosystem interaction problem helps investigate aggregation properties of biophysical metrics. In particular, we show how a metric that is dimensionally consistent in the stock-flow space can have dimensional problems in the fund-flux space. Ecological footprint is used as an illustrative example. Finally, we argue that dimensionally consistent metrics are keys to further the development of biophysical assessments as a tool for practical environmental policy.

Biological conservation in dynamic agricultural landscapes: Effectiveness of public policies and trade-offs with agricultural production

- Ecological Economics---2011---F. Barquand, Vincent Martinet

Land use change and land management intensification are major drivers of biodiversity loss, especially in agricultural landscapes, that cover a large and increasing share of the world's surface. Incentive-based

agri-environmental policies are designed to influence farmers' land-use decisions in order to mitigate environmental degradation. This paper evaluates the effectiveness of agri-environmental schemes for biological conservation in a dynamic agricultural landscape under economic uncertainty. We develop a dynamic ecological economic model of agricultural land-use and spatially explicit population dynamics. We then relate policies (subsidies to grassland, taxation of agricultural intensity) to the ecological outcome (probability of persistence of a species of interest). We also analyze the associated trade-offs between agricultural production (in value) and biological conservation (in probability of persistence) at the landscape scale.

Net primary production and gross domestic product in China derived from satellite imagery

- Ecological Economics---2011---Naizhuo Zhao, Nate Currit, Eric Samson

Since the 1980s Chinese economic reform has greatly accelerated its economic growth while in contrast China's environment is increasingly degraded. The Chinese government has recognized that environmental protection and sustainable economic development can promote mutual and sustainable co-development of the economy and the environment as a basic national principle. This paper examines the interactions between economic development and environmental change in China that were compared and analyzed for the years 1996 and 2000. Net primary production (NPP) was selected as a proxy evaluator of ecosystems and gross domestic product (GDP) was chosen as a proxy evaluator of economic development. An NPP change map was produced with Advanced Very High Resolution Radiometer (AVHRR) summed annual NPP imagery products. The Defense Meteorological Satellite Program's Operational Linescan System (DMSP/OLS) nighttime imagery was used to produce a Chinese GDP change map. An integrated map was produced to exhibit the combined changes of NPP and GDP. This map showed that in the regions with increased GDP, NPP decreased but the regions with no GDP change were smaller in area for NPP increase while larger in area for NPP decrease. The

changing pattern of NPP varied with the developing level of GDP at province level. A province's development of GDP is controlled by its accessibility to natural resources. Interactions between NPP and GDP are greatly affected by factors of spatial location aside from human factors and natural systems' characteristics.

Quantitative versus qualitative growth with recyclable resource

- Ecological Economics---2011---Jean-François Fagnart, Marc Germain

We reassess the issue of limits to growth in an endogenous growth model of a decentralized economy where final productions require a recyclable essential material input. The model relies on technological assumptions consistent with the material balance principle and on an explicit distinction between the material content and the quality of the produced goods. Growth follows from research activities that allow firms to improve the quality of their output and to reduce the material resource intensiveness of their production process. Even though recycling is assumed perfect, we show that 1) the material balance constraint may affect the whole transitory dynamics of the growth process; 2) quantitative growth (i.e. positive growth of material output) can only be a transitory phenomenon, long term economic growth taking exclusively the form of perpetual improvements in the quality of final goods. A long term growth path is characterized by constant values of material variables (or in a less favourable scenario, by a constant negative growth rate of those variables). We establish the existence conditions of a growth path based on quality improvements and constant material variables. It may fail to exist in a decentralized framework even though it is feasible from a purely physical point of view.

Corporate performance implications of extended stakeholder management: New insights on mediation and moderation effects

- Ecological Economics---2011---Marcus Wagner

This paper looks at the extent to which stakeholder

pressure is related to the integration of management practices within the firm and at the link of integration with self-reported economic and environmental performance as an outcome variable. It specifically analyses possible mediation and moderation effects through multiple-group AMOS comparing subsamples. As concerns integration, a strong mediation effect is established. As far as country location is concerned, the results show a moderating effect on the paths of integration and internal stakeholder groups and on the paths of integration with, respectively, efficiency, image, risk (as economic performance variables) as well as emissions and inputs (as environmental performance variables). It also shows a negative moderator effect of age on the relationship between integration and inputs and that profitability has a positive moderator effect on the relationship between the pressure from public actors and integration.

Endogenous property rights regimes, common-pool resources and trade

- Ecological Economics---2011---Gregmar Galinato

A model is developed where opening to trade affects a dynamic common-pool resource stock and welfare through a community's voting decision to institute a property rights regime regulating the stock. The model finds that resource stock levels can decline even when a Markov perfect equilibrium path for labor and property rights regimes are chosen to maximize welfare. Thus, opening to trade can be welfare maximizing even when resource stock declines. Experimental results show that under certain conditions, subjects briefly follow a Markov perfect equilibrium path for property rights regime choice but labor allocations are myopically chosen indicating that some resource dynamics may be considered by subjects.

No matter how it is measured, income declines with global warming

- Ecological Economics---2011---Pin Ng, Xiaobing Zhao

The contemporaneous relationship between temperature and income is important because it enables economists to estimate the economic impact of global warming without assuming a structural model. Until recently, empirical evidence generally suggests that there is a negative relationship between temperature and income, and, therefore, global warming has an adverse impact on economic activity. However, Nordhaus (2006) argues that the temperature-income relationship depends on how income is measured. We show in this paper that the results of Nordhaus (2006) may be due to an omitted-variable problem. Based on a well-motivated temperature-income model, we find that the relationship between temperature and income is not dependent on income measurement. Our regression results show that the adverse impact of an increase of 1 °C in temperature can be as much as a 3% decrease in total income for the G-7 nations. Therefore, our results suggest an aggressive climate mitigation policy.

When the public good conflicts with an apparent preference for unsustainable behaviour

- Ecological Economics---2011---Craig H. Bullock, Marcus Collier

The example of peatlands is used to demonstrate the challenges facing the sustainable management of natural resources in situations where the fragility of an environment is not appreciated by all stakeholders. We reveal, through the use of a survey applying both contingent valuation and discrete choice experiments, that many local people and others within the wider population, value peatlands as an example of a cultural landscape. However, there is a reluctance to stop extracting peat for domestic fuel even though the activity is undermining the ecological sustainability of this same landscape. This resistance is shown to arise because the cutting of peat is a well-established land use and a cessation of peat cutting is perceived to require the abandonment of traditional rights. In addition, the activity is widely regarded as more benign than industrial scale cutting for energy. The value attached to the landscape is an opportunity for conser-

vation policy, but for this to succeed there must be an acknowledgement of local interests.

What really matters: Discounting, technological change and sustainable climate

- Ecological Economics---2011---Georg Müller-Fürstenberger, Gunter Stephan

This paper discusses the interplay between the choice of the discount rate, greenhouse gas mitigation and endogenous technological change. Neglecting the issue of uncertainty it is shown that the Green Golden Rule stock of atmospheric carbon is uniquely determined, but is not affected by technological change. More generally it is shown analytically within the framework of a reduced model of integrated assessment that the optimal stationary stocks of atmospheric carbon depend on the choice of the discount rate, but are independent of the stock of technological knowledge. These results are then reinforced numerically in a fully specified integrated assessment analysis.

Biocapacity supply and demand in Northwestern China: A spatial appraisal of sustainability

- Ecological Economics---2011---Dongxia Yue, Xiaofeng Xu, Cang Hui, Youcai Xiong, Xuemei Han, Jinhui Ma

Integrating spatial analysis with the supply and demand of biocapacity is critical for the sustainable development of regional eco-economic systems. Previous studies have focused on the temporal analysis of biocapacity at broad geographical scales, but lacked the systematic spatial realization at fine scales. An improvement is proposed of this conventional methodology of the ecological footprint by incorporating land-use data derived from high-resolution remote-sensing images into the calculation of biocapacity supply at regional, provincial and county levels in Northwestern China in 2000. The spatial heterogeneity and its effect on the biocapacity supply were systematically revealed for this region. First, the biocapacity supply declined from the east (the Guanzhong Basin and the Loess

Plateau) to the middle (the Qaidam Basin and the Turpan Basin), and turned to rise from the middle to the west (the northwest of the Xinjiang Uygur Autonomy). Second, although the gap between biocapacity supply and demand resulted in a small ecological deficit at the regional level, a large ecological deficit was observed at the provincial and county levels, highlighting an unsustainable situation for some of the sub-regions. Importantly, a power law relationship was unveiled between the biocapacity supply and population density, suggesting that (i) the biocapacity supply as a critical indicator could reflect the intensity of human exploitation on local biophysical resources and (ii) humans tend to have a preference to inhabit those areas with high biological productivity. These results provide opportunities to enhance policy development by central and local governments as part of the long-term Great Western Development Strategy of China.

Species preservation versus development: An experimental investigation under uncertainty

- Ecological Economics---2011---Therese Grijalva, Robert Berrens, W. Shaw

The safe minimum standard (SMS) is a decision rule to preserve renewable resources, unless the social costs of doing so are intolerable. While unpersuasive to many, support for the SMS has been advocated by some economists for settings involving irreversibility and a high degree of uncertainty. The objective of this paper is to explore decision-making involving species preservation versus development within an experimental laboratory setting, and involving uncertainty. The experimental design implements a number of prior game-theoretic investigations of the SMS (Bishop, 1978; Ready and Bishop, 1991; Palmmini, 1999), involving insurance, and lottery or combined games against nature. The choices are between species preservation, which possibly provides a cure for a disease, or developing habitat, leading to irreversible depletion. Econometric results from a random parameters logit model, using responses from 117 participants (across both U.S. and Mexican university student samples) and 9 treatment choices, indicate that support for the SMS varies across

the type of game, the imposed maximum regret condition concerning the relative magnitude of the costs of disease and net benefits of development, a constructed measure of respondents' risk aversion, and other factors. There is also strong evidence of unobservable heterogeneous preferences for preservation within our sample.

Opening a policy window for organisational change and full-cost accounting: The creation of BC Hydro's water use planning program

- Ecological Economics---2011---Lucia Scodanibbio

British Columbia's Water Use Planning (WUP) program is a multi-stakeholder process that revises the operating plans of BC Hydro's hydroelectric facilities in order to consider water values beyond hydropower. Using a model of policy change, this paper analyses the circumstances that enabled the emergence of WUP and prompted BC Hydro to change its decision-making processes to better consider environmental and social concerns. External factors, including dam operations' ecological impacts, an imprecise regulatory environment, and worsening relationships with regulators, highlighted the need for a change in operating BC Hydro facilities. Factors internal to BC Hydro included the development of a business case, concerns regarding the utility's reputation and public expectations. While different approaches were explored for solving BC Hydro's problems, a policy window for change opened within a shifting context provided by the election of a more progressive government, the growth of the environmental movement, and new approaches to taking complex multi-stakeholder, multiple resource decisions. Following a successful pilot process and government direction to expand WUP, factors that enabled its institutionalisation included financial resources to compensate for the foregone power, the presence of visionary individuals, the background preparation that facilitated a successful pilot WUP, and the urgent need of a solution.

S. Latouche, The degrowth proposal, Farewell to Growth, Polity Press (2009)

- Ecological Economics---2011---Giorgos Kallis

2011

Mark Everard, The Business of Biodiversity, WIT Press, Southampton and Boston (2009) ISBN 978-1-84564-208-2 240 pp

- Ecological Economics---2011---Karachepone Niran

2011

Property rights and liability for deforestation under REDD+: Implications for 'permanence' in policy design

- Ecological Economics---2011---Charles Palmer

Reducing Emissions from Deforestation and forest Degradation (REDD+) is critical in efforts to mitigate the effects of anthropogenic climate change. Despite uncertainty about the exact form of a future, international REDD+ system, REDD+ carbon property rights would need to be created and allocated with liability assigned for the potential loss of climate benefits in the event of carbon reversal from deforestation. This commentary explores the links between forest property rights and liability, to different REDD+ policy options and their implications for permanence. Should national governments retain liability for permanence then project-level activities that have individually-assigned REDD+ carbon rights may have a higher risk of carbon reversal than policies where rights are assigned to the state. Knowledge of pre-existing forest rights is necessary for some policies implemented with government-assigned REDD+ rights in order to compensate for potential income losses from policy implementation.

Pursuing self-interest or self-actualization? From capitalism to a steady-state, wisdom economy

- Ecological Economics---2011---Niaz Murtaza

The co-evolution of capitalism, democracy and science since 1800 has led to enormous progress but also major existential problems. This article asserts that these problems are rooted in neo-classical economics' narrow focus within human nature on self-interest, which causes intense conflicts for scarce resources among people, societies, species and generations. It describes how an emphasis on the totality of human nature in life, with a focus on self-actualization instead of self-interest as the main driving force and wisdom rather than wealth as the ultimate aim, can lead to a steady-state, wisdom economy that can simultaneously ensure high personal welfare and collective sustainability.

Incentivizing sustainable waste management

- Ecological Economics---2011---Jeffrey Wagner

The purpose of this paper is to contribute to the integration of economic and non-economic concepts of waste management and sustainability to achieve new insights to sustainable waste management. Since landfilling will continue to be a significant waste management method, our theory and practice of sustainable waste management should focus upon incentivizing the development of more sustainable landfills. The model sheds light on the design of efficient and fair landfill siting processes; how production inputs to bioreactor landfilling should be selected; and how management practices during the facility's operation phase can achieve greater economic, ecological and social sustainability.

Significance of environment in the assessment of sustainable development: The case for south west Victoria

- Ecological Economics---2011---Anne M. Wallis, Michelle L.M. Graymore, Anneke J. Richards

The assessment of sustainable development is often based on the three pillars of sustainability model using social, economic and environmental indicators. It is thought that by measuring the performance of each system, information can be gained about the sustainability of the whole system. However it seems there has been no attempt to evaluate if such an assumption

is true. During the development of a sustainability assessment framework for south west Victoria, Australia, it has become evident that this approach to sustainability assessment does not provide an accurate assessment of system sustainability. The project found that environmental indicators were considered the most important for assessing regional sustainability. As a consequence, the assessment produced shows that in south west Victoria, sustainability is largely determined by the condition of the environment. This finding highlights the current disconnection between the theory and reality of sustainability. Here, we describe a framework for sustainability assessment that attempts to re-connect theory to practice.

The evolutionary approach to entropy: Reconciling Georgescu-Roegen's natural philosophy with the maximum entropy framework

- Ecological Economics---2011---Carsten Herrmann-Pillath

The paper explores the relevance of recent developments in the Maximum Entropy hypothesis for reinstating Georgescu-Roegen's natural philosophy, with special emphasis on the concepts of evolution and time. The key point is the naturalization of the notion of 'subjectivity' in both the Georgescu-Roegen framework and Jaynes's subjectivistic interpretation of thermodynamics and statistical mechanics. I introduce the concept of 'observer relativity' with reference to the evolution of 'physical inference devices'. Then, the MaxEnt formalism can be understood as a principle underlying natural selection. Further, given natural selection, maximum entropy production (MEP) results from the confluence of maximum power (Lotka) and the maximization of information capacity, driven by energy dispersal. In these processes, hierarchical structures of gradients of energy dissipation reflect alternative positions of system boundaries, and hence different perspectives of observer-relativity. Thus, I can distinguish between observer relative EntropyOR and observer independent EntropyOI. This allows to reconstruct conceptually the two notions of time proposed by Georgescu-Roegen, with subjectivistic time

seen as time relative to the evolutionary process involving incommensurable qualitative change. I claim that this philosophical view offers a powerful conceptual framework for recent empirical research into the energetics of economic growth.

Bio economic modeling for a sustainable management of biodiversity in agricultural lands

- Ecological Economics---2011---Lauriane Mouysset, Luc Doyen, F. Jiguet, G. Allaire, F. Leger

For several decades, significant changes in farmland biodiversity have been reported in Europe. Agriculture is a major driver of these modifications. Taking into account these environmental impacts, agriculture nowadays aims at a more sustainable way of producing which would reconcile its economic and ecological functions. The objective of this paper is to give insights into the impact of public policies on both conservation of biodiversity and farming production. We develop a macro-regional model combining community dynamics of 34 bird species impacted by agricultural land-uses and an economic decision model. The ecological dynamic model is calibrated with the STOC (French Breeding Bird Survey) and AGRESTE (French land-uses) databases while the economic model relies on the gross margins of the FADN (Farm Accountancy Data Network). We investigate the scenario based on subsidies and taxes. We show that simple economic instruments could be used to establish scenarios promoting economic performances and bird populations. It is pointed out how the sustainability of the policies is sensitive to the ecological and economic indicators used by the planner. The bio-economical analysis shows several solutions for the ecology-economy trade-off. These results suggest that many possibilities are available to develop multi-functional sustainable agriculture.

Optimal management of an ecosystem with an unknown threshold

- Ecological Economics---2011---Nicholas Brozovic, Wolfram Schlenker

We consider an ecosystem with two distinct equations

of motion that are separated by a threshold value of the state variable. We find that increasing uncertainty (both uncertainty embedded in the natural system and uncertainty of the decisionmaker about the location of the threshold) can lead to nonmonotonic changes in precaution: a reduction in uncertainty can first increase and then decrease optimal precautionary activity. This nonmonotonicity can help to explain why regulators often give conflicting arguments about optimal abatement policies in the face of uncertainty. For example, some regulators argue for an immediate reduction in pollutant loading until uncertainty about the underlying process is reduced while others call for no costly reductions in pollutant loading until the same uncertainty is reduced. These statements can be consistent even if both sides agree on both economic objectives and the system dynamics, but have different priors on the uncertainty involved.

Public transaction costs of agri-environmental schemes and their determinants--Analysing stakeholders' involvement and perceptions

- Ecological Economics---2011---E. Mettepenning, Volker Beckmann, J. Eggers

Despite an overall budget increase for rural development in the new programming period (2007-2013), most older Member States in the now expanded European Union are facing a substantial reduction in their budget for rural development and thus for agri-environmental schemes (AESs). It can be assumed that, in most countries, none or at best only part of this loss can be offset by national funds. Therefore the design of more efficient national governance structures for AESs, which decrease public transaction costs (TCs), would be an appropriate solution to this problem. The objective of this paper is to define the factors that influence these public TCs, so that appropriate action can then be taken to reduce them. A statistical analysis, with a proxy for public TCs, is combined with an analysis of stakeholder perceptions (excluding farmers) concerning public TC influencing factors. The research showed that it is mainly scheme related factors that are perceived to be important, although the governance

structure, institutional environment and level of trust also play a role. Finally, the analysis of perceptions concerning TCs also showed that AES related actors have a limited knowledge of TCs.

Trust, reputation and relationships in grazing rights markets: An experimental economic study

- Ecological Economics---2011---Andrew Reeson, John Tisdell, Ryan McAllister

Trust is frequently a requirement for economic exchanges and the management of natural resources. Providing public information on past actions can promote trust through the formation of reputations. We developed an economic experiment to test whether a formal reputation mechanism could facilitate trusting relationships in the tradable grazing rights markets. Providing information to create formal public reputations for market participants did not increase the overall efficiency of the market. However, it did result in greater equality of income between partners, suggesting that participants showed more concern for their partners when they knew they would be rated. Even with public reputation information, bilateral relationships remained central to the market. Market failures in existing grazing rights markets may be better addressed by measures to increase communication between partners rather than simply relying on a formal reputation mechanism.

A duration analysis of environmental alternative dispute resolution in Japan

- Ecological Economics---2011---Shigeru Matsumoto

The use of alternative dispute resolution (ADR) to solve environmental disputes is expected to increase in the near future. Therefore, it is important to evaluate the effectiveness of environmental ADR empirically. However, the majority of empirical literature of environmental ADR provides merely descriptive case studies. Using a large micro-level database from Japan, this paper identifies the characteristics of pollution disputes addressed by ADR and correlates those characteristics to the duration of disputes. Using the strike analysis

for reference, we estimate the standard duration models of environmental ADR. The analyses demonstrate that pollution disputes involving health damage are resolved promptly. Air pollution problems affecting multiple households are also expeditiously resolved. Moreover, we find that representative actions prolong the settlement of environmental disputes.

Species protection from current reserves: Economic and biological considerations, spatial issues and policy evaluation

- Ecological Economics---2011---Bertrand Hamaide,Jack Sheerin

The expansion of nature reserves is an important public policy strategy for the protection of biological diversity. In this paper, the authors use integer programming model structures derived from Location Set Covering Problem and Maximal Covering Location Problem approaches of location science as tools for selectively augmenting nature reserve sites for special status species protection. The linear programming models presented incorporate the following: biological constraints in the form of species' area needs; economic constraints in the form of opportunity costs of converting smaller administrative districts into nature reserves; and spatial constraints in the form of required connectivity among districts in site selection. The construction of a taxonomic data set for Thailand enables the implementation of the models, the comparison of results and evaluation of the differences in outcomes. The models build upon the existing nature reserve network in Thailand and suggest various public policy options that would augment the reserves for enhancing species protection and for possibly improving national conservation efforts at lowest costs.

Biofuel policies and the environment: Do climate benefits warrant increased production from biofuel feedstocks?

- Ecological Economics---2011---Jussi Lankoski,Markku Ollikainen

We examine whether climate benefits warrant policies

promoting biofuel production from agricultural crops when other environmental impacts are accounted for. We develop a general economic-ecological modelling framework for integrated analysis of biofuel policies. An economic model of farmers' decision making is combined with a biophysical model predicting the effects of farming practices on crop yields and relevant environmental impacts. They include GHG emissions over the life cycle, nitrogen and phosphorus runoff, and the quality of wildlife habitats. We apply our model to crop production in Finland. We find that under current biofuel production technology the case for promotion of biofuels is not as evident as has been generally thought. Only reed canary grass for biodiesel is unambiguously desirable, whereas biodiesel from rape seed and ethanol production from wheat and barley cause in most cases negative net impacts on the environment. Suggested policies in the US and the EU tend to improve slightly the environmental performance of biofuel production.

Management of an annual fishery in the presence of ecological stress: The case of shrimp and hypoxia

- Ecological Economics---2011---Ling Huang,Martin D. Smith

The emergence of ecosystem-based management suggests that traditional fisheries management and protection of environmental quality are increasingly interrelated. Fishery managers, however, have limited control over most sources of marine and estuarine pollution and at best can only adapt to environmental conditions. We develop a bioeconomic model of optimal harvest of an annual species that is subject to an environmental disturbance. We parameterize the model to analyze the effect of hypoxia (low dissolved oxygen) on the optimal harvest path of brown shrimp, a commercially important species that is fished in hypoxic waters in the Gulf of Mexico and in estuaries in the southeastern United States. We find that hypoxia alters the qualitative pattern of optimal harvest and shifts the season opening earlier in the year; more severe hypoxia leads to even earlier season openings. Failure to adapt to hypoxia leads to greater losses when the effects of hypoxia are

more severe. However, rent gains from adapting fishery management to hypoxia are relatively small compared to rent losses from the hypoxia effect itself. This suggests that it is critical for other regulatory agencies to control estuarine pollution, and fishery managers need to generate value from the fishery resources through other means such as rationalization.

On conflict over natural resources

- Ecological Economics---2011---Rafael Reuveny, John W. Maxwell, Jefferson Davis

This paper considers a game theoretic framework of repeated conflict over natural resource extraction, in which the victory in each engagement is probabilistic and the winner takes all the extracted resource. Every period, each contesting group allocates its capabilities, or power, between resource extraction and fighting over the extracted amount. The probability of victory rises with fighting effort, but a weaker group can still win an encounter. The victorious group wins all of the extracted resources and converts them to power, and the game repeats. In one model, groups openly access the resource. In a variant of the model, the stronger group can access a larger part of the resource than its rival, while in a second variant of the model the advantage of the dominant group is made more decisive than in the first two models. Our models generate outcomes that mimic several aspects of real-world conflict, including full military mobilization, defeats in one or repeated battles, victories following defeats, changes in relative dominance, and surrender. We examine comparative dynamics with respect to changes in the resource attributes, resource extraction, initial power allocation, fighting capabilities, and power accumulation. The policy implications are evaluated, and future research avenues are discussed.

An assessment of the influence of bioenergy and marketed land amenity values on land uses in the Midwestern US

- Ecological Economics---2011---Suk-Won Choi, Brent Sohngen, Ralph Alig

There is substantial concern that bioenergy policies could swamp other considerations, such as environmental values, and lead to large-scale conversions of land from forest to crops. This study examines how bioenergy and marketed environmental rents for forestland potentially influence land use in the Midwestern US. We hypothesize that current land uses reflect market values for environmental benefits of forestland, so that the marketed component of the environmental value of land can be captured as the difference between Census land values and value of land as a timber asset. We use a multinomial logit model to estimate the land use shares of forests, crops and urban in Ohio, Indiana, and Illinois. The results show that marketed environmental rents increase forestland relative to cropland. To examine the effects of biofuels on land use, we conduct policy analysis by altering future land rents. Our baseline scenario projects that urban development uses mostly cropland, but with higher crop rents resulting from increased demand for bioenergy, there will be significant losses of forestland to urban and cropland. On the other hand, if marketed environmental rents grow while crop rents are maintained at their baseline value, urban growth will occur, primarily at the expense of cropland.

Can domestication of wildlife lead to conservation? The economics of tiger farming in China

- Ecological Economics---2011---Brant Abbott, Gerrit van Kooten

Tigers are a threatened species that might soon disappear in the wild. Not only are tigers threatened by deteriorating and declining habitat, but poachers continue to kill tigers for traditional medicine, decoration pieces and so on. Although international trade in tiger products has been banned since 1987 and domestic trade within China since 1993, tigers continue to be poached and Chinese entrepreneurs have established tiger farms in anticipation of their demise. While China desires to permit sale of tiger products from captive-bred tigers, this is opposed on the grounds that it likely encourages illegal killing. Instead, wildlife conserva-

tionists lobby for more spending on anti-poaching and trade-ban enforcement. In this study, a mathematical bioeconomic model is used to investigate the issue. Simulation results indicate that, unless range states are characterized by institutions (rule of law and low corruption) similar to those found in the richest countries, reliance on enforcement alone is insufficient to guarantee survival of wild tigers. Likewise, even though conservation payments could protect wild tigers, the inability to enforce contracts militates against this. Our model indicates that wild tigers can be protected by permitting sale of products from tiger farms, although this likely requires the granting of an exclusive license to sellers. Finally, it is possible to tradeoff enforcement effort and sale of products from captive-bred animals, but such tradeoffs are worsened by deteriorating tiger habitat.

Economic valuation of species loss in the open sea

- Ecological Economics---2011---Adriana Ressorreição,James Gibbons,Tomaz Dentineho,Michel Kaiser,Ricardo S. Santos,Gareth Edwards-Jones

Although the oceans cover 70% of the surface of the planet few studies have considered the economic valuation of marine biodiversity, despite the importance of such information for marine management and conservation. This study uses a contingent valuation method to estimate the public's willingness to pay (WTP) to avoid loss in the number of marine species in the waters around the Azores archipelago. We estimated the marginal value associated with increased levels of species loss (10% and 25%) in five marine taxa (mammals, fish, algae, birds and invertebrates) and all marine species considered as a whole, via a face to face survey of residents and visitors to two Azorean islands. The results suggest small but statistically significant differences in the WTP to prevent losses in the different taxa (mammals $\hat{WTP} = \hat{WTP}_{fish} > \hat{WTP}_{birds} = \hat{WTP}_{invertebrates} = \hat{WTP}_{algae}$). The results also suggest a greater WTP to preserve all marine taxa as a whole, than for a series of individual marine taxa. The valuation of the ecosystem and taxa may be influenced by

the maritime culture of the respondents, but despite this, the findings challenge the commonly held premise that charismatic taxa have a disproportionately strong influence on WTP, and they provide important insights into human preferences for biodiversity conservation.

Assessment of net ecosystem services of plastic greenhouse vegetable cultivation in China

- Ecological Economics---2011---Jie Chang,Xu Wu,Anqin Liu,Yan Wang,Bin Xu,Wu Yang,Laura A. Meyerson,Baojing Gu,Changhui Peng,Ying Ge

Plastic greenhouse vegetable cultivation is rapidly expanding in China and elsewhere worldwide. In order to comprehensively understand the impacts of plastic greenhouse vegetable cultivation on agricultural ecosystem services and dis-services, we developed an assessment framework for the net ecosystem services and used China as a case study. Our results showed that, compared to conventional vegetable cultivation, plastic greenhouse vegetable cultivation has higher fresh vegetable production, greater CO₂ fixation (3.61 t CO₂ ha⁻¹ yr⁻¹), better soil retention (23.1 t ha⁻¹ yr⁻¹), and requires less irrigation (2132 m³ water ha⁻¹ yr⁻¹), maintains similar soil fertility, but also has higher NO₃- accumulation and N₂O emissions. In 2004, plastic greenhouse vegetable cultivation in China provided an overall net economic benefit of 67,956 yuan ha⁻¹ yr⁻¹ (8.28 yuan = 1 USD in 2004), where 68,240 yuan ha⁻¹ yr⁻¹ represented ecosystem services and 284 yuan ha⁻¹ yr⁻¹ for dis-services. The transition from conventional vegetable cultivation to plastic greenhouse vegetable cultivation resulted in a net economic benefit of 24,248 yuan ha⁻¹ yr⁻¹. A cost-benefit analysis suggests that plastic greenhouse vegetable cultivation in China has the potential to optimize social benefits in addition to increasing annual economic income to farmers directly.

The blue, green and grey water footprint of rice from production and consumption perspectives

- Ecological Economics---2011---A.K. Chapagain,A.Y. Hoekstra

The paper makes a global assessment of the green, blue and grey water footprint of rice, using a higher spatial resolution and local data on actual irrigation. The national water footprint of rice production and consumption is estimated using international trade and domestic production data. The global water footprint of rice production is 784 km³/year with an average of 1325 m³/t which is 48% green, 44% blue, and 8% grey. There is also 1025 m³/t of percolation in rice production. The ratio of green to blue water varies greatly over time and space. In India, Indonesia, Vietnam, Thailand, Myanmar and the Philippines, the green water fraction is substantially larger than the blue one, whereas in the USA and Pakistan the blue water footprint is 4 times more than the green component. The virtual water flows related to international rice trade was 31 km³/year. The consumption of rice products in the EU27 is responsible for the annual evaporation of 2279 Mm³ of water and polluted return flows of 178 Mm³ around the globe, mainly in India, Thailand, the USA and Pakistan. The water footprint of rice consumption creates relatively low stress on the water resources in India compared to that in the USA and Pakistan.

Environmental regulation and investment: Evidence from European industry data

- Ecological Economics---2011---Andrea Leiter,Arno Parolini,Hannes Winner

This paper contributes to the empirical literature on the effects of environmental regulation on investment. In particular, we ask whether and how strongly an industry's investment responds to stringency in environmental regulation. Environmental regulation is measured as (i) an industry's total current expenditure on environmental protection, and (ii) a country-industry's revenue from environmental taxes. Focusing on European data of manufacturing industries between 1998 and 2007, we estimate the differential impact of environmental stringency on four types of investment: gross investment in tangible goods, in new buildings, in machinery, and in 'productive' investment (investment in tangible goods minus investment in abatement

technologies). Both environmental variables enter positively, and their quadratic terms exhibit significantly negative parameter estimates. This, in turn, indicates a positive but diminishing impact of environmental regulation on investment.

Fine-scale conservation planning outside of reserves: Cost-effective selection of retention patches at final harvest

- Ecological Economics---2011---Karin Perhans,Dan Glöde,Jessica Gilbertsson,Anette Persson,Lena Gustafsson

Retaining forest patches at final harvest is a key conservation measure in boreal forests, but guidelines for how to increase its cost-effectiveness are lacking. In a study in boreal Sweden, we compared the cost-effectiveness of three different approaches a forest owner may use to select patches: selection based on the conservation value of patches alone, economic cost alone or both of them combined. We also compared the cost-effectiveness of six different common types of patches. Conservation value was measured as species richness of bryophytes and lichens and as structural characteristics of patches. Compared to the selection approach in which both conservation value and cost were used, cost-effectiveness was 5-14% lower when only conservation value was used, depending on how conservation value was measured. On the contrary, using only the economic cost decreased the cost-effectiveness by only 1-2%. Among the patch types, swamp forest areas and deciduous tree groups were cost-effective types to retain. However, the patch types were complementary in their species composition and all hosted unique species. We argue that, ideally, assessments of both conservation values and economic costs of retaining patches should be made prior to harvest to enable planners to make well-informed and cost-effective decisions.

Shared wealth or nobody's land? The worth of natural capital and ecosystem services

- Ecological Economics---2011---Sergio Ulgiati,Amalia Zucaro,Pier Paolo Franzese

The prerequisite for a sustainable and equitable use of common resources (the so-called Commons) must be the proper evaluation of their role within the complex network of relationships that ensure ecosystems functioning, resilience, and evolutionary dynamics. It is crucial to ascertain to what extent the common wealth is used for the common benefit. Money-based schemes for valuing the Commons, such as the so-called "willingness-to-pay", provide a user-side evaluation perspective based on the idea that value only stems from utilization by humans. As a complement to such a point of view, we present and discuss in this paper a donor-side evaluation method (Emergy Synthesis) based on the idea that a proper measure of value can be achieved by also accounting for the work done by the biosphere in generating services and resources. It should not be disregarded that such resources and services also provide support to other species in the web of life. Emergy, a scientific measure of such environmental support, is suggested as a tool capable to assess quantity and quality of shared resources, thus providing a basis for their environmentally sound management.

Regional development or resource preservation? A perspective from Japanese appliance exports

- Ecological Economics---2011---Masaaki Fuse,Eiji Yamasue,Barbara K. Reck,T.E. Graedel

This paper examines Japanese resource outflows in the form of exported used (and functional) products in 2007 by quantifying the unintentional metal exports for a number of specialty metals typically used in electronics and electrical equipment. We find that more than half of the indium and 20-30% of the barium, lead, antimony, strontium, zirconium, silver, gold, and tin in domestically discarded products were not recycled in Japan, but rather were exported in products to be used elsewhere. The destinations of these metals were mainly Asian countries with rudimentary recycling technology. These results demonstrate that although these metals could have been stockpiled domestically for future recovery and recycling, they were instead sent to countries where recycling of these scarce metals is unlikely. From a resource perspective, therefore, the

free trade of used Japanese products compromises long-term domestic resource availability as it increases the quality of life in developing countries.

The effect of climate change on optimal wetlands and waterfowl management in Western Canada

- Ecological Economics---2011---Patrick Withey,Gerrit van Kooten

Warmer temperatures and a decrease in precipitation in the 21st century could severely deplete wetlands in the prairie pothole region of western Canada. In this study, we employ linear regression analysis to determine the casual effect of climate change on wetlands in this region, with temperature, precipitation and the standardized precipitation index (SPI) used to predict the effect of potential climate change on wetlands. We then use a waterfowl-wetlands bioeconomic model to solve for socially optimal levels of duck harvests and wetlands retention under current climate conditions and various climate change scenarios. The model maximizes benefits to hunters plus the amenity values of ducks to non hunters and the non-market ecosystem benefits of wetlands. Results indicate that climate change could decrease wetlands by between 7 and 47%, and that the optimal number of wetlands to retain could decrease by as much as 38% from the baseline climate.

Group decision-making theory and behavior under performance-based water quality payments

- Ecological Economics---2011---Alan R. Collins,Peter Maille

Two theoretical models explaining group allocation decisions under watershed level, performance-based payments are explored: (I) reward and penalize individual contributors; and (II) reduce the problem with cost-sharing and cooperative abatement. Under Model I, an optimal amount of pollution from individual contributors can be achieved with proper payment incentive and group allocation formula. Model II represents a cost effective solution to pollution reduction where the

group optimizes its return from group payments, but does not necessarily achieve an optimal level of pollution. Field experiment observations support farmer behavior closer to Model II.

Using spatial microsimulation to account for demographic and spatial factors in environmental benefit transfer

- Ecological Economics---2011---John Cullinan, Stephen Hynes, Cathal O'Donoghue

This paper presents a simulation-based modelling approach for estimating total visitor numbers and amenity values for prospective non-priced open-access outdoor recreation sites. To begin, the geographic extent of the market for recreation at a policy site is estimated using data from a similar study site. The population residing within this geographic area is simulated using a spatial microsimulation model and GIS techniques and an individual-level 'visitor arrival function' is then transferred across this simulated population. This allows the latent demand for visits to the policy site by each simulated individual to be predicted and summed, providing an estimate of the total potential demand for recreation at the site. Combining this with an economic value measure of a visit provides an estimate of the potential amenity value of the policy site. The approach is applied to Moyode Wood, a small-scale forest in the West of Ireland, and estimates the potential total economic value of recreation at [euro]0.4Â million for the site. The research represents the first time that spatial microsimulation has been used in environmental benefit transfer and shows how it can be used to control for differences in demographic and spatial factors between study and policy sites. It also demonstrates how individual-level single-site travel cost models estimated using on-site survey data can be used to predict demand at alternative policy sites.

An analysis of public adaptation to climate change using agricultural water schemes in South America

- Ecological Economics---2011---S. Niggol Seo

This paper provides an analysis of public adaptation to climate change using agricultural water schemes in South American farms. Unlike other studies of adaptation, this paper examines the differences between private irrigation and public irrigation schemes based on around 1400 farm surveys collected across seven countries in South America which recorded detailed water schemes. We analyze the choice of water schemes in the first stage and the land values for each scheme in the second stage. We find that public irrigations do not increase in response to a warmer climate, but private irrigations do. On the other hand, we find that public irrigation schemes are provided primarily as a response to water scarcity. Moreover, we find that private irrigations are taken gradually while public irrigations are provided as a lump sum, resulting in either too much or too little provision. Therefore, public adaptations to climate change will likely involve two inefficiencies. No provision of irrigation in a hotter climate may result from a lack of knowledge. Overprovision of irrigation in dry zones may result from a lump-sum provision of a public good.

Sustaining sustainability science: The role of established inter-disciplines

- Ecological Economics---2011---Karen Kastenhofer, Ulrike Bechtold, Harald Wilfing

The establishment of new interdisciplinary fields such as ecological economics, human ecology or technology assessment can be interpreted as a logical consequence of striving for new sustainability sciences that address current global, multi-dimensional and multi-scale challenges. These set out to bridge the gap between the natural and the social sphere, between scientific analysis and societal action. This paper aims at re-assessing the contribution of established inter-disciplines to sustainable development. Journal articles of ecological economics, technology assessment and science and technology studies are evaluated and compared along several proposed features of sustainability science. The results converge in two crucial aspects. (1) Concise societal or political recommendations are not part of present day 'normal science', be it a disciplinary or

an explicitly interdisciplinary research context. (2) Participatory exercises are rarely applied as a socio-politically embedded practice, despite a high interest in such exercises as an object of study and discussion.

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2011

The relationship between externality, and its correction, and sustainability

- Ecological Economics---2011---Mick Common

2011

Management of non-timber forestry products extraction: Local institutions, ecological knowledge and market structure in South-Eastern Zimbabwe

- Ecological Economics---2011---M.J. Mutenje, G.F. Ortmann, S.R.D. Ferrer

Common-pool resources (CPRs), such as forests, water resources and rangelands, provide a wide variety of economic benefits to forest-fringe dwellers in semi-arid areas of southern Africa. However, the public nature and competition involved in the use of these goods, and weak enforcement of institutional arrangements governing their use may lead to resource degradation. Using survey data from four communities in south-eastern Zimbabwe for 2008 and 2009, this paper examines the extent to which forest degradation is driven by existing common property management regimes resource and user characteristics, ecological knowledge and marketing structure. A Principal Component Analysis indicates that the existence of agreed-upon rules governing usage (including costs of usage), enforcement of these rules, sanctions for rule violations that are proportional to the severity of rule violation, social homogeneity, and strong beliefs in ancestral spirits were the most important attributes determining effectiveness of local institutions in the management of CPRs. Empirical results from a regression analysis showed that resource scarcity, market integration, and infrastructural development lead to greater resource degradation, while livestock income, high ecological knowledge, older households, and effective local institutional management of the commons reduce resource degradation. The results suggest that there is need for adaptive local management systems that enhance ecological knowledge of users and regulates market structure to favour long-term livelihood securities of these forest-fringe communities.

Helping "light green" consumers walk the talk: Results of a behavioural intervention survey in the Swiss electricity market

- Ecological Economics---2011---Dorian Litvine,Rolf Wüstenhagen

While many consumer surveys show very positive attitudes towards renewable energy, the share of consumers actually purchasing green electricity is still in the single-digit percent range in most countries. What can be done to help consumers with positive attitudes towards green electricity to "walk the talk", i.e. to behave consistently with their preferences? We developed a psychological model based on the theory of planned behaviour (TPB) to design a large-scale behavioural intervention survey with 1163 Swiss electricity consumers. Our results show that by providing information targeted at the key factors influencing the intention to purchase green electricity, namely attitudes towards purchase, social norms and perceived behavioural control, a significant increase in green electricity market share can be achieved. Our results show that price is not the only barrier to purchasing green electricity, and that information to increase the perceived benefit of buying green electricity as well as targeted communication to overcome inertia among retail electricity consumers are equally important factors.

Comparing region-specific sustainability assessments through indicator systems: Feasible or not?

- Ecological Economics---2011---Annemarie van Zeijl-Rozema,Ludovico Ferraguto,Pietro Caratti

Numerous indices help us to compare country and local performance in the field of human development, globalization and sustainable development. Obvious problems arise, such as data availability and data quality. A less obvious issue is that such sets and indices do not permit the inclusion of specific characteristics or discourses that are important in a country or region. This paper investigates the possibility of comparing regional sustainability assessments in four case studies, where the indicators vary from region to region, but

the method of making the assessment is similar. The concepts of weak and strong comparability were used in this analysis. Comparability of sustainable development between different regions is not an issue of rigid comparison of indicator by indicator. It should take into account regional specifics. The resulting shift from strong to weak comparability should not be seen as a lessening of the quality of the assessment and decreasing comparability. Rather than focusing on individual indicators within frameworks that do not permit inclusion of regional developments, this approach allows to look at the broader picture of regional dynamics. It reveals specific regional weaknesses that need attention, and possible areas for building alliances between regions, thus creating a more sustainable Europe.

Economic-environmental monitoring indicators for European countries: A disaggregated sector-based approach for monitoring eco-efficiency

- Ecological Economics---2011---Sibylle Wursthorn,Witold-Roger Poganietz,Liselotte Schebek

Eco-efficiency links economic efficiency with environmental efficiency. The main purpose of the concept is to identify and implement activities to enable production that is both economically more efficient and cleaner. This means that parameters with a high indicative value have to be used. Since both the environmental and the economic performance of industries must be described concurrently, environmental intensity appears to be a good indicator of eco-efficiency. Environmental intensity is environmental impact per unit of economic performance. In this paper, the environmental impact of industry classes is derived from emission data, released by the European Pollutant Emission Register (EPER), and then aggregated and assessed using Eco-Indicator 99, a single-score life-cycle impact assessment (LCIA) method. The calculated ratio is thus an accurate description of the environmental-economic state of industry classes. The main advantage of this approach is the underlying consistent statistical framework, that permits, on a disaggregated level, economic data to be

correlated with ecological data and to be frequently updated. This single indicator facilitates a comparison of environmental intensity of different industry classes. The paper shows that it is possible to deduce a disaggregated eco-efficiency indicator, which is exemplified using German data, however could be analysed for different European countries.

The quantification and valuation of ecosystem services

- Ecological Economics---2011---Mark Sagoff

This paper explores differences between economic and ecological criteria for identifying, measuring, and evaluating ecosystem services. It argues that economic stakeholders (user groups) generally do well in identifying these services and assigning prices to them. These prices arise spontaneously in--and serve to coordinate--market activity related to the environment. The relevant ecological information which markets gather and apply tends to be dispersed, contingent, particular, local, transitory, and embedded in institutions and practices. Ecologists and other scientists, in contrast, often seek to understand how ecosystems work and which populations and processes provide ecosystem services. The knowledge science seeks, unlike the information markets gather, tends to be centralized, collaborative, collective, and consensus-based; science pursues concepts and principles that are timeless and general rather than ephemeral and site-specific. The paper contrasts the dispersed and decentralized information organized by markets with the collective and centralized knowledge characteristic of science. The paper argues that the conceptual distance between market-based and science-based methods of assembling information and applying knowledge defeats efforts to determine the "value" of ecosystem services in any integrated sense.

Assessing sustainability, a comprehensive wealth accounting prospect: An application to Mozambique

- Ecological Economics---2011---Timothée Ollivier,Pierre-Noël Giraud

We estimate the wealth of Mozambique in 2000 and 2005 in order to assess the sustainability of its development path. Our methodology builds on Arrow et al. (2010). We show that Mozambican wealth increases through human and physical capital accumulation, while the pressure on natural capital remains low. The growth of total factor productivity enhances the outcome of the different capital assets, but population growth has a strong downward effect on wealth per capita. Results suggest that Mozambican development was sustainable between 2000 and 2005, but these remain ambiguous and are highly sensitive to data and assumptions used.

The innovation impact of the EU Emission Trading System -- Findings of company case studies in the German power sector

- Ecological Economics---2011---Karoline S. Rogge,Malte Schneider,Volker H. Hoffmann

This paper provides a detailed analysis of how the European Emission Trading System (EU ETS) as the core climate policy instrument of the European Union has impacted innovation. Towards this end, we investigate the impact of the EU ETS on research, development and demonstration (RD&D), adoption, and organizational change. In doing so, we pay particular attention to the relative influences of context factors (policy mix, market factors and public acceptance) and firm characteristics (value chain position, technology portfolio, size and vision). Empirically, our qualitative analysis is based on multiple case studies with 19 power generators, technology providers and project developers in the German power sector which were conducted in 2008/09. We find that the innovation impact of the EU ETS has remained limited so far because of the scheme's initial lack of stringency and predictability and the relatively greater importance of context factors. Additionally, the impact varies significantly across technologies, firms, and innovation dimensions and is most pronounced for RD&D on carbon capture technologies and organizational changes. Our analysis suggests that the EU ETS on its own may not provide sufficient incentives for fundamental changes in

corporate innovation activities at a level which ensures political long-term targets can be achieved.

Governing uncertain and unknown effects of genetically modified crops

- Ecological Economics---2011---Valborg Kvakkestad, Arild Vatn

This paper analyzes the capabilities of three different governance regimes for adequately handling uncertain and unknown effects of genetically modified (GM) crops. Adequate handling requires the development of sound procedures for identification of uncertainty and ignorance (U&I), reduction of U&I, decisions on how to treat irreducible U&I and monitoring of unexpected effects. The nature of U&I implies, however, that these procedures will be highly incomplete. Governance mechanisms that facilitate cooperative adaptation and communicative rationality are therefore needed. The three governance regimes (GRs) compared are: GM-crops are produced by private firms and these firms are made liable for harm (GR1); GM-crops are produced by private firms and the government decides whether the crops should be marketed (GR2); and GM-crops are produced and the government decides whether the crops should be marketed (GR3). The effect of bringing the civil society into the decision-making process is also analyzed. GR3 will be stronger in cooperative adaptation and communicative rationality than GR2. Public research organizations have fewer conflicts of interest with the government than private firms, and academic norms are important. Difficulties in proving harm and identifying the responsible firm will make GR1 weak in cooperative adaptation and communicative rationality.

Conserving biodiversity with tradable permits under changing conservation costs and habitat restoration time lags

- Ecological Economics---2011---Martin Drechsler, Florian Hartig

Tradable permits are a common environmental policy instrument that has recently been applied also to the conservation of biodiversity. Biodiversity conservation

differs in many respects to the classical applications of tradable permits like emissions control. One particularity is that, even if the permit system maintains a constant total amount of species habitat, habitat turnover (the destruction of a habitat and restoration elsewhere) affects the ecosystem. Another particularity is that the restoration of habitats often takes much time, leading to time lags between the initiation of restoration activities and the time when restored habitat is available for trading. We use an agent-based model of a tradable permit market to study the influence of heterogeneous and dynamic conservation costs and habitat restoration time lags on key variables of the market, such as the costs incurred to the market participants and the amount of habitat turnover. Our results show that there may be trade-offs between these key variables. We also find that restoration time lags can lead to fluctuations in permit prices that reduce the efficiency of the permit market. We conclude that temporal lags deserve a careful analysis when implementing tradable permit systems for the preservation of natural habitats and biodiversity.

Sustainability ranking and improvement of countries

- Ecological Economics---2011---Yannis A. Phillis, Evangelos Grigoroudis, Vassilis S. Kouikoglou

Human society is on a collision course with nature, thus its sustainability is seriously questioned nowadays. To understand this problem better it is essential to define and measure sustainability. In this paper a model that uses fuzzy logic, called SAFE, is used to measure sustainability. The sustainability of a country is based on a multitude of basic indicators. In all 75 indicators for 128 countries are used. This work extends SAFE as follows: (a) The model is amended by an imputation procedure to fill in missing data, (b) the rule bases of SAFE are compiled algebraically, and (c) sustainability thresholds are defined so as to reflect expert opinion and international agreements and norms. Countries are ranked according to their sustainability index. Switzerland and Sweden take the first two

places and Mauritania and Sudan the two last ones. A sensitivity analysis pinpoints those basic indicators that affect sustainability the most. Decision makers may focus on these indicators to improve sustainability.

Who votes for public environmental goods in California?: Evidence from a spatial analysis of voting for environmental ballot measures

- Ecological Economics---2011---Xiaoyu Wu,Bowman Cutter

Voting referenda provide direct evidence of the demand for public goods. A number of previous studies have used referenda to analyze the support for public environmental goods. These studies have used aggregate data from large jurisdictional units (usually counties) and summary income measures such as the mean or median, and have usually found that higher income areas offer greater support for environmental propositions. We examine environmental referenda voting in California using census block group data, spatial dependence controls, and detailed income distribution data. We find that household income has a negative marginal effect on environmental referenda voting for most of the income range when using census block data. In addition, controls for spatial dependence significantly reduce the magnitude of most coefficients. This suggests that OLS estimates of referenda determinants are biased. We also show that county level data may be subject to severe aggregation bias and might not be appropriate for referenda studies.

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2011

On the natural capital and ecosystem services of soils

- Ecological Economics---2010---David A. Robinson, Inma Lebron

2010

Response to Robinson and Lebron -- Learning from complementary approaches to soil natural capital and ecosystem services

- Ecological Economics---2010---Estelle Dominati, Murray Patterson, Alec Mackay

We respond to the recent commentary of Robinson and Lebron (in press) on our framework to quantify and value soil natural capital and ecosystem services (Dominati et al., 2010). We argue that the framework proposed by Robinson et al. (2009) and our framework (Dominati et al., 2010) should be seen as complementary, as well as having some areas of overlap.

Landscape amenities and local development: A review of migration, regional economic and hedonic pricing studies

- Ecological Economics---2010---Fabian Waltert, Felix Schläpfer

With rapid urban expansion and loss of open space, attractive local landscapes will continue to gain importance in location decisions and on political agendas. The present study reviews the evidence on the local economic role of landscape amenities from two major strands of empirical research, migration and regional economic models, and hedonic pricing models. Following common amenity definitions we identify 71 relevant peer-reviewed studies and systematically assess the reported effects of the landscape amenity variables. The migration and regional economic studies suggest that migrants are attracted by amenities nearly as often as by low taxes. Reported effects of amenities on income and employment are less consistent. The hedonic studies suggest that nature reserves and land cover diversity have mostly, open space and forest often, and agricultural land rarely positive effects on

housing prices. Studies at larger geographic scales and studies involving urban areas were more likely to identify significant amenity effects. Some limitations of the evidence may be overcome with better datasets and modeling approaches. However, in line with other recent work, the limitations also highlight the need for complementary information from the analysis of political preferences for land-use management.

Social Metabolism, Ecological Distribution Conflicts, and Valuation Languages

- Ecological Economics---2010---Joan Martinez-Alier, Giorgos Kallis, Sandra Veuthey, Mariana Walter, Leah Temper

2010

Biophysical structure of the Ecuadorian economy, foreign trade, and policy implications

- Ecological Economics---2010---Maria Cristina Vallejo

At the core of this paper lays the notion that a systematic analysis of material flow accounts enables us to discuss the sustainability of an economic model. Ecuador is going through a socio-ecological transition from an agrarian towards an industrial regime, based on the use of nonrenewable sources of materials and energy. Direct material flow indicators are used in this article to analyze the ecological dimension of the economy of Ecuador during 1970-2007. This approach enables the concept of societal metabolism to become operative. The paper compares societal metabolic profiles showing that per capita use of materials is still at about one-fifth of the average in the high income countries of the world. Physical flows of trade indicate that there is an ecologically unequal exchange. Whereas a positive trade balance is desirable from an economic policy, its counterpart in physical units has been a persistent net outflow of material resources, the extraction of which causes environmental impacts and social conflicts.

Logging conflicts in Southern Cameroon: A feminist ecological economics perspective

- Ecological Economics---2010---Sandra Veuthey,Julien-François Gerber

Growing attention has been paid to gender in ecological economics, political ecology and development studies but a focus on gender in resource extraction conflicts is still rare. This article explores women-led resistance movements to commercial logging in South-eastern Cameroon, focusing on the moabi tree (*Baillonella toxisperma*). The latter provides oil, medicine and other non-timber products and use-values to local forest societies and particularly to women. Resistances arise because most socio-environmental costs of the international logging trade are imposed on the rural populations and especially on women of the extractive regions. The aim of this paper is to analyze the root causes of the gender structure of such mobilisations as well as the impacts on gender relations induced by such resource extraction conflicts. After proposing a typology of different environmental currents and their gender counterparts, this paper focuses on the gender construction of local Bantu societies, taking as a point of departure Paola Tabet's thesis that masculine control over production tools is the objective factor revealing the sexual division of work. In our case study, we found that the men's control over technology not only highlights the sexual work division but also the gendered division of access rights to natural resources. Thereby, we argue that the sexual division of access rights and work -- revealed through differentiated control over technology -- are two key institutions explaining the gendered structure of local mobilisations. We, then, discuss the empowerment allowed by the new forms of women's organizations, with a particular focus on the appropriation of new production tools by women. This highlights a non-Western form of environmental feminism.

Power and contestation in collaborative ecosystem-based management: The case of Haida Gwaii

- Ecological Economics---2010---Louise Takeda,Inge Røpke

The depletion of old-growth forests on Haida Gwaii as a result of decades of excessive logging poses a looming threat not only to irreplaceable biodiversity and habitat values but also to the indigenous Haida culture. This study examines the latest stages of a long-running conflict over the forests of Haida Gwaii, and the provincial government's attempt to ameliorate it through collaborative ecosystem-based land use planning. In contrast to other studies that have tended to regard collaborative planning processes in terms of either an idealised win-win outcome or the unavoidable government co-optation of opposition, this article explores both the problematic power relations found within the collaborative planning process as well as the opportunities presented by it to expand collective power and more effectively resist oppression and domination.

Jatropha plantations for biodiesel in Tamil Nadu, India: Viability, livelihood trade-offs, and latent conflict

- Ecological Economics---2010---Pere Ariza-Montobbio,Sharachandra Lele

Researchers, policy makers and civil society organizations have been discussing the potential of biofuels as partial substitutes for fossil fuels and thereby as a simultaneous solution for climate change and rural poverty. Research has highlighted the ambiguity of these claims across various dimensions and scales, focusing on ethanol-producing or oilseed crops in agricultural lands or *Jatropha*-type crops on common lands. We studied the agronomic and economic viability and livelihood impacts of *Jatropha curcas* plantations on private farms in Tamil Nadu, India. We found that *Jatropha* yields are much lower than expected and its cultivation is currently unviable, and even its potential viability is strongly determined by water access. On the whole, the crop impoverishes farmers, particularly

the poorer and socially backward farmers. Jatropha cultivation therefore not only fails to alleviate poverty, but its aggressive and misguided promotion will generate conflict between the state and the farmers, between different socio-economic classes and even within households. The water demands of the crop can potentially exacerbate the conflicts and competition over water access in Tamil Nadu villages.

Participatory processes in the soy conflicts in Paraguay and Argentina

- Ecological Economics---2010---Gustavo A. García-López,Nancy Arizpe

Within emerging environmental conflicts, different participatory processes have developed as alternatives to the top-down models that have dominated policy-making. In this paper, we focus on conflicts over the expansion of soy production. We analyze three issues related to top-down vs. bottom-up participatory processes and how they affect the proposals coming out of these processes: who counts as stakeholder (the role of social movements), what counts as participation (the role of mobilization), and who has power to select stakeholders and issues, make decisions, and influence preferences. To explore these issues, we present a case study of two parallel participatory processes in rural areas of Paraguay and Argentina. One of these, the Roundtable on Responsible Soy, is top-down, created by large agri-business multinationals and international conservation NGOs with the support of the governments in the region, and has focused on establishing criteria for "responsible soy". The other is bottom-up, self-organized by peasant and civil society organizations, and focused on stopping soy expansion and promoting food sovereignty. The findings highlight the potential of bottom-up processes to promote true agricultural sustainability while at the same time emphasizing the need for more research on grassroots participatory processes and their potential and limitations in different contexts.

Oil frontiers and indigenous resistance in the Peruvian Amazon

- Ecological Economics---2010---Martí Orta-Martínez,Matt Finer

The Peruvian Amazon is culturally and biologically one of the most diverse regions on Earth. Since the 1920s oil exploration and extraction in the region have threatened both biodiversity and indigenous peoples, particularly those living in voluntary isolation. We argue that the phenomenon of peak oil, combined with rising demand and consumption, is now pushing oil extraction into the most remote corners of the world. Modern patterns of production and consumption and high oil prices are forcing a new oil exploratory boom in the Peruvian Amazon. While conflicts spread on indigenous territories, new forms of resistance appear and indigenous political organizations are born and become more powerful. The impacts of oil exploration and exploitation and indigenous resistance throughout the oil history of the Peruvian Amazon are reviewed here, focusing on the Achuar people in Rio Corrientes. The driving forces, impacts, and responses to the current oil exploration boom are analyzed from an environmental justice perspective. We conclude that, in a context of peak oil and growing global demand for oil, such devastating effects for minor quantities of oil are likely to increase and impact other remote parts of the world.

A glocal environmental movement against gold mining: Pascua-Lama in Chile

- Ecological Economics---2010---Leire Urkidi

Gold mining projects are spreading in Latin America due to increasing international interest in gold and to the legal reforms that attract mining investment to the region. As metal mining has critical social and environmental impacts, conflicts related to it are also soaring. The conflict around the Pascua-Lama mining project in Chile is a paradigmatic example of these conflicts. Starting with the defence of some mountain glaciers being endangered by the mine, local protests have been internationalized. It has become one of the most important Chilean environmental conflicts of recent years.

In order to characterise the movement, the article analyses its social bases or participants, the values and arguments articulated and the strategies developed. This agency analysis shows that it is not a case of environmentalism of the poor or of post-materialist environmentalism, but a glocal environmental movement. The movement has not achieved to stop the project due to structural limitations; but it has been able to problematise and politicise the concept of development in the affected Chilean valley.

Valuation languages in environmental conflicts: How stakeholders oppose or support gold mining at Mount Ida, Turkey

- Ecological Economics---2010---Duygu Avcı,Fikret Adaman,Begüm Özkaynak

This paper analyses an ongoing environmental conflict over the prospect of gold mining at Mount Ida, Turkey, and aims to unpack the valuation languages social actors in the conflict use to either support or oppose gold mining. Based on a field study consisting of 37 in-depth interviews, three focus groups, and a survey administered to a total of 738 citizens, the factors that affect local public's positions vis-à-vis gold mining at Mount Ida and their choice of valuation languages are examined. Assessing the conflict at Mount Ida in terms of valuation languages enables us to better comprehend the various dimensions of the conflict and differentiate between the disagreements that can be controlled and solved via technical measures or bargaining over the amount of monetary compensation and those that cannot. We also intend to provide a useful and general methodology that combines qualitative and quantitative research methods for understanding a broad range of environmental conflicts. The results are in line with earlier findings in that local people oppose such projects for various distinct reasons and monetary and/or technical compensatory schemes do not suffice to solve the disagreements that arise in a satisfactory way.

Conflict in Campania: Waste emergency or crisis of democracy

- Ecological Economics---2010---Giacomo D'Alisa,David Burgalassi,Hali Healy,Mariana Walter

In 2008, the Italian Government issued a decree according to which obstructions or protests in the vicinity of landfills or incinerators became a penal felony. This was the outcome of a long process that began fifteen years before when regional waste treatment facilities became unable to cope with the waste accumulated in the region of Campania. This article studies the history of this conflict in order to identify a range of values and concerns about nature, health and democracy. It asserts that the decision-making process adopted by subsequent Italian governments, alongside repressive laws, oversimplified a complex crisis and obscured different emergent perspectives and values. Ultimately, denying the will of a large part of the population caused increased social unrest.

Shipbreaking at Alang-Sosiya (India): An ecological distribution conflict

- Ecological Economics---2010---Federico Demaria

More than 80% of international trade in goods by volume is carried by sea. The shipping industry constitutes a key element in the infrastructure of the world's social metabolism. Ocean-going ships are owned and used for their trade by developed countries but are often demolished, together with their toxic materials, in developing countries. Ship breaking is the process of dismantling an obsolete vessel's structure for scrapping or disposal. The Alang-Sosiya yard (India), one of the world largest shipbreaking yards, is studied here with particular attention to toxic waste management. Ship owners and ship breakers obtain large profits dumping the environmental costs on workers, local farmers and fishers. This unequal distribution of benefits and burdens, due to an international and national uneven distribution of power, has led to an ecological distribution conflict. The controversy at the Indian Supreme Court in 2006 over the dismantling of the ocean liner 'Blue

Lady,' shows how the different languages of valuation expressed by different social groups clashed and how a language that expresses sustainability as monetary benefit at the national scale, dominated. Shipbreaking in the developing world is not just an externality but a successful case of cost shifting, or else, profit accumulation by contamination.

Conceptualising environmental responsibility

- Ecological Economics---2010---Manfred Lenzen,Joy Murray

Downstream responsibility is rarely addressed in the academic literature and in corporate sustainability reporting. We conceptualise downstream responsibility for the example of carbon emissions, by establishing a terminology as well as a framework for quantifying downstream carbon footprints. By extracting emissions-intensive sales chains for a number of Australian industry sectors, and comparing these to emissions-intensive supply chains, we demonstrated the ability of input-output analysis to quantify emissions responsibility in both directions. We extend the definition of downstream responsibility beyond the product use and disposal phases, to include what we call "enabled" emissions. This term implies that whatever is sold downstream enables our customers to operate and emit, irrespective of whether it is our product that is combusted, or that directly combusts fuels, or not. Our structural path analyses and threshold-capture relationships reveal stark differences between industries with regard to the data collection efforts necessary to achieve a reasonably complete footprint assessment. Industries appear to have their own specific carbon footprint profiles, and one cannot design generic relevance tests that tell which data to collect. Moreover we conclude that current completeness standards in carbon reporting cannot be satisfied using relevance thresholds. Input-output analysis and structural path analysis are excellent tools that can help companies undertake screening exercises, which in turn help prioritising and streamlining the collection of data needed to establish a corporate downstream carbon footprint. Compared to conventional manual approaches, hybrid

life-cycle assessments assisted by input-output analysis and structural path analysis achieve more complete results, with substantially less staff, money and time.

The modest environmental relief resulting from the transition to a service economy

- Ecological Economics---2010---Sofia Henriques,Astrid Kander

A service transition is supposed to lead to the decline of energy intensity (energy/GDP). We argue that this interpretation is overly optimistic because the shift to a service economy is somewhat of an illusion in terms of real production. Several recent studies of structural effects on energy intensity have made the error of using sector shares in current prices, combined with GDP in constant prices, which is inconsistent and ignores the different behaviour of prices across sectors. We use the more correct method of sector shares in constant prices, and make an attempt to single out the effect from the real service transition by using two complementary methods: shift share analyses in current and constant prices, and Logarithmic Mean Divisia Index (LMDI) for 10 developed and 3 emerging economies. A service transition is rather modest in real terms. The major driver of the decline in energy intensity rests within the manufacturing sector. Meanwhile, the transition to a service sector had a small downward impact on energy intensity in 7 of the developed countries (and no impact in the others). For emerging economies like Brazil, Mexico and India, it is the residential sector that drives energy intensity down because of the declining share of this sector as the formal economy grows, and as a consequence of switching to more efficient fuels.

Boundary organizations for sustainable land management: The example of Dutch Environmental Co-operatives

- Ecological Economics---2010---Jeremy Franks

This paper uses Boundary Organization Theory (BOT) to examine the proposition that Dutch Environmental Co-operatives (ECs) conform to the characteristics of

boundary organizations (BOs). Many conservationists believe BO-type institutions are essential for addressing eco-system management problems, but believe there are currently too few examples of BOs working across sustainability issues. It is concluded that ECs have organizational structures and work practices typical of BOs: they allow people on different sides of the land management for food and nature conservation boundary (land managers, conservationists, scientists and policy makers) to negotiate to transform agri-environmental schemes into boundary objects and scheme options into implementable standardized packages. This is achieved by adopting convening, translation, collaboration and mediation functions that create extended peer communities able to contribute important knowledge of eco-system management, whilst allowing each participate to remain within their respective professional boundaries and responsible to their different constituencies. As an example of BOs, ECs are a post-normal sustainability technology (PNST) that offers "clumsy" solutions to the "wicked" problem of eco-system management. BOs work in many fields across the globe, showing their underling organizational principals and working practices are not restricted to any particular issue or geographical monopoly. As such, ECs - adjusted to suit local priorities and circumstances - could be the basis of a more widely used sustainability-led governance unit most particularly where cultural practices favour collective and collaborative behaviour.

Is all space created equal? Uncovering the relationship between competing land uses in subdivisions

- Ecological Economics---2010---Joshua K. Abbott, Henry Klaiber

Evaluating the importance of different forms of open space to households requires an evaluation of the service flows provided by each type of open space. For many non-market goods, these flows occur over multiple spatial scales and require analysis that simultaneously accounts for capitalization at each scale. To meet this often overlooked need, we apply a newly developed extension to the Hausman-Taylor model that

treats multiple housing transactions occurring in a spatial location as a panel. This methodology allows us to account for omitted variables within a subdivision while instrumenting for variables identified through differences between subdivisions. We measure capitalization of open space at three distinct spatial extents: adjacency, walkability, and subdivision-wide. We find that the interactions between subdivision open space and private open space in the form of lot size change from complementarity at small scales to substitutability at large scales. These results confirm much of the intuition developed by ecologists and public planners on the likely service flows associated with open space and show how our approach to accounting for multiple spatial scales of capitalization in the evaluation of non-market goods could be beneficial to other areas of applied research.

Conjoint effect of environmental labeling, disclosure of forest of origin and price on consumer preferences for wood products in the US and UK

- Ecological Economics---2010---Francisco X. Aguilar, Zhen Cai

A study that conjointly analyzed the effects of environmental labeling, disclosure of forest of origin, and price on consumer preferences for wood products was conducted in the US and the UK. A choice-based elicitation tool was used to mimic a real-life situation where a single product was selected over a set of options. Data collected were analyzed using a conditional logit model. Certification issued by a government agency or an environmental non-government organization both had a favorable effect on consumer preference over a non-certified option. The most relevant implication of our findings was the negative effect that disclosing information about a product coming from tropical forests had on consumer preferences, even compared to a product of unknown origin. A decline in product preference was observed along higher price premiums as expected. The degree of sensitivity to price changes was affected by demographic characteristics. Model coefficients were used to estimate market shares of trop-

ical wood products under different scenarios in both countries. Scenarios explored the effect of environmental certification and price premiums on product market shares.

The social development effects of primary commodity export dependence

- Ecological Economics---2010---Fabrizio Carmignani, Desire Avom

On the question of whether natural resources are a curse for growth, the jury is still out. While waiting for a decision, we study whether resource intensity has any effect on social development over and above the effect it might have on income or growth. We measure social development by a combination of health and education outcomes and resource intensity by the share of primary commodities in total merchandise exports. We find that, after controlling for per-capita income and other macroeconomic and institutional factors, a higher dependence on primary commodity exports is negative for social development. The transmission mechanism seems to operate via income inequality and macroeconomic volatility.

Climate change in a public goods game: Investment decision in mitigation versus adaptation

- Ecological Economics---2010---Reviva Hasson, Åsa Löfgren, Martine Visser

We use behavioral and experimental economics to study a particular aspect of the economics of climate change: the potential trade-off between countries' investments in mitigation versus adaptation. While mitigation of greenhouse gases can be viewed as a public good, adaptation to climate change is a private good, benefiting only the country or the individual that invests in adaptation. We use a one-shot public-goods game that deviates from the standard public-goods game by introducing a stochastic term to account for probabilistic destruction in a climate-change setting, where the probability density function is mapped to within-group levels of mitigation. We compare low-vulnerability and

high-vulnerability treatments by varying the magnitude of disaster across treatments. Our results show that there is no significant difference in the level of mitigation across these treatments. Further, our results emphasize the role of trust in enhancing cooperation.

The drawbacks and opportunities of carbon charges in metropolitan areas -- A spatial general equilibrium approach

- Ecological Economics---2010---Stefan Tscharschew, Georg Hirte

In cities there is a variety of economic and spatial forces that may influence to what extent a travel-related CO₂ emission pricing can be an effective instrument to contribute to the achievement of CO₂ reduction goals. Therefore, we examine the effectiveness and impact of CO₂ emission charges using a spatial general equilibrium model of an urban economy, calibrated according to an average German city. Our analyses suggest that the imposition of a Pigouvian type CO₂ emission charge on urban passenger travel may be able to reduce emissions by about 1%-11%, depending on the estimated social damage cost of carbon dioxide. Such a policy increases urban welfare mainly on account of a reduction of congestion costs. However, pricing congestion directly not only provides higher urban welfare but also higher emission reductions. Pricing congestion and CO₂ emissions simultaneously allows to achieve a wide range of emission reduction goals. If, however, the reduction goal is very ambitious the emission charge must be raised to higher levels. Then, distortions in the urban markets and in spatial travel decisions lower labor supply and thus urban production, income of city residents, federal tax revenue, income of landowners outside the city, all together implying losses in welfare.

Ecuador's Yasuní-ITT Initiative: The old and new values of petroleum

- Ecological Economics---2010---Laura Rival

This article examines the financial mechanism, currently known as the Yasuní-ITT Initiative, by which

Ecuador would be compensated for not exploiting the reserves of heavy crude lying underneath the Yasuní National Park, a Biosphere Reserve for Humanity located in the Amazon Region. An analysis of the ways in which the proposal is being debated is offered to illustrate the unique problems posed by the incorporation of natural capital in economic decisions. A focus on the creative measurements and calculations offered by a range of social actors highlights the relevance of morally framed evaluations in defining the future economic use of the park. I show how an anthropological perspective may complement ecological economics and various political and economic approaches to development policy, and enrich our understanding of the specific challenges posed by the design of economic instruments for the protection of ecological wealth in Latin American countries poor in financial capital, but rich in biological diversity.

Determinants of protest responses in environmental valuation: A meta-study

- Ecological Economics---2010---Jürgen Meyerhoff,Ulf Liebe

Certain design characteristics of stated preference surveys are often linked to protest responses. The dichotomous choice format, for example, is said to result in fewer protest responses. However, not much is known at present about the relationship between survey characteristics and the level of protesting. Only partial analysis comparing, for instance, the influence of different payment vehicles on protesting, has been conducted to date. This paper analyses the determinants of protest responses using 254 samples derived from 157 environmental valuation studies. Determinants include the elicitation format, the payment vehicle, the survey method, and the geographical origin. Results of bivariate and multivariate analyses confirm some of the propositions presented in the literature such as a higher number of protesters when entrance fees are used as a payment vehicle. However, many of the characteristics included in the analysis do not significantly impact protesting. Another result is that reporting on identification and treatment of protest responses in

subsequent analysis is inadequate in the majority of studies and would benefit from some standardisation.

An entrepreneurial model of economic and environmental co-evolution

- Ecological Economics---2010---Jason Potts,John Foster,Anna Straton

A basic tenet of ecological economics is that economic growth and development are ultimately constrained by environmental carrying capacities. It is from this basis that notions of a sustainable economy and of sustainable economic development emerge to undergird the "standard model" of ecological economics. However, the belief in "hard" environmental constraints may be obscuring the important role of the entrepreneur in the co-evolution of economic and environmental relations, and hence limiting or distorting the analytic focus of ecological economics and the range of policy options that are considered for sustainable economic development. This paper outlines a co-evolutionary model of the dynamics of economic and ecological systems as connected by entrepreneurial behaviour. We then discuss some of the key analytic and policy implications.

Realising the 'wellbeing dividend': An exploratory study using the Human Scale Development approach

- Ecological Economics---2010---Monica Guillen-Royo

Despite claims about the existence of the 'wellbeing dividend', that sustainable and reduced consumption is compatible with increased wellbeing, there is little evidence that this dividend is being realised. The present research illustrates how through workshops addressing the cultural, economic, political and personal factors that impede or promote human need satisfaction, a given society can unravel its own pathway towards sustainability and wellbeing. This study draws on the wellbeing literature, particularly Max-Neef's approach to human needs and satisfiers. It uses an analysis

of group discussions in Lleida, a medium-sized Catalan city, to show how unsustainable consumption is associated with local hurdles for actualising needs and how sustainable consumption is linked to local descriptions of the utopian, need-actualising society. The manner of progressing towards need actualisation and sustainability is also addressed by participants; who identify the changes in norms, institutions and personal identity that need to be in place. The analysis reveals the interrelatedness of satisfiers and argues for a systemic perspective to address social transition towards sustainability and wellbeing at the local level.

The effect of an aquatic invasive species (Eurasian watermilfoil) on lakefront property values

- Ecological Economics---2010---Congwen Zhang, Kevin Boyle

Invasive species are one of the major threats to ecosystems. One of these "invaders", Eurasian watermilfoil, can crowd out important native aquatic plants, decrease habitat and diversity of native species in a lake, and interfere with water-based recreation. This study uses a hedonic property-value method to estimate the effect of Eurasian watermilfoil on lakefront property values at selected Vermont lakes. Results indicate that as the primary component of total aquatic macrophyte growth in a lake Eurasian watermilfoil significantly and substantially affects lakefront property values. As Eurasian watermilfoil infests a lake, adding to the total macrophyte growth, property values can diminish by

Performance payments: A new strategy to conserve large carnivores in the tropics?

- Ecological Economics---2010---Astrid Zabel, Stefanie Engel

Biodiversity, including wildlife, is globally decreasing at alarming rates. This development has evoked calls for innovative conservation policies. In the present paper we explore the novel conservation performance payment approach which for wildlife-livestock conflicts, so

far, has only been implemented in Sweden. The contribution of the paper is twofold. A structural framework of performance payments' design is developed and an empirical assessment of the approach to tiger-livestock conflicts at Bandhavgarh National Park in India, an example where conservation needs compete with humans' increasing demand for land and resources, is presented. The framework focuses on issues of scheme design such as identifying performance indicators, targeting, payment amount and timing, considerations on making payments to groups vs. individuals, scheme duration, and inadvertent side effects. The assessment of the applicability of the performance payment approach to tiger (*Panthera tigris*) conservation is based on a high-profile policy workshop, an interview with the park management, and 305 household-level interviews conducted in 20 villages in the buffer zone of the park.

Valuing the non-use benefits of marine conservation zones: An application to the UK Marine Bill

- Ecological Economics---2010---Alistair McVittie, Dominic Moran

This paper presents the results of a stated preference choice experiment designed to estimate the non-market benefits derived by UK residents from the conservation of ecosystem goods and services resulting from implementation of proposed Marine Conservation Zones under the UK Marine and Coastal Access Bill (2008). The results inform an impact assessment that compares benefits to projected policy costs. As demonstrated in a paper by Hussain et al (2010) ex ante benefit estimation is complicated by the scientific uncertainty and data gaps that hinder the development of a bottom-up valuation of the ecosystem goods and services provisioned by the policy. A choice experiment approach provides an alternative top-down valuation by approximating policy outcomes, which are spatially remote from beneficiaries and therefore arguably only appreciated passively or in terms of non-use or existence value for broadly defined attributes of the policy. The choice experiment shows preferences for both halting the loss of or increasing marine biodiversity, and the

provision of other environmental services relative to current trajectories of decline. Survey respondents were indifferent to the levels of restrictions on activities needed to achieve these outcomes. As a top-down estimate of policy benefits, the study suggests that welfare improvements from the Marine Bill significantly outweigh projected regulatory costs.

From constraint to sufficiency: The decoupling of energy and carbon from human needs, 1975-2005

- Ecological Economics---2010---Julia K. Steinberger,J. Timmons Roberts

We investigate the relationship between human needs, energy consumption and carbon emissions for several indicators of human development: life expectancy, literacy, income and the Human Development Index. We find that high human development can be achieved at moderate energy and carbon levels; increasing energy and carbon past this level does not necessarily contribute to higher living standards. By conducting a novel longitudinal analysis from 1975 to 2005, we observe a previously undetected decoupling of the per capita energy and carbon required for human needs. If resources were equally distributed, current energy and carbon levels would be more than sufficient to satisfy global human needs at high levels of human development. By projecting current trends to 2030, we demonstrate that the global energy consumption and carbon emissions required to satisfy human needs will decrease with time, despite growth in population.

Does urbanization lead to less energy use and lower CO2 emissions? A cross-country analysis

- Ecological Economics---2010---Phetkeo Poumanyvong,Shinji Kaneko

Despite the relationship between urbanization, energy use and CO2 emissions has been extensively studied in recent years, little attention has been paid to differences in development stages or income levels. Most previous studies have implicitly assumed that the impact of urbanization is homogenous for all countries.

This assumption can be questionable as there are many characteristic differences among countries of different levels of affluence. This paper investigates empirically the effects of urbanization on energy use and CO2 emissions with consideration of the different development stages. Using the Stochastic Impacts by Regression on Population, Affluence and Technology (STIRPAT) model and a balanced panel dataset of 99 countries over the period 1975-2005, the findings suggest that the impact of urbanization on energy use and emissions varies across the stages of development. Surprisingly, urbanization decreases energy use in the low-income group, while it increases energy use in the middle- and high-income groups. The impact of urbanization on emissions is positive for all the income groups, but it is more pronounced in the middle-income group than in the other income groups. These novel findings not only help advance the existing literature, but also can be of special interest to policy makers and urban planners.

The pharmaceutical value of marine biodiversity for anti-cancer drug discovery

- Ecological Economics---2010---Patrick M. Erwin,Susanna López-Legentil,Peter W. Schuhmann

Marine biodiversity is a resource of enormous importance to human societies that provides critical ecosystem services. Economic valuation of some services has been utilized to promote conservation initiatives by revealing a tangible and causative link between biodiversity declines and economic losses. Other ecosystem services have eluded valuation, including the value of the sea as a repository of novel pharmaceuticals. Here, we provide the first global estimate of the number, source and market value of undiscovered oncology drugs based on empirical data, industry statistics and conservative modelling assumptions. We report US\$563 billion-5.69 trillion attributable to anti-cancer drugs of marine origin pending discovery, revealing a new and substantial at-risk ecosystem service value. Our model predicted 253,120-594,232 novel chemicals in marine organisms; 90.4-92.6% of these compounds remain undiscovered. A total of 55 to 214 new anti-cancer drugs were predicted to reach the market sourced primar-

ily from animal phyla (Chordata, Mollusca, Porifera, and Byrozoa) and microbial phyla (Proteobacteria and Cyanobacteria). While no single aspect of extractive marine resource value should be relied upon to account for the opportunity costs of conservation initiatives, the application of valuation models to ecosystem services further reveals the true, irreversible economic cost of habitat degradation and biodiversity declines.

Willingness to pay, attitudes and fundamental values -- On the cognitive context of public preferences for diversity in agricultural landscapes

- Ecological Economics---2010---Uta Sauer,Anke Fischer

Our study set out to investigate if and how willingness to pay -- both hypothetical and actual -- might reflect individuals' wider cognitive networks. We draw on the idea of cognitive hierarchies, i.e., the notion that concrete preferences and attitudes are embedded in networks of more abstract beliefs and values, and explore if willingness to pay (WTP) as expressed through contingent valuation can be understood as part of such hierarchies. To this end, we elicited stated and actual WTP in a survey of public preferences and attitudes towards the establishment of an agri-environmental payment scheme in Northeim, Germany, that rewards farmers for the provision of riparian buffer strips. Two main findings emerged from the study. First, only a very small proportion of those stating positive WTP did actually transfer the money. Second, contrary to our hypotheses, results from a Structural Equation Model suggest that stated WTP was only poorly connected to attitudes towards the payment scheme and other potentially relevant, more abstract beliefs and values. This casts doubts on the meaningfulness of such statements. Of the ten different fundamental value types included, only universalism and conformity played a significant role in the cognitive hierarchy and informed generalised environmental beliefs as well as attitudes towards the payment scheme. As attitudes seemed to be better integrated in the cognitive network than WTP, we discuss if surveys of public preferences

should rely on attitude statements rather than solely on monetary values.

Input-output analysis of CO2 emissions embodied in trade: The effects of spatial aggregation

- Ecological Economics---2010---Bin Su,B.W. Ang

Energy-related CO2 emissions embodied in international trade have been widely studied by researchers using the environmental input-output analysis framework. It is well known that both sector aggregation and spatial aggregation affect the results obtained in such studies. With regard to the latter, past studies are often conducted at the national level irrespective of country or economy size. For a large economy with the needed data, studies may be conducted at different levels of spatial aggregation. We examine this problem analytically by extending the work of Su et al. ([Su, B., Huang, H.C., Ang, B.W., Zhou, P., 2010. Input-output analysis of CO2 emissions embodied in trade: The effects of sector aggregation. *Energy Economics* 32 (1), 166-175.]) on sector aggregation. We present a numerical example using the data of China and by dividing the country into eight regions. It is found that the results are highly dependent on spatial aggregation. Our study shows that for a large country like China it is meaningful to look into the effect of spatial aggregation.

Cultural bias in contingent valuation of copper mining in the Commonwealth of Dominica

- Ecological Economics---2010---Carlisle A. Pemberton,Emaline Harris-Charles,Hazel Patterson-Andrews

Cultural bias in contingent valuation exists if groups within a population have a cultural predisposition toward answering "no" or "yes" to questions which causes the population estimate of the WTP to be underestimated or overestimated. This study estimated cultural bias through the valuation of environmental resources threatened by copper mining on the island of Dominica. The results rejected the null hypotheses of identical

social characteristics and similar answers to binary response questions by the four social groups. The Caribs answered "no" significantly more than other Dominicans. The mean WTP of the Caribs was below 0.16 of the values for the other groups. However, for the Caribs, their WTP as a percentage of their annual income was more than twice that of visitors, suggesting income was not a factor affecting the WTP. Population WTP, as the aggregate of separate group estimates of the WTP was equal to EC\$152.40 million. However, population WTP estimated from a single sample from the whole population was EC\$110.15 million. Thus, the cultural bias was estimated at EC\$-41.64 million, reducing the population WTP by 27.33%. Care is therefore needed in sampling social groups and estimating population WTP in contingent valuation studies, especially in developing countries.

Integrated regulation of nonpoint pollution: Combining managerial controls and economic instruments under multiple environmental targets

- Ecological Economics---2010---Ashar Aftab,Nick Hanley,Giovanni Baiocchi

Regulators are often reluctant to rely solely on economic incentives to achieve environmental standards. We evaluate a "mixed approach" of economic instruments and management standards when two environmental objectives need to be met simultaneously: minimum river flow rates and reductions in nitrate pollution. We show how the relative efficiency of such mixed approaches can depend on exogenous factors, in this case weather conditions. Results indicate that mixed instruments outperform stand alone economic incentives or managerial controls under wet weather conditions, but not in 'average' years. However, the relative cost-effectiveness of mixed approaches increases considerably at higher levels of environmental standard compliance.

The impact of discounting emission credits on the competitiveness of different CDM host countries

- Ecological Economics---2010---Paula Castro,Axel Michaelowa

Discounting the value of emission credits has been proposed as a possible approach for addressing some of the shortcomings of the Clean Development Mechanism (CDM). It could be used to compensate for non-additional CDM projects; to increase the incentive for advanced developing countries to move from the CDM to own mitigation commitments; and to improve the competitiveness of less developed countries as hosts for CDM projects. We assess the impact of discounting on the distribution of CDM projects in host countries, with a special focus on Least Developed Countries (LDCs). CDM-specific abatement cost curves are built for 4 regions: China, India, other advanced Asian countries and LDCs. Abatement costs are estimated using the information provided in the project documentation of 108 projects from 17 subtypes in 16 host countries. Abatement potentials are derived from the current CDM pipeline for each region. For LDCs, we additionally include an optimistic potential estimation by adding to the current pipeline the potential found by a World Bank study for LDCs in Sub-Saharan Africa. We then assess the effect of two emission credit discounting schemes on these abatement cost curves. Credit discounting is differentiated by host countries, based on an index composed of per capita GDP and per capita emissions. In the first scheme, it only affects the most advanced CDM host countries; in the second one it also affects China. We find that discounting has an impact on the competitiveness of individual CDM host countries in the carbon market, as it affects their abatement cost curves. It could become an instrument for incentivising advanced developing countries to leave the CDM and engage in other farther-reaching climate-related commitments, as a result of the resulting emission credit cost increases. However, even with discounting, LDCs remain unimportant in terms of abatement potential if the financial, technical and institutional barriers to CDM

development in these countries are not overcome.

A quantitative minimax regret approach to climate change: Does discounting still matter?

- Ecological Economics---2010---Andries F. Hof, Detlef P. van Vuuren, Michel G.J. den Elzen

Using cost-benefit analysis to determine an optimal climate mitigation target is criticised, especially because i) it fails to sufficiently take into account low-probability, high-impact events, and ii) results strongly depend on the discount rate used. One of the alternative suggestions to inform policymakers about the right mitigation target that does take the risks associated with low-probability, high-impact events explicitly into account is the minimax regret criterion. We apply the minimax regret criterion quantitatively using an integrated assessment model with extreme values for climate sensitivity, damage estimates and mitigation costs. The goal is to analyse whether such a method leads to different results compared to standard cost-benefit analysis and whether the results are still sensitive to the discount rate used. We find that the minimax regret approach leads to more stringent and robust climate targets for relatively low discount rates and if both a high climate sensitivity and high damage estimates are assumed. If one of these assumptions does not hold, the difference between the minimax regret approach and standard cost-benefit analysis is much smaller. Therefore, we conclude that the discount rate used can still be of vital importance even when applying a minimax regret approach.

Does environmental performance affect financial performance? A meta-analysis

- Ecological Economics---2010---Eva Horváthová

What do we know about the impact of environmental regulations/performance on firm performance? After more than three decades of theoretical as well as empirical research, the results seem to remain inconclusive. Some papers suggest that regulations harm firms, while others claim that regulations may contribute positively and give an impetus to innovations. Therefore,

I examine the heterogeneity in financial-environmental performance nexus, empirically carrying out a meta-regression analysis of 64 outcomes from 37 empirical studies to uncover the underlying factors, which can influence the observed variation in the empirical results. The results suggest both that the empirical method used matters for the nexus and that the likelihood of finding a negative link between environmental and financial performance significantly increases when using simple correlation coefficients instead of more advanced econometric analysis. The results also indicate that the portfolio studies tend to report a negative link between environmental and financial performance. This likely reflects the omitted factors in portfolio studies. The positive link is found more frequently in common law countries than in civil law countries. The results also point to the importance of appropriate time coverage to establish a positive link between environmental and financial performance.

Identifying important characteristics of municipal carbon footprints

- Ecological Economics---2010---Hogne N. Larsen, Edgar G. Hertwich

Local climate action has been identified as a vital contributor to global mitigation of greenhouse gas (GHG) emissions. This paper focuses on the GHG emissions resulting from the provision of local public services, illustrated through the Carbon Footprint (CF) indicator. The CF of all 429 Norwegian municipalities is calculated and compared to variables of interest. Results show that the CF changes significantly depending on size and wealth. Small and/or wealthy municipalities tend to have a much higher CF per capita compared to more populated and/or less wealthy cities. While wealth and CF relate very well linearly, increased population is only beneficial up to a certain size. Results indicate that the CF per capita increases in municipalities with more than ~50,000 inhabitants, thus indicating a possible ideal size of municipalities to achieve the optimal municipal CF.

Separate or mixed production of timber, livestock and biodiversity in the Caspian Forest

- Ecological Economics---2010---Frederik A.W. Noack, Michael Manthey, Jack H. Ruitenbeek, M.R. Marvie Mohadjer

The temperate deciduous forest on the northern slopes of the Alborz Mountains has a high biological diversity and many endemic species. Huge areas are still old-growth forest but logging and grazing have degraded large parts of the forest. These degraded areas have low timber and forage yields and a species composition that differs from its natural state. In this study we present an analytical and a numerical solution to the forest management problem by optimizing the benefits of livestock production, timber harvest and biodiversity conservation. We focus on the ecological interactions rather than on administrative restrictions. Our findings are based both, on theoretical considerations and field investigations of ecological and economic parameters in Azerbaijan and Iran. The results of the numerical optimization suggest that it is optimal to separate timber and livestock production if biodiversity is not valued. Livestock rearing is preferable at high discount rates whereas timber production becomes more profitable at low discount rates. If the valuation of diversity exceeds a certain threshold a combination of timber production and livestock rearing is socially optimal since it yields a high biological diversity.

Decomposing the change of CO₂ emissions in China: A distance function approach

- Ecological Economics---2010---Man Li

This paper examines the sources of change in carbon dioxide (CO₂) emissions. It evaluates the relative contributions of the sources to emission abatement using a new empirical approach. The method uses the data envelopment analysis (DEA) technique to decompose emission change into seven components based on the Shephard output distance function. It allows for cross-sectional analysis under flexible data requirement. The method accounts for factors that increase CO₂ emissions, as well as decrease them. With

the application of decomposing change in China's CO₂ emissions at the provincial level between the years 1991 and 2006, the study finds that 1) GDP scale effect accounts for the majority of emission increments; 2) the emission index associated with capital is a dominant contributor to emission abatement; and 3) the effects of technical change in production and change in the GDP composition by sector play positive roles in shrinking emissions.

A spatial-dynamic value transfer model of economic losses from a biological invasion

- Ecological Economics---2010---Thomas P. Holmes, Andrew M. Liebhold, Kent Kovacs, Betsy Von Holle

Rigorous assessments of the economic impacts of introduced species at broad spatial scales are required to provide credible information to policy makers. We propose that economic models of aggregate damages induced by biological invasions need to link microeconomic analyses of site-specific economic damages with spatial-dynamic models of value change associated with invasion spread across the macro-scale landscape. Recognizing that economic impacts of biological invasions occur where biological processes intersect the economic landscape, we define the area of economic damage (AED) as the sum of all areas on the physical landscape that sustain economic damage from a biological invasion. By subsuming fine-scale spatial dynamics in the AED measure, temporal dynamics of the AED can be estimated from an empirical distribution of the AED effective range radius over time. This methodology is illustrated using the case of a non-native forest pest, the hemlock woolly adelgid (HWA; *Adelges tsugae*). Geographic Information Systems and spatially referenced data provide the basis for statistical estimation of a spatial-dynamic value transfer model which indicates that HWA is annually causing millions of dollars of economic losses for residential property owners in the eastern United States.

Weak and strong sustainability assessment in fisheries

- Ecological Economics---2010---E. Garmendia,R. Prellezo,A. Murillas,Marta Escapa,M. Carmen Gallastegui

The present paper analyzes the suitability of weak and strong sustainability assessment in the context of fisheries management. This topic is a mainstream issue in the field of ecological economics, but its application to fisheries is rather unexplored, even though fisheries have been the focus of many pioneering studies related to natural resource management. An overview of the current debate in the topic together with an application of a multi-disciplinary technique designed to assess fisheries sustainability (Rapfish) allows the closing of this gap. This is achieved by looking to the potential trade-offs among the multiple dimensions of fisheries sustainability and by analyzing the role of critical thresholds in such an assessment. The study of the Basque trawl fisheries operating in the North East Atlantic in the period 1996-2005 shows that the utility of weak sustainability is limited to the comparison of sustainability between fisheries. In contrast it is found that it is the strong sustainability concept together with the definition of critical thresholds that provides management with the tools for improved management and policy within a fishery.

Economic values of species management options in human-wildlife conflicts: Hen Harriers in Scotland

- Ecological Economics---2010---Nick Hanley,Mikolaj Czajkowski,Rose Hanley-Nickolls,Steve Redpath

In this paper, we use the choice experiment method to investigate public preferences over alternative management regimes for a top-level predator in UK moorlands, the Hen Harrier. These birds are at the centre of a conflict between moorland managers and conservation organisations. Illegal killing of Hen Harriers on moorland managed for Red Grouse is considered to be one of the main factors limiting harrier population growth

in the UK. Incentives for persecution arise due to the impacts of Hen Harriers on populations of Red Grouse, which are managed for commercial shooting. Numerous alternatives have been proposed to manage this system. We considered three which have emerged from stakeholder debates and scientific enquiry: tougher law enforcement, moving "excess" birds from grouse moors, and feeding of harriers. Results showed that respondents, sampled from the Scottish general public, were willing to pay both for avoiding reductions in harrier populations and for increases, but that these values were lower than those associated with equivalent changes for another raptor sharing the same moorland habitat, the Golden Eagle. Respondents valued a move away from current management, but were largely indifferent to which management option was taken up, suggesting that management options should be selected in terms of relative costs, and on who bears these costs. Differences within our sample of respondents in preferences across management options emerge when a latent class model is estimated.

A common weight MCDA-DEA approach to construct composite indicators

- Ecological Economics---2010---S.M. Hatefi,S.A. Torabi

A common weight multi criteria decision analysis (MCDA)-data envelopment analysis (DEA) approach is proposed to construct composite indicators (CIs). The proposed MCDA-DEA model enables the construction of CIs among all entities via a set of common weights. The model is capable to discriminate entities which receive CI score of 1, i.e., the efficient entities leading to determination of a single best entity. Common weights structure of the proposed model has more discriminating power when compared to those obtained by previous DEA-like models. In order to validate the proposed MCDA-DEA model, it is applied to two case studies taken from the literature to construct two well-known CIs, i.e., Sustainable Energy Index (SEI) and Human Development Index (HDI). Both the robustness and discriminating power of the proposed method are studied through these case studies and

tested by Spearman's rank correlation coefficient. The results reveal several merits of the proposed method in constructing CIs.

Markets, pooling and insurance for managing bycatch in fisheries

- Ecological Economics---2010---D.S. Holland

Bycatch is a nearly universal problem for fisheries, and it is increasingly common to place strict limits on allowable bycatch either on individuals or an industry sector. Individual bycatch quotas strengthen individual incentives to avoid bycatch and may reduce the likelihood that the bycatch cap will limit target species catch. However, in cases where bycatch is highly uncertain and variable, individual quotas and markets may be subject to high price variability and may fail to allocate quota efficiently. In some cases such as sea turtles, marine mammals, rare seabird and certain fish species, the allowable take may be less than one per permit holder. There are a number of reasons to believe that a transferable quota market may not function effectively in these cases. I explore the implications of stochasticity and uncertainty of bycatch for valuing quota in an individual bycatch quota system. I explore the degree to which a quota market increases expected profit and reduces individual risk relative to simply having a non-transferable individual bycatch quota, and how pooling approaches and possibly market insurance can be used to reduce financial risk for fishermen associated with uncertain bycatch.

Paul G. Harris, World Ethics and Climate Change: From International to Global Justice, Edinburgh University Press (2010) ISBN 978-0-7486-3910-6 (paperback), x + 214 pages

- Ecological Economics---2010---Carlos Amador-Bedolla

2010

The Sustainable Value approach: A clarifying and constructive comment

- Ecological Economics---2010---Frederic Ang, Steven Van Passel

Recently, the original benchmarking methodology of the Sustainable Value approach became subjected to serious debate. While Kuosmanen and Kuosmanen (2009b) critically question its validity introducing productive efficiency theory, Figge and Hahn (2009) put forward that the implementation of productive efficiency theory severely conflicts with the original financial economics perspective of the Sustainable Value approach. We argue that the debate is very confusing because the original Sustainable Value approach presents two largely incompatible objectives. Nevertheless, we maintain that both ways of benchmarking could provide useful and moreover complementary insights. If one intends to present the overall resource efficiency of the firm from the investor's viewpoint, we recommend the original benchmarking methodology. If one on the other hand aspires to create a prescriptive tool setting up some sort of reallocation scheme, we advocate implementation of the productive efficiency theory. Although the discussion on benchmark application is certainly substantial, we should avoid the debate to become accordingly narrowed. Next to the benchmark concern, we see several other challenges considering the development of the Sustainable Value approach: (1) a more systematic resource selection, (2) the inclusion of the value chain and (3) additional analyses related to policy in order to increase interpretative power.

Species-specific spatial characteristics in reserve site selection

- Ecological Economics---2010---Rolf Groeneveld

This paper addresses the problem of selecting reserve sites cost-effectively, taking into account the mobility and habitat area requirements of each species. Many reserve site selection problems are analyzed in mixed-integer linear programming (MILP) models due to the mathematical solvers available for this model type.

Ideally, such reserve site selection models take into consideration the possibility that species use reserve sites, even small ones, as stepping stones to move from one site to another. This consideration, however, is difficult to include in MILP models. This paper demonstrates and evaluates three alternative MILP models that include species' mobility and habitat area requirements. All models include the possible stepping stone function of reserve sites to some extent, although none does so perfectly. The models demonstrated find spatial reserve networks at lower costs than a non-spatial reserve site selection model.

Recreational shellfish harvesting and health risks: A pseudo-panel approach combining revealed and stated preference data with correction for on-site sampling

- Ecological Economics---2010---Olivier Beaumais, Gildas Appéré

This paper assesses the value of health risks related to recreational shellfish harvesting. Combining revealed and stated preferences data from an on-site survey and using a pseudo-panel approach shows that people significantly value health risks. The combination of stated and revealed preferences data is realised through the introduction of the concept of a "hypothetical twin site". Addressing on-site sampling issues within the framework of a random-effect Poisson gamma model allows a derivation of more accurate estimates of welfare measures. Results also suggest that the demand for recreational shellfish harvesting is an inferior good.

Towards an improved understanding of farmers' behaviour: The integrative agent-centred (IAC) framework

- Ecological Economics---2010---Giuseppe Feola, Claudia R. Binder

An effective approach to research on farmers' behaviour is based on: i) an explicit and well-motivated behavioural theory; ii) an integrative approach; and iii) understanding feedback processes and dynamics. While current approaches may effectively tackle some of them,

they often fail to combine them together. The paper presents the integrative agent-centred (IAC) framework, which aims at filling this gap. It functions in accordance with these three pillars and provides a conceptual structure to understand farmers' behaviour in agricultural systems. The IAC framework is agent-centred and supports the understanding of farmers' behavior consistently with the perspective of agricultural systems as complex social-ecological systems. It combines different behavioural drivers, bridges between micro and macro levels, and depicts a potentially varied model of human agency. The use of the framework in practice is illustrated through two studies on pesticide use among smallholders in Colombia. The examples show how the framework can be implemented to derive policy implications to foster a transition towards more sustainable agricultural practices. The paper finally suggests that the framework can support different research designs for the study of agents' behaviour in agricultural and social-ecological systems.

Protecting endangered species: When are shoot-on-sight policies the only viable option to stop poaching?

- Ecological Economics---2010---Kent Messer

Protecting endangered species that offer poachers from low-income countries high economic benefits remains a policy challenge. A broadly applicable economic model of poaching shows why CITES international bans have not always been successful, especially in situations where black markets exist and nonpoaching wages are low. In these situations, poachers may have nothing left to lose, since low nonpoaching wages impose a practical cap on the potential economic costs of fines and imprisonment. Thus, the model suggests "shoot-on-sight" policies as the only viable option. Trends in animal populations appear to support the efficacy of the shoot-on-sight policies, which also suggests an inherent value of life traditionally not captured in Value of a Statistical Life estimates.

The impact of capital trade and technological spillovers on climate policies

- Ecological Economics---2010---Marian Leimbach,Lavinia Baumstark

In this paper, we present an intertemporal optimization model that is designed to analyze climate policy scenarios within a globalized world which is characterized by the existence of technological spillovers. We consider a type of technological spillovers that is bound to bilateral capital trade. Importing foreign capital that increases the efficiency of energy use represents a mitigation option that extends the commonly modeled portfolio. The technical details of the model are presented in this paper. The model is solved numerically. First model applications highlight the differences between climate policy analyses which either take or do not take technological spillovers into account. In the final part, we apply the model to investigate first-mover advantages and commitment incentives in climate policy scenarios. The existence of both is supported by simulation results.

Technology learning in the presence of public R&D: The case of European wind power

- Ecological Economics---2010---Kristina Ek,Patrik Söderholm

The objective of this paper is to analyze the role of technology learning in European wind power generation in the presence of public R&D. A Cobb-Douglas cost function is employed to derive a learning curve model for wind power, thus illustrating how the investment costs for this technology are influenced by global learning-by-doing, scale effects, and a European R&D-based knowledge stock. We assume that public R&D expenses targeting wind power add to the above stock, and these R&D outlays are in turn hypothesized to be influenced by technology cost levels, the opportunity cost of public R&D as well as by government budget constraints. We estimate the learning and the R&D model, respectively, using a panel data set covering five European countries over the time period 1986-2002. The empirical results confirm the importance of both

learning-by-doing and public R&D support in the cost reduction process, and governments' R&D expenses have declined in response to lowered investment costs. This is efficient in the sense that public funds are best targeted at technologies which are far from being commercial. The results also illustrate that governments in Europe have been sensitive to the opportunity cost of public R&D in the energy R&D budget process.

A multivariate analysis of the energy intensity of sprawl versus compact living in the U.S. for 2003

- Ecological Economics---2010---Md. R. Shammin,Robert A. Herendeen,Michelle J. Hanson,Eric J.H. Wilson

We explore the energy intensity of sprawl versus compact living by analyzing the total energy requirements of U.S. households for the year 2003. The methods used are based on previous studies on energy cost of living. Total energy requirement is calculated as a function of individual energy intensities of goods and services derived from economic input-output analysis and expenditures for those goods and services. We use multivariate regression analysis to estimate patterns in household energy intensities. We define sprawl in terms of location in rural areas or in areas with low population size. We find that even though sprawl-related factors account for about 83% of the average household energy consumption, sprawl is only 17-19% more energy intensive than compact living based on how people actually lived. We observe that some of the advantages of reduced direct energy use by people living in high density urban centers are offset by their consumption of other non-energy products. A more detailed analysis reveals that lifestyle choices (household type, number of vehicles, and family size) that could be independent of location play a significant role in determining household energy intensity. We develop two models that offer opportunities for further analysis.

Using an integrated fuzzy set and deliberative multi-criteria evaluation approach to facilitate decision-making in invasive species management

- Ecological Economics---2010---Shuang Liu,Wendy Proctor,David Cook

There are two issues at the core of invasive species risk management: on the one hand, decision-makers struggle to balance environmental goals against other often competing societal goals such as economic benefits and social welfare; on the other hand, uncertainty often prevails in understanding the invasion process and in communicating invasion risks to the stakeholders. In this paper, we describe how an integrated Deliberative Multi-Criteria Evaluation (DMCE) and fuzzy set approach can tackle these two issues in the analysis of alternative risk management strategies, using the example of European House Borer (EHB, *Hylotrupes bajulus* Linnaeus). DMCE offers a platform for stakeholders to interact and to make a trade-off decision between multiple goals based on social learning and deliberation. The fuzzy set approach, applied within a DMCE framework, explicitly incorporates the inherent uncertainty in estimating potential EHB impacts and in evaluating participants' subjective preferences. This integrated method, therefore, provides a promising approach for tackling the dual challenges of competing goals and uncertainty in the evaluation of invasive species risk management options.

To restore or not? A valuation of social and ecological functions of the Marais des Baux wetland in Southern France

- Ecological Economics---2010---Vanja Westberg,Robert Lifran,Søren Olsen

The Marais des Baux wetland in southern France has for centuries been subject to drainage, almost causing its entire disappearance. With an increasing awareness of wetland ecosystem services, the extensive drainage is being questioned today. To guide policy-makers and landowners in their decision-making, we use a Choice Experiment to elicit the preferences of the general

public for potential land use and activity changes in the Marais des Baux. These changes concern wetland restoration, the extent of tree hedges, recreational opportunities, mosquito control and biodiversity. Using a random parameter logit model, we take account of unobserved and observed preference heterogeneity, revealing that demand for a high level of biodiversity is conditional on respondents expressing a high level of environmental concern, and that parenthood raises the WTP for any future management alternative different from the current situation. Further, we find that mosquito control or attachment to the area is essential for support of large-scale wetland restoration. From the perspective of maximising the compensating surplus, the recommendation is to restore the wetland to one third of its original size in conjunction with biological control of mosquitoes, more tree hedgerows and recreational facilities, while increasing efforts to induce higher levels of biodiversity.

Farmers' preferences for crop variety traits: Lessons for on-farm conservation and technology adoption

- Ecological Economics---2010---Sinafikeh Asrat,Mahmud Yesuf,Fredrik Carlsson,Edilegnaw Wale

Although in-situ conservation is increasingly considered an efficient way of conserving plant genetic resources, little is known about the incentives and constraints that govern conservation decisions among small farm holders in developing countries. Using a choice experiment approach, we investigated Ethiopian farmers' crop variety preferences, estimated the mean willingness to pay for each crop variety attribute, and identified household-specific and institutional factors that governed the preferences. We found that environmental adaptability and yield stability are important attributes for farmers' choice of crop varieties. Farmers are willing to forego some extra income or yield to obtain a more stable and environmentally adaptable crop variety. Among other things, household resource endowments (particularly land holdings and livestock ownership), years of farming experience, and contact with extension services are

the major factors causing household heterogeneity of crop variety preferences. Based on our experimental results, we derived important policy implications for on-farm conservation, breeding priority setting, and improved variety adoption in Ethiopia.

Coexistence regulations and agriculture production: A case study of five Bt maize producers in Portugal

- Ecological Economics---2010---Theodoros Skevas,Pedro Fevereiro,Justus Wesseler

In 1998, Genetically Modified (GM) maize entered European Agriculture. After the publication of the European Commission's guidelines on coexistence in 2003, Portugal developed ex-ante regulatory and ex-post tort liability rules on the coexistence of GM and non-GM maize crops. There is an on-going debate on the extent to which the coexistence policies affect adoption. In this study we measure the costs and benefits of planting GM maize as a member of a cooperative. All group members achieved a higher gross margin by planting GM maize rather than non-GM maize on their farms. Group members did not face any ex-post liability costs and had zero ex-ante regulatory costs as they could easily internalize the ex-ante coexistence regulations. The results show that coexistence regulations such as informing neighbors or keeping minimum distances do not necessarily lead to increased production costs provided they are flexible enough.

Study on benefit transfer in an international setting. How to improve welfare estimates in the case of the countries' income heterogeneity?

- Ecological Economics---2010---Mikolaj Czakowski,Milan Ščasný

The paper aims at investigating the validity of benefit transfer in the case of transfers between countries highly heterogeneous in income, and demonstrates relative performance of different benefit transfer methods under these conditions. Lake water quality valuation studies were conducted in two countries in transition -- Poland and the Czech Republic. They reflected two earlier

studies carried out in Norway. We examine how income elasticity of WTP varies with the levels of income and find support for applying the income elasticity of 1 to adjust transferred welfare estimates in case of high differences in income between countries. In addition, we show that using site-specific measures of income outperforms transfers based on GDP per capita. The accuracy of benefit transfer is compared using equivalence testing following the TOSC (two one-sided convolutions) test. A new, more informative way of reporting equivalence is proposed, based on computing minimum tolerance level rather than specifying it a priori.

An economic assessment of the value of tropical river ecosystem services: Heterogeneous preferences among Aboriginal and non-Aboriginal Australians

- Ecological Economics---2010---Kerstin K. Zander,Anna Straton

There is a current debate about development of the river and wetland systems of tropical Australia. Aboriginal and non-Aboriginal residents of tropical river catchment areas have complex values for these systems which are difficult for decision-makers to accommodate. Aboriginal Australians are a large and growing proportion of the population and are also significant landowners, yet there is little information about the impacts of potential development scenarios on the welfare of Aboriginal Australians that can be used in benefit-cost analyses. This paper reports the application of a choice experiment to assess the potential impact of development/management strategies for three tropical rivers in Australia, and explores the differences between the preferences of Aboriginal and non-Aboriginal Australians living in the catchment areas. Most respondents preferred healthy river systems that are managed under conservation schemes even if this comes at a private cost. The willingness-to-pay of Aboriginal Australians was significantly higher than that of non-Aboriginal Australians for some river attributes, particularly those related to cultural values. Aboriginal respondents were also indifferent towards the extraction of water for ir-

rigated agriculture while non-Aboriginal respondents preferred moderate rather than large or small scale use.

Non-consumptive values and optimal marine reserve switching

- Ecological Economics---2010---Satoshi Yamazaki,R. Quentin Grafton,Tom Kompas

A bioeconomic model is constructed to analyze spatial harvesting and the effects of marine reserve "switching" between a "no-take" area and a harvested area while accounting for both harvesting/consumptive and also non-consumptive values of the fishery. Using estimated parameters from the red throat emperor fishery from the Great Barrier Reef, simulations show that an optimal switching strategy can be preferred to a fixed reserve regime, but is dependent on spillovers from reserves to harvested areas, the nature of shocks to the environment, the size of the non-consumptive values and how they change with the biomass, and the sensitivity of profits to the harvest and biomass. Importantly, the results show that how non-consumptive values change with the size of the fishery substantially affects both the returns from switching and the optimal closure time.

The impact of changing agricultural policies on jointly used rough pastures in the Bavarian Pre-Alps: An economic and ecological scenario approach

- Ecological Economics---2010---Norbert Roeder,Dirk Lederbogen,Juergen Trautner,Ariel Bergamini,Silvia Stofer,Christoph Scheidegger

The paper assesses the impact of different policy options on the land use and associated biodiversity values of jointly organised low-intensity grazing systems ('Allmende') in Bavaria. We use an integrated economic and ecological modelling approach to compare three scenarios with the situation in 2003/05. We base the economic sub-model on single farms, which alter their land use in response to economic stimuli. Within the economic part, factors like the farm's endowment

with machinery and quota are regarded. Within the rule-based ecological sub-model we analyse: area of protected habitats according to the EC Habitats Directive; biodiversity for selected taxonomic groups and habitat quality for different target species. An overall evaluation of the scenarios indicates that decoupling has a limited effect, because higher direct payments compensate the effect of lower product prices. If all payments are strictly targeted to agri-environmental measures and set to a level which guarantees a low-input management of the grassland, the public costs could be reduced and additional habitats for the target species could be provided. Regarding all indicators but the extent of protected habitats and the public costs, a scenario with a cessation of public payments and market liberalisation performs the worst.

Land subsidence, production efficiency, and the decision of aquacultural firms in Taiwan to discontinue production

- Ecological Economics---2010---Hung-Hao Chang,Richard N. Boisvert,Ling-Yi Hung

For some time the over-pumping of groundwater by aquacultural producers has contributed to severe problems with land subsidence in many areas of Taiwan. This has led to policy initiatives that impose extra costs on groundwater users. By investigating the effects of the conditions of aquifers, production efficiency and other factors on decisions of Taiwanese aquacultural producers to exit the industry, this paper lays an important foundation for an understanding of the effects of these policy initiatives. Using data from a nationwide survey, this exit decision is examined using an innovative empirical strategy that combines Data Envelopment Analysis with a discrete choice econometric model. Results indicate that less efficient firms and those located in areas where land subsidence is severe are more likely to exit. These relationships may in part reflect the effectiveness of the recent policy changes to reduce land subsidence attributable to aquaculture production.

Embedding the drivers of emission efficiency at regional level -- Analyses of NAMEA data

- Ecological Economics---2010---Massimiliano Mazzanti, Anna Montini

This paper provides new empirical evidence on regional-national disparities in environmental efficiency, based on analyses of NAMEA data referring to Italy and the Lazio region, where Rome is the main city. Shift-share analyses provide evidence on the drivers of environmental efficiency and on sector specificity. Our evidence shows that although the region around Rome has achieved higher environmental performance compared to Italy mainly thanks to its being less industry based, some critical points in the energy sector and in some services should be taken into account in shaping the future development of the region. In addition, the use of regional NAMEA for econometric investigations of emission efficiency drivers at national level shows that though north-south disparities favour northern and richer regions, in accordance with development-oriented dynamics, environmental hot spots driven by specialisation and efficiency-related issues also appear in some northern industrial regions. Further, the role of public and private R&D is of main relevance in enhancing emission on economic value ratios. Environmental, industrial and sector-oriented policy making may derive valuable information from the evidence provided by our study, that highlights how analytical exploitation of NAMEA offers a rich array of insights for regional policy making.

International inequality in energy intensity levels and the role of production composition and energy efficiency: An analysis of OECD countries

- Ecological Economics---2010---Juan Duro, Vicent Alcantara, Emilio Padilla

This paper analyses the inequality of energy intensity levels between OECD countries, its causes and evolution. The paper develops a methodology which allows the inequality in energy consumption per capita to be decomposed into explanatory factors. It also analyses

the contribution of different groups of countries to this inequality. The results show that although differences in affluence are the most significant factor in explaining inequality in energy consumption per capita, the inequality in energy intensity levels plays a prominent role in reducing the inequality in energy consumption per capita over the analysed period. The paper also develops a methodology which determines the importance of different production structures and energy efficiency of productive sectors in the differences in energy use per unit of GDP between the countries analysed. The results show that sector specialisation becomes increasingly important in explaining the inequality of energy intensity, while there is a significant trend towards the convergence of energy efficiency between countries sector by sector. This trend would explain the decreasing weight of energy intensity as an explanatory factor of the inequalities in energy consumption per capita.

The role of uncertainty and expectations in modeling (range) land use strategies: An application of dynamic optimization modeling with recursion

- Ecological Economics---2010---Stéphanie Domptail, Ernst-August Nuppenau

This paper presents a bio-economic optimization modeling approach for the simulation of land use decision making by farmers faced with climatic uncertainties. The approach is applied to the study of land use strategies on commercial ranches in Namibia. First, we compare two models differing in their structure: the first one is an inter-temporal optimization model (forward-looking with perfect foresight) while the second is recursive and it explicitly incorporates uncertainty in the decision making process. Second, we point out the structural advantage of the recursive optimization model in its ability to simulate how decision makers' perceptions on the occurrence of stochastic events alter land use strategies and their economic and ecological outcomes. Both models make use of a State-and-Transition conceptual framework to depict the bio-economic feedback. We found that the incorporation of rainfall uncertainty in decision making is

crucial when modeling land use strategies in highly variable ecological-economic systems such as ranches in arid rain-fed areas. Where knowledge of rainfall distribution is inaccurate (due to lack of experience or climate change) both, farmers and rangelands, would be better off by precautiously expecting low rainfalls. Finally, our results show that minimizing herd size adjustment costs would support the establishment of sustainable land use strategies.

From beef cattle to sheep under global warming? An analysis of adaptation by livestock species choice in South America

- Ecological Economics---2010---S. Niggol Seo,Bruce McCarl,Robert Mendelsohn

This paper examines how South American farmers' choices of livestock species vary across the range of climate and in turn infer from them as to what would happen under climate changes. We examine the choice of five primary species using a multinomial logit model with and without climate variability measures based on 1300 livestock farm surveys in seven countries. The results indicate that climate variables are highly significant determinants of primary species choice after controlling for soils, geography, household characteristics, and country fixed effects. We find the probability of adopting any livestock increases with warming, but decreases when it becomes too wet. The impacts of climate change would vary by species and climate scenarios. For example, under a hot and dry CCC scenario by 2060, beef cattle decrease by 3.2%, dairy cattle by 2.3%, pigs by 0.5%, and chickens by 0.9%, which is offset by a large increase in sheep by 7%. These adaptive changes vary again by country. Large changes are observed in the Andean countries. Under the hot dry scenario, dairy cattle increase in Uruguay and Argentina, but decrease elsewhere. The increase in sheep occurs mostly in the Andes mountain countries such as Chile, Colombia, Ecuador, and Venezuela. Under a milder and wetter scenario, beef cattle choice declines in Colombia, Ecuador, and Venezuela, but increases in Argentina and Chile. Sheep increase in Colombia and Venezuela, but decrease in the high mountains of

Chile where chickens are chosen more frequently.

Methods for greenhouse gas offset accounting: A case study of ocean iron fertilization

- Ecological Economics---2010---Wilfried Rickels,Katrin Rehdanz,Andreas Oschlies

Reducing atmospheric carbon concentration by removing past emissions can extend our rapidly diminishing emission budgets corresponding to the target of limiting the temperature increase to 2° C above preindustrial levels. Forestation measures to offset carbon emissions have already entered the Kyoto Protocol. Other carbon offset options like ocean iron fertilization or chemically enhanced weathering are currently being analyzed. The analysis and comparison of such options requires determination of the amount of carbon credits generated that can be used for compliance. In our analysis we assess the impact of various accounting methods applied to large-scale sink enhancement projects, taking into account the partly temporary storage characteristics arising from such projects. We apply the various accounting methods to hypothetical large-scale Southern Ocean iron fertilization projects for different durations. From an economic perspective, issuing temporary carbon credits would provide the largest number of carbon credits at an early stage. This is equivalent to the existing tCER regulation under the Kyoto Protocol. Issuing temporary carbon credits for short-term ocean iron fertilization would also benefit the environment, as all credits would have to be replaced in the next commitment period. As some carbon will be stored permanently, this reduces atmospheric carbon concentration.

A hybrid multi-region method (HMR) for assessing the environmental impact of private consumption

- Ecological Economics---2010---Kees Vringer,René Benders,Harry Wilting,Corjan Brink,Eric Drissen,Durk Nijdam,Nico Hoogervorst

The environmental load from consumption can be reduced by changing consumption patterns. For an ef-

fective consumer policy to reduce the environmental load from society, we need insight into the environmental load from consumption patterns. This requires detailed accurate quantitative environmental information about many consumer products. Current methods for establishing this information about many consumer products do not combine process data with multiregional data. This paper aims to give more insight into the added value of using multiregional data and process data. It also proposes to combine both kinds of data into one application. The use of multiregional input-output data appears to be important to establish the total environmental load from consumption. Using multiregional data and process data both result in substantial changes in the estimated environmental load of consumption products on a more detailed level. The results indicate that using both multiregional and process data will improve the estimates of the environmental impacts of consumption patterns. Therefore, we propose a hybrid multi-region (HMR) method, which is successfully applied for the Netherlands.

Sewage pollution and institutional and technological change in the United States, 1830-1915

- Ecological Economics---2010---Jouni Paavola

This article examines institutions for water pollution control and their interaction with water supply and sanitation technologies in the United States before the First World War. The article discusses how growth of settlements polluted waters and created pressure to adopt local institutional responses and networked water supply and sewerage technologies in the mid-19th century. However, the new urban technologies undermined local institutional responses and expanded the scale of water pollution problems they were expected to resolve. Water companies, households and local governments litigated their water pollution conflicts in the courts in the absence of other alternatives. In the end of the 19th century, many states adopted water pollution policies. At first, public health authorities enforced the new policies to protect public water supplies from sewage contamination. However, when

the effectiveness of filtration and chlorination of drinking water was demonstrated in the early 20th century, public health authorities ceased to enforce discharge prohibitions and instead pressured water companies to adopt the new technological measures to protect public health.

Can ecolabels survive in the long run?: The role of initial conditions

- Ecological Economics---2010---Javier Lozano,Ester Blanco,Javier Rey-Maqueira

This paper analyzes the interaction between three environmental strategies within a population of firms: brown, green, and certified green strategies. We first present a restricted version of an evolutionary game where only brown and green strategies are possible. Next, the model is extended to allow green firms to certify their environmental strategies by joining an ecolabel. Our analysis shows that when it survives, the ecolabel tends to fully replace other uncertified environmental initiatives and to increase the proportion of firms implementing voluntary abatement. Nevertheless, the long-run survival of the ecolabel is not a necessary outcome of the model, although it can be facilitated via policies that reduce abatement or certification costs, increase consumer's environmental concerns or improve the credibility of the certifier, whereas it may be reduced by green-wash news about the sector. An ecolabel's survival may also depend on how and when it is launched. In those common situations where the model has two stable equilibria, initial conditions play a key role in determining the ecolabel's survival. Specifically important determinants are the degree of adoption of voluntary abatement when the ecolabel is launched and the amount and composition of firms that participate in the creation of the ecolabel.

Gains from expanded irrigation water trading in Egypt: An integrated basin approach

- Ecological Economics---2010---Abdelaziz A. Gohar,Frank A. Ward

Economic development and population growth in Egypt

continue to increase the demands for water. Meeting these demands places increasing stress on Egypt's water institutions to support the country's need for food, urban, industrial, and environmental water uses. Many studies have examined measures to increase Egypt's effective water supplies or reduce its water demands. However, no research to date has examined economically efficient and culturally acceptable water institutions for improving the economic performance of Egyptian agricultural water use. The aim of this study is to examine the potential for irrigation water trading as a measure to improve the economic efficiency of Egyptian agricultural water use of the Nile River. Using data on Egyptian land, water, and agriculture, a catchment scale framework is developed to characterize hydrologic and economic impacts of limited water trading by irrigated agriculture while respecting hydrologic, environmental, food security, and institutional constraints. Results suggest that expanded water trading among Egyptian farmers could raise the economic performance of Egypt's irrigation water use. That improved performance could increase national farm income by 6.3 to 7.9% annually with little or no loss in water-related benefits outside agriculture. Worldwide, solutions to safeguard food production are needed fast. Institutionalizing currently informal water trading arrangements could be a prototype for measures to promote food and water security in Egypt and in other countries with similar water management challenges.

Estimating the ecosystem service losses from proposed land reclamation projects: A case study in Xiamen

- Ecological Economics---2010---Xuan Wang, Weiqi Chen, Luoping Zhang, Di Jin, Changyi Lu

Economic valuation of ecosystem damages is an important building block in the development of full cost accounting which may lead to improvements in environmental policy making. Based on an analysis of the negative impacts of land reclamation on coastal ecosystem services and a review of different valuation techniques, this study develops a framework for selecting relevant valuation methods for different ecosystem

services and for developing total ecosystem loss estimates for land reclamation projects. We illustrate the framework through a case study of Tong'an Bay, Xiamen, China where four reclamation schemes have been proposed. The results show that the costs associated with ecosystem damages are significantly higher than the internal costs of these reclamation projects.

Evaluating the role of co-management in improving governance of marine protected areas: An experimental approach in the Colombian Caribbean

- Ecological Economics---2010---Rocio Moreno-Sanchez, Jorge Maldonado

Complexities associated with the management of common pool resources (CPRs) threaten governance at some marine protected areas (MPAs). In this paper, using economic experimental games (EEGs), we investigate the effects of internal communication, external regulation, and the interaction between internal regulation and non-coercive authority intervention--what we call co-management--on fishermen's extraction decisions. We perform EEG with fishermen inhabiting the influence zone of an MPA in the Colombian Caribbean. The results show that co-management exhibits the best results, in terms of both reduction in extraction and resource sustainability, highlighting the importance of strategies that recognize communities as key actors in the decision-making process for the sustainable use and conservation of CPR in protected areas.

Does precipitation and runoff variability affect treaty cooperation between states sharing international bilateral rivers?

- Ecological Economics---2010---Ariel Dinar, Brian Blankespoor, Shlomi Dinar, Pradeep Kurukulasuriya

Elevated world temperatures, as forecasted by the 4th IPCC report, are expected to increase the hydrological cycle activity, leading to a change in precipitation patterns and increase in evapotranspiration. These in

turn are expected to affect river runoff and water variability, depending on basin latitude. In this paper, we assess the impact of water supply variability on 'treaty cooperation' (defined here as the likelihood of treaty formation and number of treaties formed) between international bilateral river basin riparian states. The water variability measure that we use captures both annual runoff variability and precipitation variability. We employ additional control variables adopted from economic and international relations theories on international cooperation. The main results suggest that water supply variability in international bilateral basins creates an impetus for cooperation. Our results support an inverted U-shaped relationship between water supply variability and treaty cooperation. Similarly, interactions between the states in the form of diplomatic and trade relations support cooperation. Various measures of democracy/governance suggest different impacts on cooperation. Uneven economic power between the riparian states inhibits treaty cooperation. The geography variables we use are insignificant in all the estimated relationships.

Population aging and environmental preferences in OECD countries: The case of air pollution

- Ecological Economics---2010---Tobias Menz,Heinz Welsch

Most industrialized countries will experience a significant aging of their populations in the future. The consequences of this coming population aging for environmental preferences and environmental quality are ambiguous. This paper uses data on life satisfaction to investigate how preferences and willingness to pay for air quality depend on the age composition of the population. Our estimation results on a panel of 25 OECD countries, spanning the period from 1990 to 2004, indicate that preferences for air quality are U-shaped in age, consistent with epidemiological evidence on the age-specific health consequences of air pollution. We find the projected future evolution of the aging process in OECD over the next two decades to imply a rise to the three-fold in the marginal willingness to pay for reduced air pollution.

Air pollution, health and economic benefits--Lessons from 20Â years of analysis

- Ecological Economics---2010---Jane V. Hall,Victor Brajer,Frederick W. Lurmann

This paper reviews and compares two air quality benefit assessments completed for California's South Coast Air Basin in 1989 and 2008. Specifically, we separate the influence of changes in population and air quality from that of newer health concentration-response relationships and changing economic values. The dynamic interaction of key variables, including health and economic, as well as changes in population and air quality, lead to significant changes in results over time. Results show dramatic reductions in exposures to ozone and particulate concentrations between the two time periods, a continually evolving health literature, and in contrast, fairly constant real economic unit values assigned to adverse health outcomes. Such research is important because highly technical analyses of the expected benefits of proposed air quality regulatory programs have become an increasingly important component of many decision-making processes.

Beyond fuelwood savings: Valuing the economic benefits of introducing improved biomass cookstoves in the Purépecha region of Mexico

- Ecological Economics---2010---Eduardo García-Frapolli,Astrid Schilmann,Victor M. Berrueta,Horacio Riojas-Rodríguez,Rufus D. Edwards,Michael Johnson,Alejandro Guevara-Sanginés,Cynthia Armendariz,Omar Masera

Half of the world population relies on biomass for cooking, with very significant health as well as climate change impacts. Improved cookstoves have been disseminated as an alternative to reduce these impacts. However, few detailed studies about the economic benefits of improved cookstoves (ICS) interventions, including environmental and health co-benefits, exist to date. In this paper we perform a comprehensive economic evaluation of a dissemination program of ICS in rural Mexico. The resulting cost-benefit analysis (CBA) of the Patsari improved cookstove is presented,

utilizing estimation of direct costs and benefits, including fuelwood savings, income generation, health impacts, environmental conservation, and reduction in greenhouse gas emissions. The analysis is based on comprehensive data obtained through monitoring studies carried out in the Study Area from 2003 to the present. Results show that Patsari cookstoves represent a viable economic option for improving living conditions of the poorest inhabitants of rural Mexico, with benefit/cost ratios estimated between 11.4:1 and 9:1. The largest contributors to economic benefits stemmed from fuelwood savings and reductions in health impacts, which constituted 53% and 28% of the overall benefit, respectively.

Quantifying U.S. aluminum in-use stocks and their relationship with economic output

- Ecological Economics---2010---Colin A. McMillan, Michael R. Moore, Gregory A. Keoleian, Jonathan W. Bulkley

A dynamic material flow analysis model is developed to quantify aluminum in-use stocks and old scrap recycling and recovery in the United States for the period of 1900 to 2007. The total in-use aluminum stock in 2007 is estimated as 93 million metric tons, which represents approximately 34% of the cumulative apparent consumption since 1900. Alternately, since 1900 nearly 40% of the cumulative discarded aluminum has not been recycled for domestic use in the U.S. or for export to foreign consumers. Statistical time series analysis is used to explore the relationship between model results of in-use stocks and gross domestic product (GDP). Unlike most previous studies of material consumption and economic activity, which ignore the statistical properties of time series data to the detriment of model estimation and inference, data stationarity is explicitly evaluated through unit root testing and model specification is adjusted accordingly. The annual percentage change in GDP is found to have a large and significant association with the annual percentage change in net additions to in-use stocks. Model sensitivity and uncertainty are quantified through the application of the Fourier Amplitude Sensitivity Test and alternate

specifications of product lifetime probability density functions.

Economic valuation of the influence of invasive alien species on the economy of the Seychelles islands

- Ecological Economics---2010---P. Mwebaze, A. MacLeod, D. Tomlinson, H. Barois, J. Rijpma

Biodiversity underpins most economic activities in Seychelles, and loss of biodiversity as a result of invasive alien species (IAS) could result in major negative economic impacts for the country. This paper assesses the value of impacts of IAS on biodiversity, natural resources and the national economy, using the principles of total economic value (TEV). The contingent valuation method was used to obtain a willingness to pay (WTP) estimate for a policy to protect important biodiversity from IAS. Tourists indicated a mean WTP of US\$52-US\$58 on top of their usual expenditures to fund conservation policy. At present approximately US\$0.25 million per year is spent on IAS control while the economic damage associated with 4 key IAS is approximately US\$21 million per year. Comparing the benefits from eradication with the costs involved gives a benefit-cost ratio greater than unity, indicating that the policy of eradicating IAS is economically justified. However, there is a long way to go before the resources devoted to the problem will be in proportion to the risks.

A common-pool resource experiment with postgraduate subjects from 41 countries

- Ecological Economics---2010---T.K. Ahn, Elinor Ostrom, James Walker

This study reports results from a new series of experiments that examine the robustness of face-to-face communication as a cooperation-facilitating institution in common-pool resource settings. Results are reported from nine experiment sessions, initially designed for pedagogical purposes. The sessions were conducted between 1998 and 2007 as part of a series

of summer institutes on institutional analysis and environmental change. Subjects were graduate students and professionals from diverse disciplines, representing 41 countries of residence. The participants in this study stand in sharp contrast to most previous studies, which used undergraduates who self-select into experiments by volunteering to participate. Results from these experiments substantiate earlier findings that non-binding communication can serve as an effective mechanism for solving social dilemma problems, with subjects achieving near socially efficient outcomes.

Assessing the causes of anthropogenic methane emissions in comparative perspective, 1990-2005

- Ecological Economics---2010---Andrew Jorgenson,Ryan Birkholz

The authors engage prior research and theoretical orientations to assess some of the known causes of anthropogenic methane emissions in comparative international contexts. Like carbon dioxide emissions, methane emissions are a known contributor to climate change. Results of cross-national fixed effects panel regression analyses indicate that population size, economic development, the production of cereals, cattle, natural gas and oil, and a reliance on food exports all contribute to methane emissions from 1990 to 2005. Most notably, additional findings suggest that the magnitude of the effects of multiple predictors modestly decreased during the period of investigation, while the impact of other predictors remained very stable in magnitude. The authors conclude by considering the substantive implications of the results, the limitations of the study, and outline the next steps in this research agenda.

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On the Ehrlich-Simon bet: Both were unskilled and Simon was lucky

- Ecological Economics---2010---Philip Lawn

In 1980, biologist Paul Ehrlich and economist Julian Simon entered into a bet over whether the real prices of five resources would increase or fall between 1980 and 1990. Because the real prices of the five resources declined, Simon won the bet. But Simon won, not because he was more skilled than Ehrlich, nor because he correctly predicted the changing absolute scarcity of the five relevant resources. Simon won because he was lucky. Resource prices reflect the relative scarcity of different resource types, not their absolute scarcity. Given the basis upon which Ehrlich and Simon entered the bet, both men revealed their lack of understanding of the relationship between absolute resource scarcity and resource prices. In the end, Simon was lucky because factors other than a rise in absolute scarcity had the greatest impact on resource prices between 1980 and 1990.

Externality or sustainability economics?

- Ecological Economics---2010---Jeroen van den Bergh

In an effort to develop "sustainability economics" Baumgärtner and Quaas (2010) neglect the central concept of environmental economics-"environmental externality". This note proposes a possible connection between the concepts of environmental externality and sustainability. In addition, attention is asked for other aspects of "sustainability economics", namely the distinction weak/strong sustainability, spatial sustainability and sustainable trade, distinctive sustainability policy, and the ideas of early "sustainability economists". I argue that both sustainability and externalities reflect a systems perspective and propose that effective sustainability solutions require that more attention is given to system feedbacks, notably other-regarding preferences and social interactions, and energy and environmental rebound. The case of climate change and policy is used to illustrate particular statements.

As a conclusion, a list of 20 insights and suggestions for research is offered.

Use and usefulness of sustainability economics

- Ecological Economics---2010---Peter Bartelmus

Sustainable development is at the roots of sustainability economics. Baumgärtner and Quaas (2010) define sustainability economics as the combination of economic efficiency and justice in the distribution of nature's services. Van den Bergh (in press) criticizes their approach as 'axiomatic' and incomplete, lacking a discussion of environmental externalities and dogmas like the 'GDP dogma'. The focus on non-measurable welfare or happiness in both articles impairs the use and usefulness of their sustainability notions for applied economics and policy. Alternatively, environmentally modified national accounts offer a quantifiable sustainability concept of produced and natural capital maintenance. For practical reasons, sustainability economics should therefore deal with sustainable economic performance and growth. Coordination with other social goals has to be left to politics.

Sustainability economics -- General versus specific, and conceptual versus practical

- Ecological Economics---2010---Stefan Baumgärtner, Martin Quaas

We clarify the definition and interpretation of "sustainability economics" (Baumgärtner and Quaas, 2010) in response to recent comments by van den Bergh (2010), Bartelmus (2010) and others. For that sake, we distinguish between general and specific definitions of sustainability and sustainability economics, as well as between conceptual and practical approaches.

Payments for ecosystem services: From local to global

- Ecological Economics---2010---Joshua Farley, Robert Costanza

Payment for Ecosystem Services (PES) is becoming increasingly popular as a way to manage ecosystems using economic incentives. The environmental economics

approach to PES tries to force ecosystem services into the market model, with an emphasis on efficiency. The ecological economics approach, in contrast, seeks to adapt economic institutions to the physical characteristics of ecosystem services prioritizing ecological sustainability and just distribution and requiring a transdisciplinary approach. This paper summarizes the results of a participatory "atelier" workshop held in Costa Rica. We developed a set of principles (the Heredia Declaration) for PES systems and report on evolving initiatives in several countries. We discuss how the distinction between ecosystem goods (which are stock-flow resources) and ecosystem services (which are fund-service resources) and the physical characteristics of the fund-services affect the appropriate institutional form for PES. We conclude that PES systems represent an important way to effectively manage fund-service resources as public goods, and that this represents a significant departure from conventional market institutions.

Determining when payments are an effective policy approach to ecosystem service provision

- Ecological Economics---2010---Robin J. Kemkes,Joshua Farley,Christopher J. Koliba

There are several policy tools available for the provision of ecosystem services. The economic characteristics of the ecosystem service being provided, such as rivalry and excludability, along with the spatial scale at which benefits accrue can help determine the appropriate policy approach. In this paper we provide a brief introduction to ecosystem services and discuss the policy tools available for providing them along with the dimensions, political feasibility and appropriateness of each tool. Throughout the paper we focus primarily on payments as a mechanism for ecosystem service provision. We present a framework for determining the characteristics of an ecosystem service and when payments are a viable policy tool option based on the characteristics. Additionally, we provide examples of when payments do not provide a socially desirable level of ecosystem benefits. We conclude with a summary of policy recommendations, specifically desirable prop-

erty rights and payment types based on the particular classification of an ecosystem service. We also discuss the advantages of creating monopsony power to reduce transaction costs, delineating and bundling ecosystem services and utilizing existing intermediaries.

Global mechanisms for sustaining and enhancing PES schemes

- Ecological Economics---2010---Josh Farley,André Aquino,Amy Daniels,Azur Moulaert,Dan Lee,Abby Krause

An international payment for ecosystem service (IPES) schemes may be one of the only mechanisms available to stimulate the provision of vital non-marketed ecosystem services at the global level, as those nations that benefit from global ecosystem services (GES) cannot readily force other sovereign nations to provide them. Currently, international trade offers trillions of dollars in incentives for countries to convert natural capital into marketable goods and services, and few payments to entice countries to conserve natural capital in order to sustain critical non-marketed ecosystem services. We examine the biophysical characteristics of climate change and biodiversity to understand the obstacles to developing effective IPES schemes. We find that none of the existing schemes for providing GES are adequate, given the scale of the problem. A cap and auction scheme for CO₂ emissions among wealthy nations could fund IPES and simultaneously deter carbon emissions. To disburse funds, we should adapt Brazil's ICMS ecológico, and apportion available funds to targeted countries in proportion to how well they meet specific criteria designed to measure the provision of GES. Individual countries can then develop their own policies for increasing provision of these services, ensured of compensation if they do so. Indirect IPES should include funding for freely available technologies that protect or provide GES, such as the low carbon energy alternatives that will be essential for curbing climate change. Markets rely on the price mechanism to generate profits, which rations technology to those who can afford it, reducing adoption rates, innovation and total value.

Ecosystem services from agriculture: Steps for expanding markets

- Ecological Economics---2010---Marc Ribaud,Catherine Greene,LeRoy Hansen,Daniel Hellerstein

Farmers in the United States produce a wide variety of commodities for food and fiber. Farmers can also produce a variety of non-commodity ecosystem services for which markets do not exist or are imperfectly formed. Such services may be valued by society, but due to their nature or institutional arrangements, farmers often do not receive a price signal for them. This results in inefficient allocations of resources, in that farmers under-produce non-commodity ecosystem services. One possible way to increase private investment in ecosystem services is to create a market for them. We draw lessons from six different markets for providing ecosystem services from farms (water quality trading, wetland mitigation, carbon cap-and-trade, over-the-counter carbon, eco-labeling, and fee hunting) on what is required for a market to function, and the problems these markets might face.

Targeting and implementing payments for ecosystem services: Opportunities for bundling biodiversity conservation with carbon and water services in Madagascar

- Ecological Economics---2010---Kelly J. Wendland,Miroslav Honzák,Rosimeiry Portela,Benjamin Vitale,Samuel Rubinnoff,Jeannicq Randrianarisoa

Payments for Ecosystem Services (PES) are generating a lot of attention among conservationists because they have the potential to create new funding opportunities for biodiversity protection and other ecosystem services that contribute to human well-being. A number of recent publications have suggested ways to target and implement PES projects in order to maximize their cost-effectiveness and efficiency, and the Heredia Declaration (this issue) sets forth a list of agreed-upon principles concerning the use of PES schemes. One of those principles concerns the "bundling" of joint

products of intact ecosystems in PES schemes in order to maximize the benefits to society. There have been several recent studies focusing on the degree of overlap between biodiversity and other ecosystem services and therefore the opportunities and constraints to bundling these services. Building on this idea, the bulk of this paper focuses on developing a method for selecting sites for PES where the main interest is to bundle biodiversity with other ecosystem services. We focus our analysis on Madagascar, a country with globally important biodiversity that is also beginning to explore the utility of PES as a conservation mechanism. Specifically, we assess the opportunities for bundling biodiversity conservation with carbon and water services at the national scale and identify where using PES to protect these areas of multiple benefits would be most cost-effective and efficient. This analysis identifies almost 30,000 km² -- out of 134,301 km² -- of natural habitat that could potentially meet biodiversity conservation goals and protect additional ecosystem services through a PES scheme. One of the places identified by our methodology corresponds to an ongoing conservation project that has already begun using payments from carbon emission reductions to protect standing forests and restore important biodiversity corridors -- the Ankeniheny-Mantadia-Zahamena Biodiversity Conservation and Restoration Project. This project site was selected for its high biodiversity and carbon values, lending credibility to our spatial targeting methodology and providing a case study to draw insights on how multiple-benefit PES schemes can be implemented in biodiversity "hotspots". In the discussion section of this paper we draw on experiences from this project to consider how many of the principles outlined in the Heredia Declaration affect implementation of PES schemes in Madagascar, providing lessons for similar countries experimenting with PES for biodiversity conservation.

Designing spatially explicit incentive programs for habitat conservation: A case study of the Bicknell's thrush wintering grounds

- Ecological Economics---2010---Charles Kerchner, Miroslav Honzák, Robin Kemkes, Amanda Richardson, Jason Townsend, Christopher C. Rimmer

The Bicknell's thrush (*Catharus bicknelli*) is among North America's migratory bird species of greatest conservation concern. Protecting habitat at both ends of its range has been identified as a high priority action. An estimated 90% of the species' global population overwinters on the island of Hispaniola, where ongoing habitat loss is a severe problem. Preventing further loss of Bicknell's thrush habitat on Hispaniola will require, among other efforts, establishing conservation areas on private lands, where success will depend on cooperation with landowners. This paper considers a voluntary incentive program to landowners in the Dominican Republic to yield a cost-effective network of protected habitat to sustain overwintering Bicknell's thrush populations. TAMARIN, a Geographic Information System (GIS) based model, evaluates the economic and ecological considerations for a voluntary bid scenario where landowners sell their property rights to a government agency or non-governmental organization. Results indicate that two scientific reserves in north-eastern Dominican Republic could be connected under one viable forest fragment valued at US \$5.5 x 10⁶, increasing the total protected land by 87% to 19,357 ha. Incorporating the spatial variability of economic costs and biological benefits into a conservation program, such as the Bicknell's Thrush Habitat Protection Fund will help planners achieve habitat conservation at least cost.

Understanding the impacts of Costa Rica's PES: Are we asking the right questions?

- Ecological Economics---2010---Amy E. Daniels, Kenneth Bagstad, Valerie Esposito, Azur Moulart, Carlos Manuel Rodriguez

PES is an increasingly mainstream tool for influencing

land-use decisions on private land and Costa Rica's experience provides critical insight. We review findings of PES impacts on forest cover, a proxy for forest-based ecosystem services. National studies conclude that PES has not lowered deforestation rates. Yet in northern Costa Rica, there is evidence of additionality for PES-related avoided deforestation. Moreover, sub-national studies of bi-directional forest cover change, along with farm-level interview data and an understanding of ground-based operations, demonstrate that avoided deforestation is an incomplete measure of PES impact. Sub-national case studies suggest PES is associated with agricultural abandonment and net gains in forest cover via forest regeneration and plantation establishment. Explanations include that forest regeneration has always been an accepted PES modality for some regions. Also, early PES cohorts have an implicit spatial correlation with pre-PES incentives focusing exclusively on reforestation. Without understanding de facto PES implementation, it is impossible to appropriately evaluate PES impacts or discern whether PES outcomes--positive or negative--are due to PES design or its implementation. This distinction is critical in refining our understanding of both the utility and limitations of PES and has some practical implications for PES-style REDD initiatives.

Why and how much are firms willing to invest in ecosystem services from tropical forests? A comparison of international and Costa Rican firms

- Ecological Economics---2010---Thomas Koellner, Joachim Sell, Guillermo Navarro

In recent years, schemes for payment for ecosystem services PES have emerged in tropical countries. Besides public demand, the private demand offers the opportunity to develop PES. The goal of this paper is to investigate the potential demand by firms for four ecosystem services from tropical forests: biodiversity conservation, carbon sequestration, scenic beauty, and watershed protection. Those are the four granted in the forest legislation and rewarded for in the PES scheme in Costa Rica. To explain stated willingness to

invest WTI, we assess influential factors: expectations with respect to financial and non-financial benefits of investing in ecosystem services; experience with forest ecosystem services; firm attributes, like origin, sector membership, and size; and finally, perceived behavioral control. We sent a questionnaire to over 900 international and Costa Rican firms from different sectors. The low response rate of the survey of overall 6% can be explained by - in a business context - rather new topic of ecosystem services from tropical forests. The analysis showed that a firm's willingness to invest (WTI) depends on the origin of the firm. International firms are interested in buying certificates mainly for carbon sequestration; Costa Rican firms, for all four ecosystem services in the following order: watershed protection, biodiversity conservation, carbon sequestration, and scenic beauty. Indirect and non-financial benefits are surprisingly important and can impede the development of ecosystem service markets. At the same time, the activities of intrinsically motivated green entrepreneurs in a financially oriented firm setting might be a prerequisite within a firm context for bringing such innovative topics as ecosystem services from tropical forests to the table.

Investing in human and natural capital: An alternative paradigm for sustainable development in Awassa, Ethiopia

- Ecological Economics---2010---Travis W. Reynolds, Joshua Farley, Candice Huber

Ethiopia remains underdeveloped due to limitations in natural, human, social and built capital. A 2006 scientific atelier conducted in the city of Awassa, Ethiopia investigated investments in human and natural capital as a sustainable development strategy. Local stakeholders identified firewood shortages, degradation of croplands, rising lake levels encroaching on croplands and poor water quality as major impediments to development. They further identified ecological degradation as a key component of these problems, and they acknowledged multiple vicious cycles compounding the environmental and economic threats to the Awassa community. Proposed solutions included investment in

natural capital in the form of reforestation activities, investment in human capital in the form of promoting more efficient wood stoves along with increasing public awareness of environmental threats, and investments in social capital in the form of inter-institutional coordination to address environmental problems. All recommended investments rely primarily on national resources, in distinct contrast to the extensive imports required for most built capital investments. Unfortunately, Awassa lacks the surplus necessary for major capital investments of any kind. The atelier therefore helped local participants identify potential funders and write grant proposals for various projects, though none have been funded so far. Reversing the ecological degradation on the scale necessary for sustained economic development in Ethiopia however will require a steady flow of substantial investments, and cannot rely solely on the short term generosity of funders. International payments for carbon sequestration and other ecosystem services could help provide the necessary resources.

Valuing the environmental externalities of oasis farming in Left Banner, Alxa, China

- Ecological Economics---2010---Yongping Wei, Robert White, Kelin Hu, Ian Willett

Agriculture's environmental footprint is expanding and one of its most critical impacts in China is the over-exploitation of surface water and groundwater from aquifers. This study investigated an approach for estimating the physical dimensions of the environmental externalities from a maize cropping system in oasis farming of the arid north-west of China, and the monetary valuation of these environmental externalities based on integrated process-based biophysical and economic models. The simulation results show that current farming practices cause 7854 Yuan/ha of groundwater recharge cost, 7696 Yuan/ha of water treatment cost, and 91 Yuan/ha of N2O mitigation cost. These costs lead to a social benefit-cost ratio of only 0.55, although the farmers' benefit-cost ratio was 1.85. A combination of adoption of recommended best management practices by farmers, and an increase in the water price to 1.1 Yuan/m³ could maintain both the

social and farmers' benefit-cost ratios above 1, but the costs of recharging groundwater were large in all cases.

Goal programming synthetic indicators: An application for sustainable tourism in Andalusian coastal counties

- Ecological Economics---2010---Francisco J. Blancas,Rafael Caballero,Mercedes González,Macarena Lozano-Oyola,Fátima Pérez

This paper proposes a methodology for obtaining a synthetic indicator to facilitate decision making in practical situations. It is based on goals provided by the users, which will be included in a synthetic indicator by a goal-programming approach. This methodology facilitates interpreting the values of the synthetic indicator, and thus helps in the decision-making process. We not only formulate these indicators, but also analyze their properties and apply them to the analysis of a complex concept, sustainable tourism. We use this methodology to study the case of coastal areas of Andalusia (Spain), attempting to identify the main characteristics of the different elements, their weakness and strengths.

Between estimates of the emissions-income elasticity

- Ecological Economics---2010---David Stern

Recent papers by Wagner and Vollebergh et al. point out some fundamental econometric problems with traditional methods of estimating the environmental Kuznets curve (EKC) and propose alternative approaches that avoid these issues. Wagner notes that traditional methods do not take into account the presence of powers of unit root variables and cross-sectional dependence in the data while Vollebergh et al. point out that the time effects are not uniquely identified in the EKC model. The between estimator is a simple estimator that also addresses the concerns of these authors. It makes no a priori assumption about the nature of the time effects and is likely to provide consistent estimates of long-run relationships in real world data situations. I apply several common panel data

estimators including the between estimator to OECD and global carbon and sulfur emissions datasets. The between estimates of the sulfur-income elasticity are 0.732 in the OECD and 1.067 in the global data set and the estimated carbon-income elasticity is 1.612 in the OECD and 1.509 globally.

The demand for earmarking: Results from a focus group study

- Ecological Economics---2010---Steffen Kallbekken,Marianne Aasen

Environmental taxes might be efficient, but plans to impose new taxes are often met with fierce public resistance. In order to design environmental taxes that are both efficient and acceptable to the public -- so that they can be politically feasible -- it is important to understand public attitudes towards environmental taxes. We conduct a focus group study in Norway to extend the current knowledge on this issue. We find less general resistance to taxation as a policy instrument, and seemingly more trust in government, than what has been reported in similar studies from other countries. The participants are, however, very skeptical and do not see the point of using the revenues from an environmental tax to reduce other taxes, such as the payroll tax. Instead they express a very strong preference for earmarking the revenues for environmental purposes. They also call for more information about environmental taxes, in particular on how the revenues are spent. Providing more information, including what the revenues are spent on -- irrespective of whether they are earmarked or not, would seem to provide a relatively cheap and possibly effective way to increase the public acceptability of new or increased environmental taxes.

Corruption and the environmental Kuznets Curve: Empirical evidence for sulfur

- Ecological Economics---2010---Alexandra Leitão

We investigate how corruption influences the income level at the turning point of the relationship between sulfur emissions and income, using a wide cross-

national panel of countries, at different levels of development and with different degrees of corruption. Our results support the Environmental Kuznets Curve hypothesis for sulfur. We find evidence that the higher the country's degree of corruption, the higher the per capita income at the turning point, suggesting different income-pollution paths across countries due to corruption. We build upon a new specification for the EKC developed by Bradford et al. (2005) that avoids using nonlinear transformations of potentially nonstationary regressors in panel estimation. Also, we account for the indirect impact of corruption on emissions through its impact on per capita income. Our main findings remain unchanged when we investigate additional heterogeneity allowing for different income slopes across richer and poorer countries.

Ecolabeling, consumers' preferences and taxation

- Ecological Economics---2010---Ingmar Schumacher

Ecolabeling is a means of reducing the information gap between consumers and producers. We study the implication of ecolabeling a supposedly green good for a consumer's allocation of income between a dirty and the supposedly green good. In the model, the role of the ecolabel is to help product differentiation, to give reliable information and to reduce informational asymmetries. We show that a conscious consumer (someone with a stronger green attitude or quality concerns) demands more ecolabeled goods; price-oriented consumers demand fewer ecolabeled goods; a subsidy (resp. tax) on the price of the ecolabeled (resp. dirty) good leads to a larger consumption of the ecolabeled (resp. dirty) good whereas it may increase or decrease the demand for the dirty (resp. ecolabeled) good, depending on whether the consumer views both goods as gross substitutes or complements. We then use a cross-individual dataset of 22,568 consumers and show that the demand for ecolabeled goods increases strongly with the consciousness of the consumer but decreases for price-oriented consumers. Ecolabel-oriented consumers feel more informed; more conscious consumers

prefer a subsidy on green goods and a tax on dirty goods; price-oriented consumers do not care about the green subsidy but would vote against a tax on the dirty goods.

The end of economic growth? A contracting threshold hypothesis

- Ecological Economics---2010---Philip Lawn, Matthew Clarke

This paper argues that GDP growth in both developed and developing countries has associated costs that can outweigh the benefits and thus reduce sustainable well-being. This conclusion is based upon the findings of empirical applications of the Genuine Progress Indicator (GPI) to a range of countries in the Asia-Pacific region. The studies conducted on seven Asia-Pacific countries indicate that, in the case of five of the seven nations, more recent GDP growth has reduced the sustainable well-being experienced by the average citizen residing within them. Moreover, the threshold point at which the costs of GDP growth outweigh the benefits appears to be contracting (i.e., occurring at a much lower per capita level of GDP). This paper therefore introduces a new contracting threshold hypothesis: as the economies of the Asia-Pacific region and the world collectively expand in a globalised economic environment, there is a contraction over time in the threshold level of per capita GDP. As a consequence, the threshold point confronting growth late-comers (i.e., developing countries) occurs at a much lower level of sustainable welfare than what wealthy nations currently enjoy. The consequences of this for developing countries are clearly significant and require a new approach to economic development.

Responsibility and trade emission balances: An evaluation of approaches

- Ecological Economics---2010---Mònica Serrano, Erik Dietzenbacher

This paper compares two concepts to evaluate the international responsibility of a country with respect to its emissions. Using a multi-regional input-output

model, we show that the trade emission balance and the responsibility emission balance yield the same result. In practical work, however, a lack of data availability implies that the same technology assumption has been commonly adopted. In that case, also a third alternative exists, which simply evaluates the emissions embodied in the trade balance of the country. This third alternative yields the same results as the other two approaches at the aggregate level. At the level of individual products, however, the results are clearly different and it turns out that the third alternative answers a different question. That is, it is appropriate for measuring the emission content of the products that cross the border. In our empirical application, we consider Spain in 1995 and 2000, distinguishing nine different gases: CO₂, CH₄, N₂O, SF₆, HFCs, PFCs, SO₂, NO_x, and NH₃.

The effects of wildfire and environmental amenities on property values in northwest Montana, USA

- Ecological Economics---2010---Kyle M. Stetler, Tyron Venn, David E. Calkin

This study employed the hedonic price framework to examine the effects of 256 wildfires and environmental amenities on home values in northwest Montana between June 1996 and January 2007. The study revealed environmental amenities, including proximity to lakes, national forests, Glacier National Park and golf courses, have large positive effects on property values in northwest Montana. However, proximity to and view of wildfire burned areas has had large and persistent negative effects on home values. The analysis supports an argument that homebuyers may correlate proximity to and view of a wildfire burned area with increased wildfire risk. Indeed, when a burned area is not visible from a home, wildfire risk appears to be out of sight and out of mind for homebuyers. Findings from this research can be used to inform debate about efficient allocation of resources to wildfire preparedness, including public education programs, and suppression activities around the wildland-urban interface.

Evaluating the impact of regional development policies on future landscape services

- Ecological Economics---2010---Louise Willemen, Lars Hein, Peter Verburg

In this paper we analyse the potential impact of an integrated policy package for the Gelderse Vallei region in the Netherlands on seven landscape services (residential use, intensive livestock husbandry, drinking water supply, attractiveness for overnight tourism, habitat provision for rare, endemic and indicator plant species, arable agricultural production, and attractiveness for leisure cycling). The spatially explicit methodology focuses on the changes in landscape properties resulting from the implementation of these policies and its effects on the supply of landscape services and economic values of the landscape services. After the policy implementation the strongest increase in services supply is expected in rural areas while the strongest increase in value is expected to occur in (peri-) urban areas of the study area. In addition, full implementation of the policy package will lead to an increase in multifunctional areas. This study presents one of the first spatially explicit methodologies to quantify and analyse spatial variation in economic value of landscape services in time, and therefore can contribute to well-informed management of landscapes.

On the causal dynamics between emissions, nuclear energy, renewable energy, and economic growth

- Ecological Economics---2010---Nicholas Apergis, James Payne, Kojo Menyah, Yemane Wolde-Rufael

This paper examines the causal relationship between CO₂ emissions, nuclear energy consumption, renewable energy consumption, and economic growth for a group of 19 developed and developing countries for the period 1984-2007 using a panel error correction model. The long-run estimates indicate that there is a statistically significant negative association between nuclear energy consumption and emissions, but a statistically significant positive relationship between emissions and

renewable energy consumption. The results from the panel Granger causality tests suggest that in the short-run nuclear energy consumption plays an important role in reducing CO₂ emissions whereas renewable energy consumption does not contribute to reductions in emissions. This may be due to the lack of adequate storage technology to overcome intermittent supply problems as a result electricity producers have to rely on emission generating energy sources to meet peak load demand.

On the relationship between scale, allocation, and distribution

- Ecological Economics---2010---Deepak Malghan

We develop a formal framework to investigate the relationship between ecological economics' concept of scale, and the more traditional concerns of allocation, and distribution. The framework presented here helps clarify differences between the normative and positive aspects of scale, allocation, and distribution. In particular, we distinguish between 'normative rules' and 'normative benchmarks'. This distinction helps untangle the web of hierarchical and evolutionary relationships that connect scale, allocation, and distribution. We also introduce concepts of scale efficiency and distribution efficiency as counterparts to the widely used allocation efficiency, and develop a simple dynamic model relating these three efficiencies. We then present stylized facts about the relationship between scale, allocation, and distribution that this model helps uncover.

Can de-growth be considered a policy option? A historical note on Nicholas Georgescu-Roegen and the Club of Rome

- Ecological Economics---2010---Clement Levallois

At a few months' interval, Georgescu-Roegen's *The Entropy Law and the Economic Process* (1971) and Club of Rome's *Limits to Growth* (1972) were published. Both emphasized the dangers of economic growth, and both drew negative reactions from mainstream economists. Relying on archival evidence, we show that Georgescu-Roegen and the Club of Rome

developed strategies of mutual support, which would present them at first view as natural allies. Georgescu-Roegen actually became a member of the Club of Rome, while Dennis Meadows acknowledged the influence of Georgescu-Roegen's ideas on the team of authors of *Limits to Growth*. But in the late 70's, the gap widened between Georgescu-Roegen's adamant defense of de-growth, and the Club of Rome's less firm view of "sustainable growth." This paper explores the process leading to the self-isolation of Georgescu-Roegen, by showing that beyond a shared acknowledgment that economic and biologic systems were interdependent, technological optimism and ambitions for the global management of growth were central to the Club of Rome, while Georgescu-Roegen's personal history led him to ignore those practicalities and judge that de-growth was inescapable.

Insurance, prevention or just wait and see?

Public preferences for water management strategies in the context of climate change

- Ecological Economics---2010---Klaus Glenk, Anke Fischer

Policies in the context of global change involve a high degree of uncertainty, as knowledge about future changes and the effectiveness of potential measures is insufficient. Our study set out to investigate how members of the public evaluate policy options that aim at adaptation to climate change, and more specifically, to reduce the risk from flooding and low flows. We explored how hierarchically structured networks of values and beliefs shape public preferences and attitudes towards two different policies, insurance and a sustainable flood management scheme. In particular, we assessed the role of governance-related values such as efficiency, solidarity and sustainability that allow individuals to evaluate a policy option even if its outcomes are highly uncertain. To this end, we conducted a survey among members of the Scottish public ($n = 1033$). Findings from spike models and structural equation modelling suggested that there was general support for both policy measures, with a preference for the sustainable flood management approach. In par-

ticular, we found perceived severity of change, trust in government, governance-related values and fundamental values to inform attitudes and willingness to pay (WTP) for policy measures. More specific constructs, such as attitudes, were embedded in contexts of more abstract and situation-transcendent values.

A value chain analysis of the organic cotton industry: The case of UK retailers and Indian suppliers

- Ecological Economics---2010---Alison Rieple,Rajbir Singh

This paper analyses the different activities within the value chain of organic cotton production in India to understand where, and how, value is added at each stage. Transforming a cotton crop into a textile and then into a final item of clothing involves many stages of processing, using many skills and technologies. We examine the activities and the prices achieved at each stage of this chain, from the farming of the cotton crop to its eventual sale in clothes' retailers.

Environmental sustainability as the first principle of distributive justice: Towards an ecological communitarian normative foundation for ecological economics

- Ecological Economics---2010---Nathan Pelletier

The ecological economic concern with environmental sustainability embodies the normative orientations of the field. This concern is foremost a matter of distributive justice, the definition of which determines the relevance of the appropriate scale and efficient allocation criteria. Yet it would appear that the discipline lacks a shared, internally consistent set of ethical premises by which this concern might be legitimized. Various authors have embraced a Rawlsian conception of liberal justice as the appropriate banner for ecological economics in place of the consequentialist-libertarian foundations of neoclassical economics (including environmental economics). It is argued here that this is insufficient in so far as it is premised on a vision of a discrete, self-sufficient economic actor. Instead, it

is posited that an ecological economic ethic must proceed from an understanding of the economic actor as community member -- a recognition implicit in recent ecological economic contributions focused on discourse ethics and deliberative democracy. An ecological communitarian conception of distributive justice, which views the well-being of the individual as inseparable from the integrity of its implicate, mutually constituting human and non-human natural communities, is advanced as the appropriate basis for the ecological economic world-view. In this light, the thermodynamic foundations of ecological economics are seen to provide the necessary departure point for normative decision-making oriented towards ensuring sustainability in economic organization.

Low discount rates and insignificant environmental values

- Ecological Economics---2010---Colin Price

Difference between the discount rate on consumption and the rate of return on investment is often taken to prevent the former's being used as a social discount rate. Yet techniques have long been known for incorporating both these rates in a shadow price of investment funds. Assumptions about the proportion of investment revenues saved and reinvested are crucial in determining whether a low discount rate favours or discriminates against long-term environmental values. Even a moderate saving rate may make the shadow price of funds indefinitely large. The conceptually correct discount rate then becomes the growth rate of investment funds, and the relative value of environmental effects becomes zero. Stochastic variation in rate of return makes this result more likely. Such an outcome may be avoided by setting reinvestment to zero, or assuming convergence of rates of return and discount, but no firm justification exists for these stratagems. However, various reasonable assumptions about environmental costs - especially, that they embody an investment element, or require adequate compensation to be paid - may make such costs indefinite also, and therefore capable of standing against indefinite values of investible funds.

Energy use and economic development: A comparative analysis of useful work supply in Austria, Japan, the United Kingdom and the US during 100 years of economic growth

- Ecological Economics---2010---Benjamin Warr,Robert Ayres,Nina Eisenmenger,Fridolin Krausmann,Heinz Schandl

This paper presents a societal level exergy analysis approach developed to analyse transitions in the way that energy is supplied and contributes to economic growth in the UK, the US, Austria and Japan, throughout the last century. We assess changes in exergy and useful work consumption, energy efficiency and related GDP intensity measures of each economy. The novel data provided elucidate certain characteristics of divergence and commonality in the energy transitions studied. The results indicate that in each country the processes of industrialization, urbanisation and electrification are characterised by a marked increase in exergy and useful work supplies and per capita intensities. There is a common and continuous decrease in the exergy intensity of GDP. Moreover for each country studied the trend of increasing useful work intensity of GDP reversed in the early 1970s coincident with the first oil crisis.

A directional distance function approach to regional environmental-economic assessments

- Ecological Economics---2010---Alexander J. Macpherson,Peter P. Principe,Elizabeth R. Smith

Numerous difficulties await those creating regional-scale environmental assessments, from data having inconsistent spatial or temporal scales to poorly-understood environmental processes and indicators. Including socioeconomic variables further complicates assessments. While statistical or process-based regional environmental assessment models may be computationally or financially expensive, we propose a simple nonparametric outcomes-based approach using a directional distance function from the efficiency and productivity analysis literature. The regional environmental-economic directional distance function characterizes

the relative efficiency of geographic units in combining multiple inputs to produce multiple desirable and undesirable socioeconomic and environmental outputs. This function makes no assumptions about the functional relationships among variables, but by quantifying the extent to which desirable outputs can be expanded and inputs and undesirable outputs contracted, the function can help decisionmakers identify the most important broad-scale management and restoration opportunities across a heterogeneous region. A case study involving 134 watersheds in the Mid-Atlantic region of the USA indicates that, depending on which outputs are specified as desirable in the models, 25%-33% of the watersheds are efficient in producing desirable outputs while minimizing inputs and undesirable outputs. Models including socioeconomic indicators exhibit increased watershed efficiency compared to models using only environmental indicators. Efficiency levels appear to be correlated with ecoregions.

A theoretical model of agrobiodiversity as a supporting service for sustainable agricultural intensification

- Ecological Economics---2010---Amani Omer,Unai Pascual,Noel Russell

This paper addresses the relationship between agrobiodiversity conservation and sustainable agricultural intensification. A stylised theoretical model is used to explore the conditions by which both agrobiodiversity and conventional input intensification may increase through optimal adjustments of input use in agrobiodiversity-poor agroecosystems. The model shows that this result can arise in quite general circumstances where there is (1) an agricultural production technology that allows a positive relationship between ecological integrity of a given agricultural area and agricultural productivity, and (2) decision maker preferences that recognise this positive relationship and generate resource allocation decisions that support it. While increase in agrobiodiversity conservation is a necessary condition for optimal resource adjustments, whether input use will increase or decrease along this optimal path depends on the buffering effect of agrobiodiversity on ecosystem

damage and the relative societal welfare impacts of agricultural output (e.g., food and fibre) reductions and ecosystem damage. Thus we identify conditions that promote agrobiodiversity as a supporting service for the sustainable intensification of agricultural production. A provocative hypothesis derived from the model points at the possibility that ecosystem damage (agrobiodiversity loss) can optimally decline even when agriculture undergoes an intensification process.

Analysis of genuine saving and potential green net national income: Portugal, 1990-2005

- Ecological Economics---2010---Rui Mota,Tiago Domingos,Victor Martins

The context of this paper is the measurement of welfare and weak sustainability (defined as non-declining utility) in dynamic economies, i.e., comprehensive or green accounting. We estimate green net national income (GNNI) and genuine saving (GS) for Portugal, for the years 1990 to 2005, accounting for the disamenity of air pollution emissions, the depreciation of commercial forests and the value of time, discussing the implications of the assumptions underlying the inclusion of these terms in the green accounting model. The influence of short-run cycles is analyzed by estimating GNNI excluding business cycles. Our results suggest that business cycles affect the sustainability message of GNNI. We find that potential GNNI is growing and GS is positive in the analyzed period, thereby not indicating a weak sustainability problem in Portugal, although both depict a trend towards unsustainability. Excluding technological progress there is a contradiction in the sustainability message of GNNI and GS.

Sustainable governance of the agriculture and the Baltic Sea -- Agricultural reforms, food production and curbed eutrophication

- Ecological Economics---2010---Markus Larsson,Artur Granstedt

Agricultural production and nutrient loads to the Baltic Sea are likely to increase following Poland's and the

Baltic States' entrance into the EU. According to HELCOM these trends will be highly dependent on the agricultural policies of the EU. The expansion of the EU can be seen as a window of opportunity where agricultural policy could improve the Baltic Sea environment. Longstanding initiatives with local organic food systems and Ecological Recycling Agriculture (ERA) in the eight EU-countries in the Baltic Sea drainage area were evaluated during 2001-2004. The empirical results were scaled up to calculate environmental impact and food production for three different scenarios. In one scenario the Baltic Countries and Poland convert their agriculture following the average Swedish production. This resulted in 58% increase of nitrogen and 18% increase in phosphorus surplus, a corresponding increase in the load to the Baltic Sea and increased food production. In two other scenarios agriculture production in the whole Baltic Sea drainage area converts to ERA. This halved the nitrogen surplus from agriculture and eliminated the surplus of phosphorus. In these scenarios food production would decrease or remain stable depending on strategy chosen.

Farming vs forests: Trade-off between agriculture and the extraction of non-timber forest products

- Ecological Economics---2010---Prabodh Illukpitiya,John F. Yanagida

A number of empirical studies on tropical forests have focused on the issues of agricultural development and deforestation. According to these studies, deforestation is assumed to be an increasing function of agricultural yields hence implying a negative external effect. Contrary, this article presents a case which explores the trade-off between agriculture and extraction of forest products. We measure the technical efficiency of agriculture in natural forest peripheries and test the results from forest resource extraction. The study findings show that non-timber forest product extraction is a decreasing function of agricultural efficiency, hence producing a positive externality in the conversion of forest resources. This study also determines the level of efficiency improvement necessary to compensate the

current income generated by non-timber forest products (NTFPs). Improving agricultural efficiency in forest peripheries should be an integral component of forest conservation policy.

The role of ambiguity in the evaluation of the net benefits of the MOSE system in the Venice lagoon

- Ecological Economics---2010---Fulvio Fontini,Georg Umgiesser,Lucia Vergano

Several environmental problems are complicated by ambiguity. Sea-level rise following climate change is one relevant example. In this paper, we apply a decision-making approach specifically designed to deal with ambiguity in order to evaluate the net benefits of the mobile barriers system (MOSE), which aims to protect the Venice Lagoon from periodic flooding. We show that the estimated impacts crucially depend on the level of optimism and pessimism of the decision maker and substantially differ from those calculated on the basis of the expected value. We also calculate the implicit ambiguity attitude of the decision maker.

Trade-offs between ecosystem services: Water and carbon in a biodiversity hotspot

- Ecological Economics---2010---Ryan A. Chisholm

Carbon sequestration by afforestation can help mitigate global climate change but may have adverse environmental and economic impacts in some regions. For example, economic incentives for carbon sequestration may encourage the expansion of *Pinus radiata* timber plantations in the Fynbos biome of South Africa, with negative consequences for water supply and biodiversity. I built a dynamic ecological-economic model to investigate whether afforestation of a Fynbos catchment with *Pinus radiata* is economically viable when the potential benefits of carbon sequestration and timber production are balanced against the losses to water supply. I found that afforestation appears viable to the forestry industry under current water tariffs and current carbon accounting legislation, but would appear unviable if the forestry industry were to pay the

true cost of water used by the plantations. I also found that under various plausible future economic scenarios, afforestation can be associated with either large future economic gains or losses, suggesting a need for future analyses based on branches of decision theory that deal with severe uncertainty. I conclude with a general recommendation that climate legislation should be explicit about the conditions under which afforestation for carbon sequestration of native vegetation is a legitimate climate mitigation strategy.

Does encouraging the use of wetlands in water quality trading programs make economic sense?

- Ecological Economics---2010---Matthew Heberling,Jorge García,Hale W. Thurston

This paper examines a proposal to incorporate the use of wetlands in water quality trading (WQT) programs in order to meet national wetlands goals and advance WQT. It develops a competitive WQT model wherein wetland services are explicitly considered. To participate in a WQT program, an agricultural producer could employ wetlands as his nutrient management practice. Unlike most other management practices, wetlands not only remove nutrients from agricultural runoff but also provide ancillary benefits like wildlife habitat and flood control that do not exclusively accrue to the farmer. Thus, when appropriate, a WQT program should be coupled with additional incentives for wetland creation and restoration, such as using a wetland subsidy. Despite the water quality enhancement properties of wetlands, the model reveals that implementing a wetland subsidy will not necessarily translate into water quality improvements. While wetland creation is externally incentivized, the farm's opportunity cost of fertilizer usage in the WQT market is also reduced. In this sense, a wetland subsidy acts like a fertilizer subsidy. Conditions under which a wetland subsidy will help expand WQT include some degree of farmland area fixity, which is resembled in some, but not all, watersheds, and high efficiency of the wetland abatement technology.

Trade, environmental regulations and industrial mobility: An industry-level study of Japan

- Ecological Economics---2010---Matthew Cole,Robert Elliott,Toshihiro Okubo

This paper contributes to the small but growing body of literature which tries to explain why, despite the predictions of some theoretical studies, empirical support for the pollution haven hypothesis remains limited. We break from the previous literature, which tends to concentrate on US trade patterns, and focus on Japan. In common with Ederington et al.'s (2005) US study, we show that pollution haven effects are stronger and more discernible when trade occurs with developing countries, in industries with the greatest environmental costs and when the geographical immobility of an industry is accounted for. We also go one step further and show that our findings relate not only to environmental regulations but also to industrial regulations more generally.

Austria's CO2 responsibility and the carbon content of its international trade

- Ecological Economics---2010---Pablo Muñoz,Karl Steininger

Seeking to limit global warming to 2° C puts narrow restrictions on the remaining carbon budget. While the prevalent accounting framework for carbon emissions is production based (Production-Based Principle, PBP), we here quantify the CO2 emissions on the basis of the Consumption-Based Principle (CBP) for Austria. At a methodological level, a Multi-Regional Input-Output model with full linkages is used to account for Austria's CO2 responsibility on a global scale. Estimates are carried out for the years 1997 and 2004. Results show that during 1997 CO2 responsibility based on CBP were 36% larger than those based on PBP. This relation has increased through time. The CBP indicator of 2004 was 44% larger than the PBP. In terms of carbon emission location, for each Euro spent on Austrian final demand in 2004, it is estimated that two-thirds of the CO2 emissions occur outside Austrian borders.

Regarding the origin of the emissions embodied in imports, it is estimated that about one-fourth originated in non-Annex I countries in 1997. This proportion increased to one-third by 2004. Due to this divergence between CBP and PBP indicators, there is a need to re-think current accounting bases in order to properly assign CO2 responsibilities.

Valuing marine turtle conservation: A cross-country study in Asian cities

- Ecological Economics---2010---Jianjun Jin,Anabeth Indab,Orapan Nabangchang,Truong Dang Thuy,Dieldre Harder,Rodelio F. Subade

The prime objective of this paper is to estimate from a cross-country perspective the willingness to pay for marine turtle conservation using the contingent valuation method. A secondary objective is to investigate two methodological issues about contingent valuation study: scope effect and payment vehicle effect. Using a uniform survey instrument and protocol, a sample of 3680 respondents from Beijing (China), Davao City (Philippines), Bangkok (Thailand) and Ho Chi Minh/Hanoi (Vietnam) were interviewed. Results indicate that the respondents in all cities have a positive willingness to pay for marine turtle conservation. The type of scope effect and payment vehicle effect considered did not seem to be significant in Beijing, Davao City and Bangkok. But some evidence show that there are scope effect and payment vehicle effect in Ho Chi Minh/Hanoi sample. Our study offers practical insights into Asian household preferences for marine turtle conservation.

Refuting two claims about virtual water trade

- Ecological Economics---2010---Erik Ansink

Using the Heckscher-Ohlin trade model, I refute two prominent but incorrect claims on virtual water trade. These claims are that virtual water trade (i) levels uneven water distribution, and (ii) reduces the potential for water conflict. Both claims are based on an incorrect understanding of comparative advantage in the production of water-intensive goods. The results show that both claims only hold under certain conditions,

but do not necessarily follow from the Heckscher-Ohlin trade model.

An experimental investigation of revealed environmental concern

- Ecological Economics---2010---Natalia V. Czap,Hans J. Czap

This paper explores the determinants of revealed environmental concern. Specifically, the model proposed in this paper examines the connection between the willingness to sacrifice monetary well-being to support the environment and stated environmental concern, psychological predispositions, socio-economic and demographic characteristics, and pecuniary incentives. Empirical tests show that certain facets of stated environmental concern (such as New Environmental Paradigm, environmental-economic tradeoff, and participation in outdoor activities), psychological traits of trust and empathy, socio-demographic characteristics of gender and residence, as well as pecuniary incentives, including monetary benefits and opportunity costs, are good predictors of actual behavior in the revealed environmental concern experiment. The results support general external validity of environmental concern constructs. They also add to the discussion of what psychological factors drive individuals' actions benefiting the environment, which is of particular interest to environmental agencies and organizations. In addition, we find evidence of a common understanding of how much ought to be donated, as donations are less sensitive to external factors compared to actions based on monetary incentives. The results also demonstrate that an increase in the opportunity costs of donations leads to a very modest decrease in donations, which is good news for environmental agencies.

Christos Zografos and Richard B. Howarth,
Editors, Deliberative Ecological Economics,
Oxford University Press (2008) ISBN
9780195696974 271 pp

- Ecological Economics---2010---Alex Lo

2010

Sustainable de-growth: Mapping the context, criticisms and future prospects of an emergent paradigm

- Ecological Economics---2010---Joan Martínez-Alier,Unai Pascual,Franck-Dominique Vivien,Edwin Zaccai

"Sustainable de-growth" is both a concept and a social-grassroots (Northern) movement with its origins in the fields of ecological economics, social ecology, economic anthropology and environmental and social activist groups. This paper introduces the concept of sustainable de-growth by mapping some of the main intellectual influences from these fields, with special focus on the Francophone and Anglophone thinking about this emergent notion. We propose hypotheses pertaining to the appeal of sustainable de-growth, and compare it to the messages enclosed within the dominant sustainable development idea. We scrutinize the theses, contradictions, and consequences of sustainable de-growth thinking as it is currently being shaped by a heterogeneous body of literature and as it interacts with an ample and growing corpus of social movements. We also discuss possible future paths for the de-growth movement compared to the apparent weakening of the sustainable development paradigm.

Evaluating China's urban environmental sustainability with Data Envelopment Analysis

- Ecological Economics---2010---Yan Yu,Zongguo Wen

China's rapid urbanization has been characterized by excessive economic growth and a series of environmental issues. The urban environmental sustainability of 46 typical Chinese cities in 2007 was evaluated with Data Envelopment Analysis in this paper, and the Malmquist Productivity Index was used to identify the change within 2006-2007. This analysis employed indicators from economic, environmental, and resource subsystems which are frequently involved in the concept of environmental sustainability. We introduced projecting and benchmarking as two possible approaches for less sustainable cities to refer to their peers. Based on the

computed results and empirical analysis, the roles of GDP per capita, city scale, and industrial structure as influence factors of environmental sustainability were explored; and the regional disparity of urban environmental sustainability was also investigated. The results show: (1) 24% of the sample cities (e.g. Beijing, Hohhot, etc.) are relatively "environmentally sustainable." The efficiency scores of Urumqi rank the last. (2) GDP per capita, city scale, and industrial structure factors all exert significant influence on urban environmental sustainability. (3) The environmental sustainability of southeast cities leads the 6 major Chinese regions, and cities around the Bohai area are rapidly approaching environmental sustainability.

The (limited) political influence of ecological economics: A case study on Dutch environmental policies

- Ecological Economics---2010---Daan Boezeman, Pieter Leroy, Rob Maas, Sonja Kruitwagen

Although the ecological economics (EE) discourse attempts to influence environmental policy, empirical studies have concluded that its success in this endeavour has been limited thus far. In the Netherlands, however, two EE-related policy concepts, Environmental Utilisation Space and Ecological Footprint, were strongly present in environmental policy during certain periods in time, but subsequently disappeared from the environmental agenda. The central question of this article is how these ups and downs of the EE concepts can be understood: which factors determine their rise on and fall from the policy agenda over time? To answer this question, this article offers a conceptual model informed by the approaches in political science on framing, agenda-setting and knowledge utilisation. We conclude that the interplay of concept-specific characteristics, the formation of coalitions around the concept and contextual variables explain the rise and fall of the aforementioned concepts. A match between the dominant policy frame and the core elements of the concept provides the opportunity for the two concepts to be pushed on the agenda. We observe the alternation of 'constraining' frames, which allows for EE

concepts to survive, and 'reconciling' frames, which block agenda entrance for EE concepts. Furthermore, the alternation of these frames seems to correlate with economic and public environmental attention cycles in the Netherlands.

Measuring and decomposing sustainable efficiency in agricultural production: A cumulative exergy balance approach

- Ecological Economics---2010---Viet-Ngu Hoang, D.S. Prasada Rao

Environmental efficiency measures constructed using the materials balance principle have two important shortcomings: (1) the ambiguity in the treatment of immaterial inputs and the various types of energy and (2) the lack of universally accepted weights for various material inputs. These two limitations are primarily caused by the fact that the materials balance condition is strictly regulated by the law of mass/energy conservation and that mass/energy content cannot be a good physical common unit of various inputs. The use of cumulative exergy content overcomes these problems. The use of cumulative exergy content allows the inclusion of life cycle assessment; hence facilitates the analysis of the cumulative pollution and total affects on natural resources. The present study uses cumulative exergy content to construct new efficiency sustainable measures and decomposes them into technical efficiency and cumulative exergy allocative efficiency in agricultural production. Empirical applications on OECD agriculture yielded a number of important findings: (1) OECD has the potential to save 72.3% of cumulative exergy consumption and improvements can be achieved by being more technically efficient and choosing a better combination of inputs; (2) the sustainable efficiency varied enormously across countries; and (3) the efficiency levels in 2003 was lower than in 1990.

Influences of transaction costs in environmental policy

- Ecological Economics---2010---Anthea Cogan, Stuart Whitten, Jeffrey Bennett

There is a growing literature reporting the extent of transaction costs for environmental policies. However understanding why transaction costs occur and why they are small or large is also important for efficient policy selection and evaluation. Following an analysis of the organisational economics literature and reports of the extent of transaction costs for a number of environmental policies, three key influences to transaction costs in environmental policies are identified. These are the following: 1) the characteristics of the transaction for the environmental good; 2) the nature of the transactors; and 3) the current institutional environment and arrangements. These affect transaction costs to the government and all other parties influenced by a policy. Transaction costs occur due to actions of information collection and policy design, policy enactment and establishment, implementation and contracting, administration and monitoring, and enforcement. An interrogation of transaction cost influences reveals that: 1) the influence varies between parties and is affected by the actions and interactions of and between all parties to a policy; 2) how transaction costs are experienced varies across time; and 3) who experiences transaction costs depends on the policy itself. Future policy selection and refinement will benefit from empirical analysis of the causes of transaction costs.

Certified organic agriculture in China and Brazil: Market accessibility and outcomes following adoption

- Ecological Economics---2010---Myles Oelofse, Henning Høgh-Jensen, Lucimar S. Abreu, Gustavo F. Almeida, Qiao Yu Hui, Tursinbek Sultan, Andreas de Neergaard

Based on three case studies in China and Brazil, this paper explores the terms of access for farmers' participation in certified organic agriculture (OA) and investigates the influence of adoption on productivity, nutrient budgets, income and labour use. Small-scale farmers converting to OA require substantial external production-related, marketing and certification support. Access to OA was strongly dependent upon the type of support available to farmers. Organization

based on a contract-farming model resulted in OA only being an option available to a narrow group of farmers, whilst OA initiated by a farmer cooperative provided better access. Gross output was significantly higher for oranges, whilst for the other crops gross output was similar. However, organic farmers in China felt that adoption had improved prices, incomes and market access. Farmers' perception of improved incomes is probably due to improved market access coupled with either a large production base, production intensification and production diversification. This study demonstrates that organization of farmers, and the manner in which this is structured, is crucial for external support to have an effect. Thus, OA may be a development path for small farmers if the supporting structures are provided at a small financial interest rate.

The bare necessities: How much household carbon do we really need?

- Ecological Economics---2010---Angela Druckman, Tim Jackson

The consumption patterns of Western nations are generally deemed to be unsustainable. Yet there is little attempt to restrain either material throughput or income growth. Nonetheless, in the face of the need to make 'deep' cuts in carbon emissions (for instance), consumption restraint may be a perfectly legitimate response. This paper explores the potential for a Reduced Consumption Scenario in the UK constructed by assuming that households achieve a specific 'minimum income standard' which is deemed to provide a decent life for each household type. The minimum income standards are taken from a recent study for the Joseph Rowntree Foundation and include not only subsistence commodities such as food, warmth and shelter but also the means to participate effectively in society. The Joseph Rowntree Foundation study produced detailed household expenditure budgets for these income standards. The paper uses an environmentally extended Quasi-Multi-Regional Input-Output model to estimate the greenhouse gas (GHG) emissions required in the production and distribution of all goods and

services purchased according to these budgets. Our results show that average household GHG emissions in the UK would be around 37% lower in the Reduced Consumption Scenario than they are currently. We explore several implications of these findings including: the need to change social norms around consumption, the need for investment to improve the thermal performance of homes and the need to develop new transport infrastructures. We also address the potential to reduce emissions below the level achieved in this Scenario and discuss the implications for policy.

An improved input-output model for energy analysis: A case study of Suzhou

- Ecological Economics---2010---Sai Liang,Can Wang,Tianzhu Zhang

There are some disadvantages in current input-output models for energy. This study proposes a methodology named hybrid physical input-output model for energy analysis (HPIOMEA) to study energy metabolism, taking Suzhou in China as an example. The HPIOMEA calculates energy resources in both energetic and mass units and air pollutants in mass units simultaneously from the perspective of energy balance and mass balance, which is beyond the reach of current input-output tables for energy. In addition, it can validate the rationality of the table compilation and energy projection, and illustrate the direct and accumulative effects of energy and air pollutants. The HPIOMEA reflects the physical reality of energy metabolism much better. In addition, future work on energy analysis is proposed.

Moral concerns on tradable pollution permits in international environmental agreements

- Ecological Economics---2010---Johan Eyckmans,Snorre Kverndokk

We investigate how moral concerns about permit trading affect an endogenous pollution permit trading equilibrium, where governments choose non-cooperatively the amount of permits they allocate to domestic industries. Politicians may feel reluctant to allow permit

trading and/or may prefer that abatement is undertaken domestically because of moral concerns. This will have an effect on the initial permit allocations, and, therefore, on global emissions. The impact on global emissions depends on the precise formulation of the moral concerns, but under reasonable assumptions, we show that global emissions may increase. Thus, doing what is perceived as good does not always yield the desired outcome. However, this can be offset by restrictions on permit trading when governments have moral concerns about this trade.

Public acceptability of personal carbon trading and carbon tax

- Ecological Economics---2010---Abigail L. Bristow,Mark Wardman,Alberto Zanni,Phani K. Chintakayala

Climate change is one of the greatest challenges confronting the international community requiring action to achieve deep cuts in carbon emissions. The implementation of potentially uncomfortable but necessary policy measures is, though, critically dependent upon public acceptability. This paper reports a novel application of stated preference techniques to explore the influence of key design attributes on the acceptability of a personal carbon trading scheme in isolation and when compared to a carbon tax. Illustrative forecasts from the models developed indicate the importance of design attributes, especially the basis of the initial permit allocation for personal carbon trading and the use to which revenues are put for carbon tax. Results indicate that the "best" scheme designs could be acceptable to a majority of respondents.

The physical dimension of international trade: Part 1: Direct global flows between 1962 and 2005

- Ecological Economics---2010---Monika Dittrich,Stefan Bringezu

The physical dimension of international trade is attaining increased importance. This article describes a method to calculate complete physical trade flows

for all countries which report their trade to the UN. The method is based on the UN Comtrade database and it was used to calculate world-wide physical trade flows for all reporting countries in nine selected years between 1962 and 2005. The results show increasing global trade with global direct material trade flows reaching about 10 billion tonnes in 2005, corresponding to a physical trade volume of about 20 billion tonnes (adding both total imports and total exports). The share from European countries is declining, mainly in favour of Asian countries. The dominant traded commodity in physical units was fossil fuels, mainly oil. Physical trade balances were used to identify the dominant resource suppliers and demanders. Australia was the principal resource supplier over the period with a diverse material export structure. It was followed by mainly oil-exporting countries with varying volumes. As regards to regions, Latin America, south-east Asian islands and central Asia were big resource exporters, mostly with increasing absolute amounts of net exports. The largest net importers were Japan, the United States and single European countries. Emerging countries like the 'Asian Tigers' with major industrial productive sectors are growing net importers, some of them to an even higher degree than European countries. Altogether, with the major exception of Australia and Canada, industrialized countries are net importers and developing countries and transition countries are net exporters, but there are important differences within these groups.

Peace, health or fortune?: Preferences for chicken traits in rural Benin

- Ecological Economics---2010---Vidogbèna Faustin, Anselme A. Adégbidi, Stephen T. Garnett, Delphin O. Koudandé, Valentin Agbo, Kerstin K. Zander

Fifty-four percent of Benin's population in rural areas keep indigenous chickens for subsistence livelihoods. Despite the potential to alleviate poverty by improving indigenous chicken breeds, smallholders' participation in the implementation of breeding programmes is weak. Participation could be improved with greater under-

standing of the many functions of chickens to smallholders. The objectives of this study are (1) to evaluate chicken traits including market and non-market values, and (2) to assess factors that influence the conservation of indigenous breeds. Choice modelling, a multi-attribute preference elicitation technique, was applied across 300 households in two districts in Benin. The results revealed that many of the preferred traits are expressed in indigenous chickens, whose conservation should be supported through village chicken breeding programmes and that preferences differed greatly between farmers in the two districts. However, from an economic point of view, the aim of conserving culturally significant and disease resistant indigenous breeds is contrary to the objective of increasing chicken productivity. A preference for white plumage, most common among exotic breeds, could further hinder conservation of indigenous breeds, which are mostly brown or black. The lack of knowledge about chicken characterization and flock management were identified as further severe constraints to village conservation programmes.

A framework for classifying and quantifying the natural capital and ecosystem services of soils

- Ecological Economics---2010---Estelle Domini, Murray Patterson, Alec Mackay

The ecosystem services and natural capital of soils are often not recognised and generally not well understood. This paper addresses this issue by drawing on scientific understanding of soil formation, functioning and classification systems and building on current thinking on ecosystem services to develop a framework to classify and quantify soil natural capital and ecosystem services. The framework consists of five main interconnected components: (1) soil natural capital, characterised by standard soil properties well known to soil scientists; (2) the processes behind soil natural capital formation, maintenance and degradation; (3) drivers (anthropogenic and natural) of soil processes; (4) provisioning, regulating and cultural ecosystem services; and (5) human needs fulfilled by soil ecosystem services.

Who bears the environmental burden in China--An analysis of the distribution of industrial pollution sources?

- Ecological Economics---2010---Chunbo Ma

A remaining challenge for environmental inequality researchers is to translate the principles developed in the U.S. to China which is experiencing the staggering environmental impacts of its astounding economic growth and social changes. This study builds on U.S. contemporary environmental justice literature and examines the issue of environmental inequality in China through an analysis of the geographical distribution of industrial pollution sources in Henan province. This study attempts to answer two central questions: 1) whether environmental inequality exists in China and if it does, 2) what socioeconomic lenses can be used to identify environmental inequality. The study found that: 1) race and income--the two common lenses used in many U.S. studies play different roles in the Chinese context; 2) rural residents and especially rural migrants are disproportionately exposed to industrial pollution.

Regional sustainability in Northern Australia --A quantitative assessment of social, economic and environmental impacts

- Ecological Economics---2010---Richard Wood,Stephen Garnett

This paper seeks to provide a picture of sustainability of the Northern Territory by analysing a number of sustainability indicators across indigenous status and remoteness class. The paper seeks to extend current socio-economic statistics and analysis by including environmental considerations in a 'triple bottom line' or 'sustainability assessment' approach. Further, a life-cycle approach is employed for a number of indicators so that both direct and indirect impacts are considered where applicable. Whereas urban populations are generally doing better against most quantitative economic and social indicators, environmental indicators show the opposite, reflecting the increasing market-based environmental impacts of urban populations. As we seek to value these environmental impacts appropriately, it

would be beneficial to start incorporating these results in policy and planning.

Magali A. Delmas and Oran R. Young, Editors, Governance for the Environment, New Perspectives, Cambridge University Press (2009) ISBN 0521743001 300 pp

- Ecological Economics---2010---Niki Frantzeskaki
- 2010

Debal Deb, Beyond developmentality: constructive inclusive freedom and sustainability, Earthscan, London (2009) ISBN 978-1-84407-712-0 583 pp

- Ecological Economics---2010---John Gowdy,Aneel Salman
- 2010

Wim Soetaert and Eric J. Vandamme, Editors, Biofuels, Wiley Publishers (2009) ISBN:0470026774X, 256 pp

- Ecological Economics---2010---David Pimentel
- 2010

The state of the art of environmental valuation with discrete choice experiments

- Ecological Economics---2010---David Hoyos

This paper provides with a review of the state of the art of environmental valuation with discrete choice experiments (DCEs). The growing body of literature on this field serves to emphasize the increasing role that DCEs are playing in environmental decision making in the last decade. The paper attempts to cover the full process of undertaking a choice experiment, including survey and experimental design, econometric analysis of choice data and welfare analysis. The research on this field is found to be intense, although many challenges are put forward (e.g. choice-task complexity and cognitive effort, experimental design, preference and scale heterogeneity, endogeneity or model uncertainty).

Reviewing the state of the art of DCEs serves to draw attention to the main challenges that this methodological approach will need to overcome in the coming years and to identify the frontiers in discrete choice analysis.

Dimensions and logarithmic function in economics: A short critical analysis

- Ecological Economics---2010---Kozo Mayumi,Mario Giampietro

When dealing with sustainability, we are concerned with the biophysical and the monetary aspects of economic and ecological interactions. This multidimensional approach requires that special attention is paid to dimensional issues. However, many studies in economics, as well as in ecological economics, apply dimensional numbers to exponential or logarithmic functions. We show first that it is an analytical error to put a dimensional number x into exponential functions (ax) and logarithmic functions ($\log ax$). We introduce several examples of this analytical error both in ecological economics and conventional economics. These observations are presented with the hope that they will orient future quantitative analyses toward more constructive ends. Since the empirical and theoretical studies in economics often adopt the logarithmic specification of the production and cost function, we derive a procedure or an algorithm, concerned with the given data set, by which we can examine whether or not a particular logarithmic specification is superior to the usual regression specification in terms of the least square norm.

Applying methodological pluralism to wildlife and the economy

- Ecological Economics---2010---Shekhar K. Niraj,Vikram Dayal,Paul R. Krausman

Methodological pluralism is important when we study complex systems. We aim to show that methodological pluralism yields additional insight by applying it to a specific question: how are the economy and wildlife related in developed and developing countries? We identify three possible ingredients of methodological pluralism: (1) using both qualitative and quantitative

information; (2) tapping the potential of history to illuminate slow-moving variables; and (3) explicitly synthesizing either individually or in groups, by thinking about the corresponding system. We illustrate with examples.

Incidence of forest income on reduction of inequality: Evidence from forest dependent households in milieu of joint forest management

- Ecological Economics---2010---Nimai Das

This study suggests that there is a narrower scope to expand income inequality with the increase in forest source of income to total income relative to non-forest income irrespective of the type of forest fringe villages. The addition of forest income after joint forest management (JFM) reduces measured income inequality by about 12%, all else equal, in the JFM involved households. But no such perceptible decrease has been found for non-JFM households during this period. Categorically, forest income plays the dominant role in reducing measured income inequality for those households who are relatively asset poor and that also live below poverty line. The study also shows that the non-involvement in JFM programme by the non-JFM households might bring about a major environmental shirking, because illegal timber income constitutes the major part in total income for non-JFM households even after JFM scenario.

User financing in a national payments for environmental services program: Costa Rican hydropower

- Ecological Economics---2010---Allen Blackman,Richard Woodward

National government-funded payments for environmental services (PES) programs often lack sustainable financing and fail to target payments to providers of important environmental services. In principle, these problems can be mitigated by supplementing government financing with contributions from leading environmental service users. We use original survey data and official statistics to analyze user financing in Costa

Rica's renowned national PES program, focusing on the amounts and sources of user financing, the drivers of contributions, and contributors' perceptions of the PES program. We find that user financing has supported less than 3% of the acres enrolled in the program and that hydroelectric plants are the largest private sector contributors. Large hydroelectric plants tend to contribute while small ones do not. The weight of evidence suggests that in addition to ensuring the provision of forest environmental services, hydroelectric plants' motives for contributing to the PES program include improving relations with local communities and government regulators--common drivers of participation in all manner of voluntary environmental programs. These findings raise questions about the potential of user financing to improve the efficiency and financial sustainability of national PES programs.

Place oriented ecological footprint analysis -- The case of Israel's grain supply

- Ecological Economics---2010---Meidad Kissinger,Dan Gottlieb

In today's world, any nation's ecological footprint is spread all over the globe. Still, most footprint studies are not yet sensitive to the specific locations on which the footprint falls and to the unique production characteristics of each supporting region. In recent years some studies have acknowledged the need to quantify the 'real land' footprints and particularly the share of the footprint embodied in trade. Our goal is to analyse the ecological footprint of grain-based consumption in the state of Israel during the last two decades. We present a detailed, place oriented calculation procedure of Israel's grain footprint on specific locations around the world. We document modes of production, major energy inputs in specific sources of supply, the energy required for shipping from each source, and the CO2 emissions from those operations. Our research reveals that most of Israel's grain footprint falls on North America followed by the Black Sea region. It also shows that while the overall consumption of grain products has increased throughout the research period, the size of the footprint has been dropping in recent

years as a consequence of changing sources of supply and grain composition. Finally, we discuss some of the implications of the method presented here for future footprint calculations and environmental resource management.

The value of urban tree cover: A hedonic property price model in Ramsey and Dakota Counties, Minnesota, USA

- Ecological Economics---2010---Heather Sander,Stephen Polasky,Robert G. Haight

Urban tree cover benefits communities. These benefits' economic values, however, are poorly recognized and often ignored by landowners and planners. We use hedonic property price modeling to estimate urban tree cover's value in Dakota and Ramsey Counties, MN, USA, predicting housing value as a function of structural, neighborhood, and environmental variables, including tree cover, using a spatial simultaneous autoregressive (SAR) error model. We measure tree cover as percent tree cover on parcels, and within 100, 250, 500, 750, and 1000 m. Results show that tree cover within 100 and 250 m is positive and statistically significant. A 10% increase in tree cover within 100 m increases average home sale price by \$1371 (0.48%) and within 250 m increases sale price by \$836 (0.29%). In a model including both linear and squared tree cover terms, tree cover within 100 and 250 m increases sale price to 40-60% tree cover. Beyond this point increased tree cover contributes to lower price. Tree cover beyond 250 m did not contribute significantly to sale price. These results suggest significant positive effects for neighborhood tree cover, for instance, for the shading and aesthetic quality of tree-lined streets, indicating that tree cover provides positive neighborhood externalities.

Fat tails, exponents, extreme uncertainty: Simulating catastrophe in DICE

- Ecological Economics---2010---Frank Ackerman,Elizabeth A. Stanton,Ramón Bueno

The problem of low-probability, catastrophic risk is increasingly central to discussion of climate science and policy. But the integrated assessment models (IAMs) of climate economics rarely incorporate this possibility. What modifications are needed to analyze catastrophic economic risks in an IAM? We explore this question using DICE, a well-known IAM. We examine the implications of a fat-tailed probability distribution for the climate sensitivity parameter, a focus of recent work by Martin Weitzman, and the shape of the damage function, one of the issues raised by the Stern Review. Forecasts of disastrous economic outcomes in DICE can result from the interaction of these two innovations, but not from either one alone.

An economic analysis of Midwestern US criteria pollutant emissions trends from 1970 to 2000

- Ecological Economics---2010---Zhining Tao, Geoffrey Hewings, Kieran Donaghy

From 1970 to 2000, U.S. economic output doubled but emissions of four criteria pollutants from economic activity--CO, NO_x, VOC, and SO₂--decreased by 20%. Understanding what factors have contributed to this pollution reduction in the U.S. as a whole, as well as in various regions within the country, has important policy implications. A recently developed regional environmental-econometric input-output model for the Midwestern states of the U.S. has been used to examine the causes of pollution reduction in this regional economy over a thirty-year period. Simulations conducted with this model suggest that, for the rate of growth experienced over the period, technological improvement has dominated economic structural change in the reduction of pollutant emissions. On average, technological improvement has accounted for approximately 80% of emissions reduction, while economic structural change explains the remaining 20% of the decrease. Our analysis suggests that, while much remains to be done in reducing emissions in both developed and developing countries, policies that are informed by an understanding of the role of structural change and which promote the adoption of more recently developed technologies may contribute substantially to

sustainable development.

Income effects and the inconvenience of private provision of public goods for bads: The case of recycling in Finland

- Ecological Economics---2010---Anni Huhtala

Absent or weak income effects reported in many contingent valuation studies have cast doubt on the reliability of the survey method. We find that the income effect depends on the type of public good in question: there is a negative income effect for willingness to pay for recycling, which requires time and effort for sorting, but a positive effect for the more convenient incineration. Hence, high-income (low-income) individuals may display less (more) effort on environmental behavior. This stresses the importance of comprehensive distributional analyses when assessing alternative environmental policies.

CO₂ emissions of international freight transport and offshoring: Measurement and allocation

- Ecological Economics---2010---María-Ángeles Cadarso, Luis López, Nuria Gómez, María-Ángeles Tobarra

The growing offshoring process is the result of the fragmentation of production processes and the creation of global supply chains. This process has increased final and intermediate imports, but also the distance that goods travel in different stages until they reach the final consumer, as well as the requirements of transport per unit of output and the volume of CO₂ emissions generated in transporting them. Nowadays, there is no generally accepted criterion for international transport pollution allocation. No single country has the responsibility for emissions of international bunkers provided by IPCC. In this paper we propose a new methodology for quantifying by sector the impact of international freight transport on total pollution and assigning responsibility to consumers. This methodology considers the distance and the means of transport as key elements and uses input-output methodology. We apply this to the Spanish economy combining data

from input-output tables, import data, and CO₂ emission data. The results show that the proportion of total CO₂ emissions accounted for by emissions from international freight transportation, allocated via the consumer criterion, increase up to 4.16% between 1995 and 2000. As expected, the industries where this offshoring process is more intense show the greatest increases in carbon emissions related to international transport. These emissions are significantly higher than emissions embodied in domestic inputs in some of those industries where international fragmentation of production is relevant and increasing.

Seeds for livelihood: Crop biodiversity and food production in Ethiopia

- Ecological Economics---2010---Salvatore Di Falco,Mintewab Bezabih,Mahmud Yesuf

This paper uses a farm level panel data from Ethiopia and a comprehensive empirical strategy to investigate the contribution of crop biodiversity on food production. We find that increasing the number of crop variety increases production. This result is stronger when rainfall level is lower. Moreover, the productivity analysis is complemented with the study of the determinants of farm level crop biodiversity. Empirical results suggest that rainfall, tenure security and household endowments tend to govern crop diversity decisions at the farm level.

Focus: (Re)productivity: Sustainable relations both between society and nature and between the genders

- Ecological Economics---2010---Adelheid Biesecker,Sabine Hofmeister

The paper is embedded in the multiplicity of discourses concerned with a viable, sustainable development of society and its economy. It makes a case for a mode of economic activity geared to systematically integrating production and reproduction processes. Its starting hypothesis is that the persistent, constantly changing and expanding crises that weigh so heavily on modern societies - above all the ecological crisis and the

crisis of reproductive work - have their common origin in the separation of production from reproduction constitutive for industrial modernity. A reformulation of the category of (re)productivity - the idea of the unity of and at the same time the distinction between production and reproduction in the economic process - could set the stage for us to review today's crisis phenomena, relocalize problems, and in this way to develop new solutions for them. A sustainable society would be in a position to grasp, and shape, the economy as a (re)productive regulative system, with economic space constituted consciously as a socioecological action space.

Public participation for sustainability and social learning: Concepts and lessons from three case studies in Europe

- Ecological Economics---2010---Eneko Garmendia,Sigrid Stagl

Shaping change such that it avoids losing potentially useful options for future development is a challenging task in the face of complex, coevolving socio-ecological systems. Sustainability appraisal methods, which open up dialogue and options before closing down and making suggestions, pay attention to the inclusion of various and conflicting points of view and address uncertainty, are increasingly used in the science, environment and energy policy domains. The quality of the process is seen as key to high quality appraisal outcomes. Dimensions of quality include learning opportunities which are seen as ways for addressing complexity and uncertainty. Participatory sustainability appraisal methods intend to support social learning among participants. Despite high expectations, social learning processes in sustainability appraisals are poorly conceptualized and empirically understudied. This paper (1) briefly reviews theories of social learning; (2) develops a conceptual framework for the analysis; and (3) presents an empirical application of the framework by use of data obtained from three energy and natural resource management case studies around Europe.

Efficiency of public goods provision in space

- Ecological Economics---2010---Travis Warziniack

This article incorporates a political decision process into an urban land use model to predict the likely location of a public good. It fills an important gap in the literature by modeling the endogenous location of open space. The article compares open space decisions made under a majority rules voting scheme with welfare-improving criterion and finds households tied to a location in space compete for public goods. Significant differences emerge between the two decision criteria, indicating that requiring referenda for open space decisions is likely to lead to inefficient outcomes. Specifically, many open space votes are likely to fail that would lead to welfare improvements, and any open space decisions that do pass will require amenities larger than needed to achieve the social optimum. The more dispersed and large the population, the larger the gap between the socially efficient level and the level needed for a public referendum to pass.

Using ecological indices to measure economic and environmental performance of irrigated agriculture

- Ecological Economics---2010---Md A.S. Azad,Tiho Ancev

Growing public concern about the health of rivers and wetlands, and the ecosystems they support, puts pressure on large water users-such as the irrigation industry-to find ways to use less water. At the same time, the growing competitiveness of the economic environment places demands on the industry to maintain its productivity and profitability. This study develops a method, based on the concept of an environmental performance index (EPI), to measure the economic and environmental performance of irrigated agricultural enterprises. In defining environmental pressure exerted by the irrigation industry the method incorporates certain characteristics of ecological assets affected by water withdrawal for irrigation. As an empirical application, the method was applied to a case study of seventeen natural resource management (NRM) regions

within the Murray-Darling Basin (MDB), Australia. Data Envelopment Analysis was used to compute the component distance functions in order to construct an EPI for each considered irrigated enterprise in each NRM region. The results of the analysis show that environmental efficiencies of irrigated enterprises vary considerably across NRM regions. These findings support the case for policy targeting by type of irrigation enterprise and by location of enterprises.

Luck or skill? An examination of the Ehrlich-Simon bet

- Ecological Economics---2010---Katherine Kiel,Victor Matheson,Kevin Golembiewski

In 1980, Paul Ehrlich and Julian Simon placed a famous bet on whether the prices of a bundle of natural resources would rise or fall over the ensuing decade. Simon won the bet as the real price of the bundle fell significantly, and the result of this bet has been taken as proof that technological progress is likely to overcome that of any Neo-Malthusian concerns about natural resource scarcity. Contrary to the popular perception, however, an examination of the price history of the identical bundle of goods from 1900 to 2008 shows that Ehrlich and not Simon would have won a majority of the bets over the past century and would have done so by a wide margin.

Bridging theories on environmental governance: Insights from free-market approaches and institutional ecological economics perspectives

- Ecological Economics---2010---Lenka Slavíková,Tatiana Kluvánková-Oravská,Jirina Jílková

Due to methodological problems and their practical limitations, the criticism of neoclassical environmental economics is increasing. The goal of this paper is to stress the differences and similarities between the two competing alternative approaches - institutional ecological economics and free-market approaches to environmental protection - to encourage their interactions towards a possible synthesis in the future.

How costly is mitigation of non-CO2 greenhouse gas emissions from agriculture?: A meta-analysis

- Ecological Economics---2010---Bruno Ver-
mont,Stéphane De Cara

This text reviews the assessments of marginal abatement costs of methane and nitrous oxide emissions from agriculture. We use agricultural emissions and the corresponding prices collected from 21 studies that have assessed abatement potentials and costs using various modeling approaches and assumptions. We first highlight the implications of the modeling approach for marginal abatement costs. Harmonized abatement rates for three emission prices (10, 20 and 50 $\text{€}/\text{tCO}_2\text{eq}$) are regressed on variables that reflect various modeling assumptions and study characteristics. In a second step, the emission price is introduced as an explanatory variable. When controlling for a few key characteristics of the studies, the models explain an important share of the observed variability in abatement rates. The type of modeling approach is found to have a significant effect. In particular, we find that equilibrium models lead to higher abatement rates for a given price. The flexibility in nitrogen use and its effect on crop yields also plays a significant role in lowering marginal abatement costs. The results of the second step indicate that the price elasticity of the abatement rate is about 0.6. This estimate is found to be robust to several specifications and consistent with previous assessments covering other economic sectors.

Ecosystem services valuation in China

- Ecological Economics---2010---Shuang Liu,Robert
Costanza

2010

Ecosystem services research in China: Progress and perspective

- Ecological Economics---2010---Biao
Zhang,Wenhua Li,Gaodi Xie

This paper provides a comprehensive review of ecosystem services and their economic valuation in China. The main objective of this review is to introduce the findings of the various valuation studies, and explore the challenges that emerged in these studies. This paper shows that ecosystem services research in China went through four stages covering all the main ecosystem types and multi-scales. These studies have raised public awareness of the value of ecological and bio-resource issues, and promoted the establishment of eco-compensation mechanisms in China. However, there are still many controversies and challenges that have emerged from current ecosystem services research. We propose that future ecosystem services research focuses on i) the corresponding definition and classification systems for all ecosystems; ii) the observation and establishment of the relationship between ecosystem structures and corresponding functions; iii) the improvement and normalization of valuation methods; and iv) the exploration and analysis of the spatial and temporal variations of ecosystem services. Furthermore, it is important to improve the accessibility of ecosystem services valuation in environmental decision-making.

Total embodied energy requirements and its decomposition in China's agricultural sector

- Ecological Economics---2010---Shuyan Cao,Gaodi
Xie,Lin Zhen

Humanity faces the important challenge of understanding and integrating human and natural processes, including agriculture. In China, the scarcity of arable land (0.09 ha per capita), increasing population, and migration of the workforce to cities pose a significant challenge for food security. Agricultural energy productivity has therefore become a key concern. In this study, we used input-output analysis to measure energy productivity at a national agro-ecosystem scale for China using the total embodied energy requirement (TEER) to reveal hidden energy flows. We introduced a structural decomposition technique that reveals how changes in TEER for the agricultural sector were driven by changes in energy-use technology and the inter-

relationships among two agricultural sectors (farming and animal husbandry). The results will help both policymakers and farmers to improve the efficiency and environmental compatibility of agricultural production. Declining TEER for both sectors means that China's overall agro-ecosystem has increased its energy productivity since 1978 due to improved relationships between the agricultural sectors and increased use of biological energy. However, the net positive energy income decreased in the farming sector and an increasing proportion of fossil energy use, accompanied by increased energy income in the animal sector, provide incentives to increase yield and decrease labor by using more fossil energy, thus raising more animals in the animal husbandry sector. Overuse of fossil energy since 1990 has resulted in decreasing fossil energy efficiency, requiring immediate measures to improve the use of fossil-fuel-intensive materials such as fertilizers.

Spatial and temporal flows of China's forest resources: Development of a framework for evaluating resource efficiency

- Ecological Economics---2010---Shengkui Cheng,Zengrang Xu,Yun Su,Lin Zhen

Population growth and resource scarcity have remained major constraints on China's development for several decades. Under conditions of resource limitations, utilization efficiency is a key concern for Chinese scientists and decision-makers. Based on forest production and trade data for China, we present a conceptual framework for resource flow analysis, calculate the quantities and analyze the characteristics of flows of forest resources (primarily wood and wood byproducts) during the critical early economic development of China (from 1953 to 2000) by converting the forest resource flows into log equivalents (i.e., the quantity of logs required to generate a unit of each type of product). The consumption of forest resources has accelerated throughout the study period, and the structure and efficiency of forest resource utilization have both improved. The proportion of forest resource flows obtained from outside China has increased, and most of this wood was consumed by wood-processing industries. Over time,

consumption has shifted from logs and lumber to the pulp and paper and artificial board industries. To improve the economics and sustainability of its use of forest resources, China should increase consumption of forest resources by its pulp and paper industry, more fully utilize forest resources obtained from outside China, and weaken the dependence on these foreign forest resources by promoting increased utilization efficiency and structural readjustment of the forest industry. Therefore, improved forest management is an effective mean of weakening the dependence on foreign forest resources.

Water conservation of forest ecosystem in Beijing and its value

- Ecological Economics---2010---Zhang Biao,Li Wenhua,Xie Gaodi,Xiao Yu

Under a scenario of global climate change, the water conservation function of Beijing's forest ecosystems has attracted considerable public attention. In this paper, the term of water conservation is described as a comprehensive regulation of forests on water resources through various hydrological processes, and grouped into three services, i.e., rainfall interception, soil water storage and fresh water provision. On the basis of Beijing's forest resource survey data and mathematical simulations, the function and the economic value of water conservation was estimated. The result showed that, the forest ecosystems of Beijing could intercept approximately 1.43 billion cubic meters of rainfall and 277.82 million cubic meters of soil water under ideal conditions, and supply 286.67 million cubic meters of fresh water, their economic values were estimated to be about 2.77 billion RMB(Chinese Currency, 8.28RMB = US\$1), 2.15 billion RMB, and 315.33 million RMB, respectively. The total economic value of water conservation provided by Beijing's forests was 5.23 billion RMB, and the economic benefit per hectare was equal to 5704 RMB. Furthermore, the spatial variation of water conservation functions and the monetary values of the main forest ecosystems in different locations in Beijing were analyzed, and the effects of water conservation provided by the forest

ecosystem on the development of society and economy in Beijing were discussed. This work contributes to the realization and preservation of forest resources in Beijing.

Variations in ecosystem service value in response to land use changes in Shenzhen

- Ecological Economics---2010---Li Tianhong,Li Wenkai,Qian Zhenghan

Urban sprawl significantly impacts ecosystem services and functions. The exact impacts, however are difficult to quantify and are often neglected in policy making. The evaluation of ecosystem services is conducive to clarifying the ecological and environmental changes caused by urbanization. The objective of this study is to investigate variations in ecosystem services in response to land use changes during urbanization. The aim is to provide useful information and advice for policy makers concerned with sustainable development. Shenzhen, one of the fastest growing metropolitan areas in China, is selected as the study area. A fast evaluation method for ecological service values based on land use change was proposed and applied to the city for 1996, 2000 and 2004. The total value of ecosystem services in Shenzhen was 2776.0 million Yuan in 1996, 2911.4 million Yuan in 2000 and 2544.7 million Yuan in 2004 respectively, with a decrease of 231.3 million Yuan from 1996 to 2004 mainly due to the decreasing areas of woodland, wetland and water body. The combined ecosystem service value of woodland, wetland, water body and orchard was over 90% of the total value. Water supply and waste treatment were the top two service functions with high service value, contributing about 40% of the total service value. The results suggest that a reasonable land use plan should be made with emphasis on protecting wetland, water body and woodland, which have the highest ecosystem service value.

Valuing environmental externalities from rice-wheat farming in the lower reaches of the Yangtze River

- Ecological Economics---2010---Yao Lv,Shu-zhong Gu,Dong-mei Guo

Environmental externalities generated by agriculture are attracting considerable attention. However, most research has focused either on environmental services that agriculture provides as a distinct ecosystem or the negative environmental impacts that agriculture imposes. Therefore, there is a great need to re-evaluate the all-round environmental roles of agriculture, to optimize environmental performance of agriculture and non-trade concerns in World Trade Organization (WTO) negotiations. By valuing the environmental externalities of agriculture, this article aims to heighten awareness of the environmental roles of agriculture to stimulate its implication in agricultural policy-making. The study presents estimates of economic values of environmental externalities from rice-wheat farming system in Zhenjiang, in aspects of greenhouse gas emissions, non-point source pollution, carbon sequestration and water containing capacity. We provide a step-by-step analytic procedure, with each step including measurement of physical dimensions and monetary evaluation. The former is based on a large-scale literature review, which provided a vital foundation for the monetary valuation. The results reveal that the values of greenhouse gas emissions from agricultural land, agricultural non-point source pollution, carbon sequestration by crop and soil, and the flood control function provided by agricultural land are estimated as: -US\$3.61 $\times 10^7$ a⁻¹, -US\$4.59 $\times 10^6$ a⁻¹, +US\$2.30 $\times 10^9$ a⁻¹ and +US\$2.21 $\times 10^7$ a⁻¹, respectively. The net value of environmental externalities is as high as +US\$2.28 $\times 10^9$ a⁻¹, representing 17.87% of local GDP and 4.12 times the total agricultural output value in 2006. The results suggest that crops and soil in Zhenjiang are the most important carbon sinks, and that agriculture in Zhenjiang has huge positive environmental externalities, although both greenhouse gas emissions from agricultural land and agricultural non-point sources pollution have negative environmental

impacts.

Arable land requirements based on food consumption patterns: Case study in rural Guyuan District, Western China

- Ecological Economics---2010---Lin Zhen, Shuyan Cao, Shengkui Cheng, Gaodi Xie, Yunjie Wei, Xuelin Liu, Fen Li

In comparison with all data for rural China, deficiencies of animal protein and fat intake were identified using the method of Gerbens-Leenes et al. ([Gerbens-Leenes, P.W., Nonhebel, S., Iven, W.P.M.F., 2002. A method to determine land requirements relating to food consumption patterns. *Agriculture, Ecosystems and Environment*, 90: 47-45]) in examining food consumption patterns and arable land requirements of Guyuan District, a remote rural area of western China. Population growth and rapid economic development have increasingly been reducing the land available for primary production, creating potentially serious risks for China's food security. Land required to produce food is determined by population size, consumption patterns, land resource endowment - or "agro-ecological" conditions and the level of farm intensification. Per capita land requirements in Guyuan District were identified to meet basic consumption needs, and to evaluate nutritional conditions related to current consumption patterns. Data used for this analysis were obtained from surveys of household food consumption. Food consumption involved only meeting basic requirements for sustenance, with grains, potatoes, vegetables, fruits, and plant oils being the most commonly consumed foods. Per capita intake of calories totaled $11.1 \text{ MJ} \cdot \text{day}^{-1}$, matching the recommended level for China to meet basic health requirements. Daily protein intake was $66.8 \text{ g} \cdot \text{person}^{-1} \cdot \text{day}^{-1}$, being below the recommended standard of $77 \text{ g} \cdot \text{person}^{-1} \cdot \text{day}^{-1}$. Of this total, protein from animal meat accounted for only 7.5% of total protein. Fat intake totaled only $47.4 \text{ g} \cdot \text{person}^{-1} \cdot \text{day}^{-1}$, being far below the standard of $70 \text{ g} \cdot \text{person}^{-1} \cdot \text{day}^{-1}$. Yet, farmers must sell their limited livestock to earn enough income to meet their daily consumption needs. This

expenditure accounted for nearly 33% of mean annual household income, so only 28% of domestic animal products were consumed locally. Benchmark data is provided to assist with improving living standards of rural people.

Impacts of the Natural Forest Conservation Program on the livelihoods of residents of Northwestern China: Perceptions of residents affected by the program

- Ecological Economics---2010---Shixiong Cao, Xiuqing Wang, Yuezhen Song, Li Chen, Qi Feng

Conservation of the ecological environment presents scientists with a challenging dilemma because the strategy often leads to negative impacts on impoverished people in the area affected by the project. To consider this problem, we investigated the implications of China's national and regional policies related to the Natural Forest Conservation Program (NFCP) for poverty in the dryland regions of northern Shaanxi Province. We found that 34.9, 47.0, and 59.8% of farmers, livestock grazers, and forest workers respectively, felt that their livelihoods had been adversely affected by the NFCP due to the ban on logging and grazing imposed by this program, and they perceived additional economic losses because they were not adequately compensated for their economic losses under the program. These perceptions are supported by economic data. In addition, our results showed that the poorer the survey respondent, the greater the likelihood they believed that they had suffered from the implementation of the NFCP. Although Chinese citizens have become more favorable towards environmental conservation efforts, the poorest citizens still need considerable help to make it possible for them to participate in both economic development and environmental restoration.

Multiple criteria evaluation of ecosystem services for the Ruorgai Plateau Marshes in southwest China

- Ecological Economics---2010---Xiaoyun Zhang, Xianguo Lu

Understanding total ecosystem value is useful for decision making and sustainable management. This paper demonstrates how to integrate social factors into the ecosystem service appraisal with a social welfare weight using the Ruoergai Plateau Marshes as a case study. The AHP method is used to determine the social welfare weight. With analyses of the Ruoergai Plateau Marshes' functions, stakeholders and ecosystem services, a three-level hierarchical structure model is established. After each ecosystem service was calculated, the total value of the Ruoergai Plateau Marshes is determined by introducing the social welfare weight. After including the social welfare weight, the value of the Ruoergai Plateau Marshes ecosystem services increases from US\$2.31 billion to US\$9.97 billion.

Energy quality

- Ecological Economics---2010---David Stern

This paper develops economic definitions of energy quality for individual fuels and energy aggregates. There are use- and exchange-value concepts, as well as marginal and total measures, of energy quality. A factor augmentation or quality coefficients approach corresponds to the use-value definition while indicators based on distance functions and relative prices are exchange-value based definitions. These indicators are identical when the elasticity of substitution between fuels is infinity but diverge or cannot be computed for other interfuel elasticities of substitution. When the elasticity of substitution is zero only the quality coefficients approach is defined. I also show that 1) the ratio of an energy volume index to aggregate joules cannot be considered a complete indicator of aggregate energy quality as it does not account for quality changes in the component fuels 2) demand curve integrals do not provide information on relative use-values or fuel qualities when the elasticity of substitution is unity or less.

Valuing ecosystem services on the basis of service-providing units: A potential approach to address the 'endpoint problem' and improve stated preference methods

- Ecological Economics---2010---Areti Kontogianni, Gary W. Luck, Michalis Skourtos

Standardized methods are required to measure ecosystem services in order to value them. In this paper, we argue that the service-providing unit (SPU) concept may help achieve this objective by promoting the systematic quantification of the key components of nature that provide services (e.g., population density of a key pollinator) and linking these with measurable outcomes for human well-being. We discuss and provide examples of the potential role of the SPU concept in improving economic valuation of ecosystem services. Further, we suggest the concept may contribute to addressing the endpoint problem, which can be defined simply as the inability of researchers to communicate the implications of environmental change in a way that is understood by a broad cross-section of society. The endpoint problem is of particular relevance to stated preference approaches, and we discuss the capacity of the SPU concept to refine these approaches. We argue that the concept enhances interdisciplinary collaboration, promoting more validated, well-informed valuation applications. It also has the potential to minimize 'warm glow effects' and put the notion of marginal changes in the provision of ecosystem services in a new light.

Finding common ground between ecological economics and post-Keynesian economics

- Ecological Economics---2010---Tobias Kronenberg

Post-Keynesian economics and ecological economics have in common that they are considered to be 'heterodox' schools of thought. Aside from that, there has not been a strong connection between them. Previous books on post-Keynesian economics contain no chapter on environmental or ecological issues. This neglect has led leading ecological economists to criticize post-Keynesians for succumbing to the same growth

paradigm as the neoclassical school. This paper argues that the two approaches are complementary in the sense that they each have different strong points. Ecological economics has correctly pointed out that the growth of the global economy may not be welfare-improving anymore, whereas post-Keynesians have gained valuable insights into the functioning of the capitalist growth process. To determine the feasibility of a synthesis between the two schools, the paper compares their approaches to the problems of production, consumption, and economic dynamics as well as the associated policy recommendations. It shows that on a theoretical level the two schools have much in common, but their policy conclusions differ with regard to the desirability of further growth. The paper concludes that a synthesis of both approaches may lead to a better understanding of how a capitalist economy operates in a natural environment with limits to growth and to better-informed policy advice.

Paying the piper and calling the tune?: A meta-regression analysis of the double-dividend hypothesis

- Ecological Economics---2010---Niels Anger,Christoph Böhringer,Andreas Löschel

We present a meta-regression analysis of model-based simulation studies assessing the employment effects of environmental tax reforms. Besides the role of central modeling assumptions we investigate the implications of contracting bodies on the simulation results. Our analysis reveals the importance of unobservable study characteristics for the prospects of a double dividend in terms of lower emissions along with higher employment levels. While at first glance labor market assumptions and the contracting body seem to play a central role for the model outcome, these observable features are no longer significant when unobservable study features are controlled for. In contrast, we find the simulated employment impacts of environmental tax reforms to be determined by a joint set of explicit model assumptions as well as implicit characteristics of the respective studies.

The economics of cropland conversion in Amazonia: The importance of agricultural rent

- Ecological Economics---2010---Michael L. Mann,Robert Kaufmann,Dana Bauer,Sucharita Gopal,Maria Del Carmen Vera-Diaz,Daniel Nepstad,Frank Merry,Jennifer Kallay,Gregory S. Amacher

We use spatially efficient logit models to explore the role of economic incentives on the expansion of cropland in the Mato Grosso region between 2001 and 2004. An empirical measure for agricultural economic rent is used to quantify the desirability of a particular plot of land, which previous research proxies with variables such as distance to roads or urban areas, and simple climatic and edaphic variables. Results indicate that the measure for economic rent provides additional information and explanatory power to one of the most commonly used proxies, distance to roads. As predicted by economic theory, it is not simply access or variation in transportation costs that drives the spatial determinants of agricultural expansion, but the expected total returns from the venture. This suggests that spatially explicit rent models can be used to simulate the location and quantity of land-use change in an economically consistent framework. Such a framework lays the foundation for an enhanced methodology that can evaluate the ability of fiscal policy levers to influence the location of agricultural conversion with the ultimate aim of balancing economic and environmental goals.

A framework for the assessment of ecosystem goods and services; a case study on lowland floodplains in England

- Ecological Economics---2010---H. Posthumus,J.R. Rouquette,J. Morris,D.J.G. Gowing,T.M. Hess

The rural space is increasingly valued for the multiple ecosystem services that it can deliver. For example, priorities in many lowland floodplains in England have changed in recent years from a focus on agricultural production towards environmental quality and the management of flood risk, in part linked to climate change.

Recent concerns about food security, however, may reinstate the importance of agricultural production in these fertile areas. This paper explores changes in rural land use in floodplains by measuring the range of ecosystem services provided under different management scenarios. Generic land use scenarios consider management options that focus on single objectives, such as maximising agricultural production, maximising biodiversity and maximising flood storage capacity. Indicators are developed to value the ecosystem services provided by floodplains under each scenario, identifying potential synergy and conflict. This integrated ecosystems approach can help to inform future policy and practice for floodplain management, hopefully in ways that appeal to key stakeholders.

The citizen versus consumer distinction: An exploration of individuals' preferences in Contingent Valuation studies

- Ecological Economics---2010---Peter Howley, Stephen Hynes, Cathal O'Donoghue

Contingent valuation has been used extensively in estimating the value of environmental goods. One criticism of this approach, however, is that respondents in referendum-style contingent valuation surveys may express citizen assessments that take into account benefits to others rather than benefits that accrue purely to the respondent themselves. Within this context, the aim of this paper is to examine to what extent individuals express different preferences when adopting a personal or a social/citizen perspective. While this paper provides some support for the hypothesis that individuals express different preferences when adopting collective as opposed to personal choices, reported willingness to pay (WTP) was found to be insensitive to whether or not the respondents were asked the WTP question from a personal or social perspective.

Preferences for site and environmental functions when selecting forthcoming national parks

- Ecological Economics---2010---Jette Bredahl Jacobsen, Bo Thorsen

A political decision to establish the first ever national parks in Denmark allowed us to examine if people hold preferences regarding which site to be designated as national park, separate from the preferences for its environmental functions. To this end, we designed a choice experiment representing the national park alternatives by the possible site and the possible improvements in environmental functions. Results revealed that respondents have strong preferences for the establishment of a national park per se. Furthermore, there are significant differences in taste parameters for the different sites, which cannot be explained by respondents' valuing the different functions differently across sites. Instead we explain the results with differences in regional and cultural preferences. We also performed a balanced split-sample test of anchoring effects and found clear evidence of this. We included a zero-bidder screening question prior to the choice set part of the survey instrument to improve WTP estimation.

Decoupling waste generation from economic growth -- A CGE analysis of the Swedish case

- Ecological Economics---2010---Magnus Sjöström, Göran Östblom

Over the past decades, we have seen the quantities of solid waste increase in close relation to economic growth. To tackle this problem of continuing waste growth, the EU has on its agenda that waste generation should decouple from economic growth within the EU in the future. Sweden also has stated a target of non-increasing future waste quantities. The strength of the policy measures needed to attain this target is here illustrated by comparing the waste intensity outcomes in a 'Decoupling scenario' and a 'Baseline scenario' of the Swedish economy 2006-2030. A Computable General Equilibrium (CGE) model is used for linking waste generation to firms' material input, firms' production and households' consumption when projecting future quantities of hazardous and non-hazardous waste in Sweden. We show that to offset the effect of economic growth on waste generation in the 'Decoupling scenario', the intensities of material-related wastes must decrease at a yearly rate that is about

twice the historically estimated reduction rate used in the 'Baseline scenario'. The reduction in the intensities of waste related to firms' production and households' consumption must also be substantial compared to historical estimates.

The role of corporate sustainability performance for economic performance: A firm-level analysis of moderation effects

- Ecological Economics---2010---Marcus Wagner

This paper analyses the link between sustainability management and economic performance. Its main research question concerns the association of social responsibility and environmental management with economic performance, determinants of the latter and possible moderation effects. Based on data collected from financial databases and Kinder Lydenberg Domini for the period 1992 to 2003, the paper analyses the link of corporate sustainability performance with economic performance using panel estimation techniques. The analysis shows that advertising intensity moderates the association of corporate sustainability performance and economic performance as measured by Tobin's q. For research and development efforts relative to firm size, no moderating role on the link between corporate sustainability and economic performance is identified. A sensitivity analysis using separate measures for social and environmental performance reveals that the latter only has a direct effect and the former only a fully moderated effect on economic performance. Policy and management implications of these findings are discussed.

Two unannounced environmental tax reforms in the UK: The fuel duty escalator and income tax in the 1990s

- Ecological Economics---2010---Paul Ekins,Harold Kleinman,Sarah Bell,Andrew Venn

Environmental tax reform (ETR) is a process of shifting the weight of taxation from socially desirable activities, such as labour and profit-generation, to the use of natural resources and the generation of pollution. The

paper calculates the revenues from the UK fuel duty escalator (FDE) (an above-inflation increase in fuel duty implemented from 1993 to 1999), and compares these with the revenues lost from the cuts in income tax in 1995 and 1996, and again in 2001. The paper finds that the lost revenue was roughly the same as the revenue from the FDE. In effect the governments concerned had implemented an ETR without in any way drawing attention to the fact. The FDE was discontinued in 1999 when the oil price rose and, in the face of protests at the level of fuel duty the following year, real revenues from fuel duty subsequently declined. It is at least arguable that, had the fact that FDE had facilitated income tax cuts been established by the government at the time, the FDE and fuel duty generally would have been less unpopular.

Balancing the use of wetlands for economic well-being and ecological security: The case of the Limpopo wetland in southern Africa

- Ecological Economics---2010---Wellington Jogo,Rashid Hassan

Wetlands in southern Africa continue to be degraded and lost through conversion to agriculture and other uses. One of the major constraints to sustainable management of wetlands in the region is that wetland users and decision-makers have insufficient understanding of the consequences of alternative management and policy regimes on wetland functioning, ecosystem services and human well-being. This study developed an ecological-economic model based on the system dynamics framework to simulate the impacts of alternative policy regimes on wetland functioning and economic well-being. Results showed that wetland services (crop production and natural resource harvesting) are inter-linked with trade-offs involved through their competition for labour, land and water resources. Policy scenario simulation results showed that diversifying livelihoods out of agriculture simultaneously improves economic well-being and enhances wetland conservation. Pure conservation strategies impose significant losses in the economic welfare of local population unless supported with diversification of livelihood sources.

Government policies that support livelihood diversification into off-farm livelihood opportunities for the rural poor are critical for sustainable wetland management.

Balancing state and volunteer investment in biodiversity monitoring for the implementation of CBD indicators: A French example

- Ecological Economics---2010---Harold Levrel,Benoît Fontaine,Pierre-Yves Henry,Frédéric Jiguet,Romain Julliard,Christian Kerbiriou,Denis Couvet

According to the Convention on Biological Diversity (CBD), states have to provide indicators in order to assess the performance of their initiatives for halting the loss of biodiversity. Sixteen headline indicators have been identified for monitoring the CBD targets. Of these indicators only one, "Trends in the abundance and distribution of selected species," is a direct headline indicator of "non-exploited" biodiversity. In France, the implementation of this indicator is completely dependent on data collected by volunteers. Since this investment of volunteer time is equivalent to savings in administrative costs, we attempt in this paper to assign it a monetary value. This enables us to estimate how much the French administration saves thanks to volunteer efforts and how much public funding would have to be invested if volunteers were no longer willing to participate in these biodiversity monitoring schemes. We estimate this amount to be between 678,523 and 4,415,251 euros per year, depending on the scenario selected.

Anxiety and technological change -- Explaining the inverted U-curve of sulphur dioxide emissions in late 20th century Finland

- Ecological Economics---2010---Jan Kunnas,Timo Myllyntaus

This article examines the linkage between per capita GDP and sulphur dioxide emissions for one single country, in this case Finland. The narrow approach together with a combination of a historical and economical approach enables us to cut deeper into the controversial

environmental Kuznets curve-hypothesis. We found the main reasons for a downturn in sulphur emissions to be: technological development and anxiety about possible environmental damage and economic costs related to that. It can be discussed whether our results refute the environmental Kuznets curve or just show possible ways in which the environmental Kuznets curve is achieved. Nevertheless our case study casts some serious doubt on the most straightforward assumption coming out from the EKC, that economic growth would automatically solve environmental problems. We claim that the causal connection might also go in an opposite direction: proper environmental standards and conservation comprise a necessary condition for economic growth in the long run.

Know, live and let live: Towards a redefinition of the knowledge-based economy -- sustainable development nexus

- Ecological Economics---2010---Gabriela L. Sabau

Most economic analyses of the Knowledge-Based Economy (KBE) and Sustainable Development (SD) use the analytical framework provided by neo-classical economics. Evolutionary and ecological approaches bring new insights and techniques borrowed mainly from evolutionary biology. This paper proposes a broader definition of both concepts and relates them by means of a wider pre-analytical vision.

Reconciling theory and practice: An alternative conceptual framework for understanding payments for environmental services

- Ecological Economics---2010---Roldan Muradian,Estevé Corbera,Unai Pascual,Nicolás Kosoy,Peter H. May

This article provides an alternative and novel theoretical approach to the conceptualization and analysis of payments for environmental services (PES). We devote special emphasis to institutional and political economy issues, which have been somewhat neglected in the literature on PES. We argue that the Coasean

and pure market approach dominating the conceptualization of PES in the literature cannot be easily generalized and implemented in practice. By contrast, taking into account complexities related to uncertainty, distributional issues, social embeddedness, and power relations permits acknowledging the variety of contexts and institutional settings in which PES operate. The alternative approach presented in this introductory article to the special section may be more appealing to PES practitioners, since while avoiding restrictive and prescriptive standpoints, it allows some key sources of complexities they usually deal with on the ground to be more easily understood.

The history of ecosystem services in economic theory and practice: From early notions to markets and payment schemes

- Ecological Economics---2010---Erik Gómez-Baggethun, Rudolf de Groot, Pedro L. Lo-mas, Carlos Montes

This paper reviews the historic development of the conceptualization of ecosystem services and examines critical landmarks in economic theory and practice with regard to the incorporation of ecosystem services into markets and payment schemes. The review presented here suggests that the trend towards monetization and commodification of ecosystem services is partly the result of a slow move from the original economic conception of nature's benefits as use values in Classical economics to their conceptualization in terms of exchange values in Neoclassical economics. The theory and practice of current ecosystem services science are examined in the light of this historical development. From this review, we conclude that the focus on monetary valuation and payment schemes has contributed to attract political support for conservation, but also to commodify a growing number of ecosystem services and to reproduce the Neoclassical economics paradigm and the market logic to tackle environmental problems.

Ecosystem services: From eye-opening metaphor to complexity blinder

- Ecological Economics---2010---Richard B. Norgaard

What started as a humble metaphor to help us think about our relation to nature has become integral to how we are addressing the future of humanity and the course of biological evolution. The metaphor of nature as a stock that provides a flow of services is insufficient for the difficulties we are in or the task ahead. Indeed, combined with the mistaken presumption that we can analyze a global problem within a partial equilibrium economic framework and reach a new economy project-by-project without major institutional change, the simplicity of the stock-flow framework blinds us to the complexity of the human predicament. The ecosystem services approach can be a part of a larger solution, but its dominance in our characterization of our situation and the solution is blinding us to the ecological, economic, and political complexities of the challenges we actually face.

Payments for ecosystem services as commodity fetishism

- Ecological Economics---2010---Nicolás Kosoy, Esteve Corbera

Payments for Ecosystem Services (PES) economically reward resource managers for the provision of ecosystem services and are thus characterised by (i) an ecological function subject to trade; (ii) the establishment of a standard unit of exchange; (iii) and supply, demand and intermediation flows between those who sell and buy ecosystem services. This paper departs from the term commodity fetishism, broadly understood as the masking of the social relationships underlying the process of production, to illuminate three invisibilities in the commodification of ecosystem services. Firstly, we argue that narrowing down the complexity of ecosystems to a single service has serious technical difficulties and ethical implications on the way we relate to and perceive nature. Secondly, the commodification of ecosystem services denies the multiplicity of

values which can be attributed to these services, since it requires that a single exchange-value is adopted for trading. Finally, we suggest that the process of production, exchange and consumption of ecosystem services is characterised by power asymmetries which may contribute to reproducing rather than addressing existing inequalities in the access to natural resources and services.

Exploring the links between equity and efficiency in payments for environmental services: A conceptual approach

- Ecological Economics---2010---Unai Pascual,Roldan Muradian,Luis C. Rodríguez,Anantha Duraiah

This paper addresses the relationship between equity and efficiency in PES schemes from a conceptual point of view. Emphasis is placed on the role of the institutional setting, social perceptions about economic fairness (or distributive justice of the payments), uncertainty and interactions between agents, including power relations. We introduce the heuristic concept of the 'efficiency-equity interdependency curve' to illustrate potential combinations between equity and efficiency that may be theoretically possible. The paper argues that different types of institutional factors determine which equity-efficiency combinations may be potentially feasible, influence the actual combination that will be achieved on the ground, and condition possible changes in that combination due to exogenous factors. By stressing the role of institutional aspects in shaping the equity-efficiency relationship, the paper attempts to go beyond the dominant Coasean vision of PES.

An institutional analysis of payments for environmental services

- Ecological Economics---2010---Arild Vatn

In this paper the characteristics and functioning of PES is analyzed from an institutional perspective. While in theory PES is seen as a market solution to environmental problems -- as an alternative to state (hier-

archical) and community governance -- a review of a large amount of case studies shows that PES in practice depends rather fundamentally on state and/or community engagement. Hence PES are foremost a reconfiguration of the roles of public bodies and communities becoming core intermediaries or 'buyers'. First, to establish PES, rights to the land that delivers the environmental service must be clarified. This demands public action. Second, transacting over environmental amenities is very costly. Creating 'markets' for environmental services depends therefore crucially on state and community facilitation. Hence 'buyers' are often public agencies. High transaction costs also influence price setting. Payments do not follow the market format as intermediaries frequently are setting the price, with users often being unaware even of the fact that they pay. Finally, the distinction between payments as incentives and as fair compensations is emphasized. While payments may strengthen community relations and simplify action for environmental care, they may also introduce a purely instrumental logic and in some cases worsen the environmental status by crowding out environmental virtues. For the future, greater awareness of these dynamics is warranted.

Common pool resource management and PES: Lessons and constraints for water PES in Tanzania

- Ecological Economics---2010---Brendan Fisher,Kassim Kulindwa,Iddi Mwanyoka,R. Kerry Turner,Neil D. Burgess

Research into common pool resources from the field and in the laboratory has provided a series of insights for the successful management of such resources. The consequences of action and inaction in managing common pool resources are often most strongly felt (gains or losses) by local people. Several ecosystem services can be considered CPRs but in some cases the benefits of (mis)management are enjoyed by one group while the costs are levied on another group. Here we discuss some of the key findings of the CPR literature and how these relate to key considerations for using PES as a management tool. We focus on the role that ecosys-

tems play in regulating water flows in two basins in Tanzania where feasibility studies have been conducted for the potential implementation of PES for water. We find that the lessons from CPR research shed light on some of the key implementation problems for PES mechanisms, and provide a useful guide for highlighting important user-resource considerations especially in contexts similar to East Africa.

The role of fairness and benefit distribution in community-based Payment for Environmental Services interventions: A case study from Menabe, Madagascar

- Ecological Economics---2010---Matthew Somerville, Julia P.G. Jones, Michael Rahajaharison, E.J. Milner-Gulland

Community-based conservation interventions can only be successful in the long term if their aims and activities are accepted by local people. A key determinant of acceptability is the perceived fairness of the distribution of the costs and benefits of the intervention. We examined the opportunities and challenges posed by benefit distribution in community-based Payment for Environmental Services (PES) interventions through a case study from Menabe, Madagascar. The intervention appears to be an overall success, with individuals reporting high levels of perceived fairness of payment distribution and a high proportion of individuals expressing overall net benefit. Nevertheless, a lack of adequate benefits accruing to those individuals facing high agricultural opportunity costs and evidence of sub-groups in the community reaping excessive benefits was noted across communities, and instances of poor governance were observed as a barrier to success in some communities. We present solutions to address these key challenges in the design and implementation of community-based PES interventions.

Direct conservation payments in the Brazilian Amazon: Scope and equity implications

- Ecological Economics---2010---Jan Börner, Sven Wunder, Sheila Wertz-Kanounnikoff, Marcos Rüginitz Tito, Ligia Pereira, Nathalia Nascimento

This article looks into the scope and equity implications of applying payments for environmental services (PES) as a REDD implementation mechanism in the Brazilian Amazon. We establish a set of economic and institutional preconditions for PES to become a feasible and cost-effective conservation mechanism. We proceed with a macro-scale spatial analysis and overlay of opportunity costs, deforestation patterns, carbon services, and land tenure, in order to assess where these conditions hold. We then screen how the benefits of potential PES schemes might be distributed across different socioeconomic groups of service providers in different land tenure categories. Our economic-quantitative analysis, though sensitive to documented assumptions, suggests that under current carbon prices the economic preconditions are in place to pay for avoided deforestation in over half of threatened forests over the next decade. Unfortunately, the same optimism does not apply to institutional preconditions. Land grabbing, insecure tenure, overlapping claims, and lacking information on private tenure constitute real medium-term impediments to PES. If payments were to accrue to current landholders regardless of current tenure insecurities, large landowners who account for about 80% of all deforestation would reap the highest benefits, though per-capita benefits other tenure categories are also high. Schemes that closely align payments with opportunity costs are preferable for cost-effectiveness, and not necessarily more inequitable in outcomes. Essentially, PES systems cannot substitute command-and-control measures: the former depend on the latter for basic governance systems to secure effective rights of exclusion, which land stewards essentially need in order to become reliable service providers.

Payments for biodiversity conservation in the context of weak institutions: Comparison of three programs from Cambodia

- Ecological Economics---2010---Tom Clements, Ashish John, Karen Nielsen, Dara An, Setha Tan, E.J. Milner-Gulland

Implementing any conservation intervention, including Payments for Ecosystem Services (PES), in the

context of weak institutions is challenging. The majority of PES programs have been implemented in situations where the institutional framework and property rights are strong and target the behaviours of private landowners. By contrast, this paper compares three PES programs from a forest landscape in Cambodia, where land and resource rights are poorly defined, governance is poor, species populations are low and threats are high. The programs vary in the extent to which payments are made directly to individuals or to villages and the degree of involvement of local management institutions. The programs were evaluated against three criteria: the institutional arrangements, distribution of costs and benefits, and the conservation results observed. The most direct individual contracts had the simplest institutional arrangements, the lowest administrative costs, disbursed significant payments to individual villagers making a substantial contribution to local livelihoods, and rapidly protected globally significant species. However, this program also failed to build local management organisations or understanding of conservation goals. By contrast the programs that were managed by local organisations were slower to become established but crucially were widely understood and supported by local people, and were more institutionally effective. PES programs may therefore be more sustainable when they act to empower local institutions and reinforce intrinsic motivations.

Participation in the world's first clean development mechanism forest project: The role of property rights, social capital and contractual rules

- Ecological Economics---2010---Yazhen Gong,Gary Bull,Kathy Baylis

Clean Development Mechanism (CDM) forest projects are perceived as an attractive way to both help mitigate climate change and transfer income to rural poor. However, to engender participation of small-scale producers, a CDM forest project must offer sufficient incentives, while minimizing their costs of participation, all the while respecting the need for additionality. Property rights, social capital and contractual rules are critical

in the success of CDM forest projects. In this paper, we ask what factors affect participation in the world's first CDM project, established in Guangxi Province, China. Using village-level surveys, we find that although the project facilitates participation through carbon pooling and a share-holding system, much of the project land remains unforested. We find that the primary reasons for the unforested regions are constrained contractual rules, property rights allocation disputes and low levels of social capital in some villages.

Comprehensive bioeconomic modelling of multiple harmful non-indigenous species

- Ecological Economics---2010---L. Roman Carrasco,J.D. Mumford,A. MacLeod,J.D. Knight,R.H.A. Baker

Harmful non-indigenous species (NIS) introductions lead to loss of biodiversity and serious economic impacts. Government agencies have to decide on the allocation of limited resources to manage the risk posed by multiple NIS. Bioeconomic modelling has focused on single species and little is known about the optimal management of multiple NIS using a common budget. A comprehensive bioeconomic model that considers the exclusion, detection and control of multiple NIS spreading by stratified dispersal and presenting Allee effects was developed and applied to manage the simultaneous risk posed by Colorado beetle, the bacterium causing potato ring rot and western corn rootworm in the UK. A genetic algorithm was used to study the optimal management under uncertainty. Optimal control methods were used to interpret and verify the genetic algorithm solutions. The results show that government agencies should allocate less exclusion and more control resources to NIS characterised by Allee effects, low rate of satellite colonies generation and that present low propagule pressure. The prioritisation of NIS representative of potential NIS assemblages increases management efficiency. The adoption of management measures based on the risk analysis of a single NIS might not correspond to the optimal allocation of resources when other NIS share a common limited budget. Comprehensive bioeconomic modelling of mul-

multiple NIS where Allee effects and stratified dispersal are considered leads to a more cost-effective allocation of limited resources for the management of NIS invasions.

Restoring and managing natural capital towards fostering economic development: Evidence from the Drakensberg, South Africa

- Ecological Economics---2010---James Blignaut, Myles Mander, Roland Schulze, Mark Horan, Chris Dickens, Catherine Pringle, Khulile Mavundla, Isaiah Mahlangu, Adrian Wilson, Margaret McKenzie, Steve McKean

Can a payment for flows of ecosystem goods and services system, following appropriate management and restoration of natural capital produced in rural areas of a developing country, be developed in a way that benefits communities, the commercial sector and the environment? This fundamental question acts as rationale for conducting an in-depth assessment as to whether the development of markets for ecosystems is both appropriate and sufficient when dealing with the restoration of natural capital of two degraded study areas within the Maloti-Drakensberg mountain range in southern Africa, which is a fire-prone grasslands ecosystem. The mountain range is South Africa's most strategic source of fresh water. While occupying less than 5% of South Africa's surface area, it produces 25% of the country's runoff through rivers, major dams, and national and international inter-basin transfers. Addressing the question, the study develops an integrated hydrology-ecology-economic model based on the functional relationships between these three aspects in managing and restoring the natural capital of the two study areas. It was found that the benefits of introducing improved management practices exceeds cost in low to medium degraded quinarys, but not in heavily degraded quinarys. The economic return on the water (baseflow) produced by such a system of improved land use management, however, far exceeds that of conventional (construction-based) water development programmes and offers meaningful economic and market development opportunities.

Energy savings from tree shade

- Ecological Economics---2010---Ram Pandit, David Laband

Trees cast shade on homes and buildings, lowering the inside temperatures and thus reducing demand for power to cool these buildings during hot times of the year. Drawing from a large sample of residences in Auburn, Alabama, we develop a statistical model that produces specific estimates of the electricity savings generated by shade-producing trees in a suburban environment. This empirical model links residential energy consumption during peak summer (winter) months to average energy consumption during non-summer/non-winter months, behaviors of the occupants, and the extent, density, and timing of shade cast on the structures. Our estimates reveal that tree shade generally is associated with reduced (increased) electricity consumption in the summertime (wintertime). In summertime, energy savings are maximized by having dense shade. In wintertime, energy consumption increases as shade percentage in the morning, when outdoor temperatures are at their lowest, increases.

Estimating natural resource harvests: Conjectures?

- Ecological Economics---2010---Mary C.S. Merton, Anna Lawrence, Frank Merry, Nick D. Brown

Estimates of natural resource harvests often inform rural conservation and development strategies. Retrospective household surveys remain one of the most commonly employed methods for estimating harvests. Pair-wise comparisons of estimates from household surveys versus diary records were performed for household harvests in the Brazilian Amazon. Although diaries and surveys produce similar estimates of mean economic value for different product groups, 33% of product-level estimates showed a three-fold difference between methods with no consistent patterns in discrepancy direction. Significant differences in estimates for highly valued products (cash crops, game animals, and fish) together with higher respondent confidence

in diaries may undermine household models based exclusively on surveys.

Unravelling the argument for bioenergy production in developing countries: A world-economy perspective

- Ecological Economics---2010---Magdalena Kuchler

This paper offers a critical look at how energy security-, food and agriculture-, and climate change-oriented international organizations frame biomass energy production in developing countries, in particular, ethanol production in Brazil. Using the world-economy system as a theoretical lens, the paper raises a concern as to whether the way these global institutions frame bioenergy's role in developing regions manifests energy and ecological inequalities between the core and the periphery, as well as creates internal contradictions that perpetuate unequal exchange embedded in the system. Simultaneously, these organizations frame Brazil as a semi-peripheral state that, while successful in finding a niche concurring with the core's demand for cheap energy and cost-effective decarbonization strategies, is not necessarily a suitable role model for the periphery's socio-economic development.

The production and allocation of information as a good that is enhanced with increased use

- Ecological Economics---2010---Ida Kubiszewski,Joshua Farley,Robert Costanza

Information has some unique characteristics. Unlike most other goods and services, it is neither rival (use by one prevents use by others) nor non-rival (use by one does not affect use by others), but is enhanced with increased use, or 'additive'. Therefore a unique allocation system for both the production and consumption of information is needed. Under the current market-based allocation system, production of information is often limited through the exclusive rights produced by patents and copyrights. This limits scientists' ability to share and build on each other's knowledge. We break the problem down into three separate questions: (1)

do markets generate the type of information most important for modern society? (2) are markets the most appropriate institution for producing that information? and (3) once information is produced, are markets the most effective way of maximizing the social value of that information? We conclude that systematic market failures make it unlikely that markets will generate the most important types of information, while the unique characteristics of information reduce the cost-effectiveness of markets in generating information and in maximizing its social value. We then discuss alternative methods that do not have these shortcomings, and that would lead to greater overall economic efficiency, social justice and ecological sustainability. These methods include monetary prizes, publicly funded research from which the produced information is released into the public domain, and status driven incentive structures like those in academia and the "open-source" community.

Property rights in UK uplands and the implications for policy and management

- Ecological Economics---2010---C.H. Quinn,E.D.G. Fraser,K. Hubacek,M.S. Reed

Rural areas are subject to changing and often competing demands. Where agricultural production was once paramount, it now competes with other ecosystem services such as carbon storage, rural amenity, and wildlife habitat. If rural areas are to be managed to produce this broad range of goods and services, then more diverse and complex management regimes are needed. This paper explores the literature on property rights before using a 'property rights bundle' approach in the UK uplands to (1) examine the distribution of property rights between stakeholders in a multi-resource system and (2) evaluate the effect of state intervention on the redistribution of property rights and the resulting management regimes. Private land owners were found to be the dominant type of property rights holder and private property the dominant management regime in the uplands of the UK. Government intervention has also created private-state regimes for some public goods such as biodiversity but common prop-

erty management is still in its infancy with regards to ecosystem services and few stakeholders have claimant rights over resources. As a result, many stakeholders are unable to influence management to produce the goods that they want. A property rights perspective highlights that single management regimes alone are unlikely to manage land sustainably for both private and public goods. Instead, a complex mix of private, private-state and common property regimes are found to be emerging in this multi-resource system. These mixed management regimes have the potential to produce sustainable outcomes but only if the appropriate management regime is matched to each resource, if links are developed between each regime to deal with conflict and if mixed management is adaptable enough to cope with new and changing demands.

Facilitating the transition to a steady-state economy: Some macroeconomic fundamentals

- Ecological Economics---2010---Philip Lawn

Central government policy is based on a misguided understanding of the macroeconomics of a modern, fiat-currency economy. As the owner/issuer of a nation's currency, a central government has unlimited spending power. Moreover, taxation exists as nothing more than a means by which a central government can destroy the spending power of the private sector. In the process of outlining some of the policies required to facilitate the transition to a steady-state economy, this paper does not recommend that central governments should spend wildly and irresponsibly. To the contrary, this paper explains how a central government can use its unique spending and taxation powers in a disciplined and policy-effective manner, yet in a manner that is being largely overlooked.

The art of the cognitive war to save the planet

- Ecological Economics---2010---Miklós Antal, Janne I. Hukkinen

Major and urgent behavioral change is required to address the unprecedented environmental challenges facing civilization on Earth. Individuals striving to free

themselves from the biophysical constraints of life with material gain only strengthen their collective dependence on natural life support systems. Human belief networks from ancient to modern times are studied to point out factors of success and failure rooted in the mental representations of the dilemma in human-environment interaction. The analysis provides cognitive grounds for a major revision of climate change communication and highlights the need for technology-oriented policy programs with a clearly focused message on saving our civilization.

Pig genetic resource conservation: The Southern African perspective

- Ecological Economics---2010---T.E. Halimani, F.C. Muchadeyi, M. Chimonyo, K. Dzama

Local pigs in Southern Africa are an important component of resource-based subsistence farming systems and contribute substantially to the improvement of livelihoods of farmers. In addition to utilising by-products and feed resources that are otherwise of no use, they serve various socio-economic functions. The numbers, breeds and population genetic structures, attributes and risk status of these pigs are understudied. In the few studies to date, they have been shown to be tolerant to parasites that are endemic in their production environment. They also have a better chance to survive various disease outbreaks and have a higher capacity to utilise fibrous and poor quality feed resources compared to exotic breeds. Their production environment has also been described with women owning most of the pigs. The farmers tend to keep the herd sizes small in order to adequately meet the animals' nutrition needs. This leads to small populations that are vulnerable to inbreeding and disasters. In addition, there are no incentive systems in place to promote conservation of the pigs. There is an urgent need to address research and policy gaps, and to formulate strategies for the conservation of this resource.

Climate change, economics and Buddhism -- Part I: An integrated environmental analysis framework

- Ecological Economics---2010---Peter L. Daniels

The maintenance of climatic conditions that support biotic integrity and human life is a critical aspect of sustainable development. Serious instability in global economic and environmental spheres calls for an intensive search for new paradigms guiding human understanding, motivation and action. This two-part paper examines how central Buddhist world views and themes can contribute to effectively addressing climate change and other sustainability problems confronting consumer economies. Environmental, economic, ethical and cosmological dimensions of Buddhism are presented as a logical and practical basis for reducing the climate change pressures deriving from prevailing global modes of production and consumption. This first paper presents an analytical framework and philosophical base for understanding the causes and refining the goals behind human and societal endeavor. This frames the relevant adaptive responses outlined in the concluding paper. The paper begins by developing an innovative systems framework for analyzing major environmental problems such as climate change. Building on this framework, we then examine Buddhist insights into the fundamental nature of the behavior and driving forces that generate climate change. The model not only provides an improved basis for human-environmental analysis in general, but is applied to demonstrate and specify how the Buddhist world view could be operationalized to tackle anthropogenic climate change -- the task is undertaken in second paper. Buddhist notions of interconnectedness, dependent origination, and mindful consumption and production can help explain and reshape human motives and actions for climate and other forms of environmental sustainability.

Climate change, economics and Buddhism -- Part 2: New views and practices for sustainable world economies

- Ecological Economics---2010---Peter L. Daniels

The evidence of impending and serious climate and other consequences of an expanding world economy based on fossil carbon energy continues to accumulate. This two-part paper examines the potential contribution of the world view and insights of Buddhism to this search. It presents both a conceptual and practical case that Buddhism can help shape and move towards an alternative and effective paradigmatic basis for sustainable economies -- one capable of bringing about and maintaining genuine, high welfare levels across the world's societies. The first paper outlined a comprehensive analytical framework to identify the fundamental nature of anthropogenic climate change. Based on the integration of two of the most influential environmental analysis tools of recent decades (the DPSIR model and IPAT equation), the framework was then broadened to facilitate ideas from the Buddhist world view by injecting two key missing aspects -- the interrelated role of (1) beliefs and values (on goals and behavior) and (2) the nature of well-being or human happiness. Finally, the principal linkages between this climate change analysis framework and Buddhism were explored. In this concluding paper, the systems framework is used to demonstrate how Buddhist and related world views can feed into appropriate and effective responses to the impending challenges of climate change. This is undertaken by systematically presenting a specific, if indicative, list of relevant strategies informed by the understanding of interconnectedness and other basic principles about the nature of reality and human well-being as proposed in Buddhism.

Boulding's welfare approach of communicative deliberation

- Ecological Economics---2010---Stefan Kesting

British institutional economist Shaun Hargreaves Heap once wrote: "... that orthodox welfare economics runs into problems generating public policy prescriptions

because it works with a picture of individuals as solely a bunch of well-behaved preferences, which they are motivated in their actions to satisfy in an instrumental fashion" (1989, 206). Most ecological economists will probably agree with this critique, because it is certainly true, when the welfare objective shifts from quantitative economic growth to preserving this planet as a life provisioning and enjoyable habitat for future generations. So what constitutes and enhances ecologically sustainable welfare? To answer this question a number of scholars have highlighted the need for an alternative model of behaviour -- be it as a micro-foundation for a sustainability oriented welfare theory or as a normative guiding post to direct our concrete action and institutional change. This article will show that Kenneth E. Boulding developed such an alternative welfare approach, based on a communicative behavioural conception over about forty years of his academic career. Founded on a communicative action his welfare theory is based on deliberative valuation.

Can the concept of ecosystem services be practically applied to improve natural resource management decisions?

- Ecological Economics---2010---Lisa A. Wainger, Dennis M. King, Richard N. Mack, Elizabeth W. Price, Thomas Maslin

Applying ecosystem service valuation principles to natural resources management has the potential to encourage the efficient use of resources, but can decision support systems built on these principles be made both practical and robust? The limitations to building such systems are the practical limits on managers' time to develop or learn tools and the state of the science to support decision-making components. We address this question by applying a cost-effectiveness analysis framework and optimization model to support the targeting of restoration funds to control an invasive grass (*Bromus tectorum*) in agro-ecosystems. The optimization aims to maximize benefits derived from a suite of ecosystem services that may be enhanced through site restoration. The model combines a spatially-varying cost function with ecosystem service benefit functions

that are risk-adjusted to capture the probability of successful restoration. We demonstrate that our approach generates roughly three times the level of ecosystem service benefits (as measured through indicators) compared to the current management strategy of selecting restoration sites that are superlative producers of one ecosystem service. The results showed that spatial (GIS) data and ecosystem understanding were sufficient to formally capture the managers' informal decisions and that cost-effectiveness of restoration could be improved by considering the ability of sites to jointly produce multiple ecosystem services and adjusting expected benefits by the probability of success.

Consistent and unbiased carbon dioxide emission multipliers: Performance of Danish emission reductions via external trade

- Ecological Economics---2010---José Rueda-Cantucho, Antonio Amores

Climate change research is currently a topic of great interest for economic researchers. In particular, environmental input-output analysis increasingly plays an important role in measuring the economic and environmental effects of sustainable development policies in Europe. Other approaches also exist, such as econometric modelling, in which impacts are quantified on statistical grounds and with certain desirable properties (efficient estimates, confidence intervals, hypothesis testing, etc.) that are not found in the input-output approach. Consequently, this paper merges the two approaches to address the calculation of unbiased and consistent carbon dioxide emission multipliers for Denmark and their respective confidence intervals. The use of the supply and use system instead of the symmetric input-output table also presents the opportunity to avoid the common problems associated with the construction of technical coefficients (technology assumptions, negatives, etc.). Moreover, a new policy-relevant application of these multipliers is introduced: the quantification of the performance of the carbon dioxide emission reductions carried out by industries via external trading.

Water and poverty in rural China: Developing an instrument to assess the multiple dimensions of water and poverty

- Ecological Economics---2010---Alasdair Cohen,Caroline A. Sullivan

This paper describes the theoretical foundations and development of a multidimensional, water-focused, thematic indicator of rural poverty: The Water, Economy, Investment and Learning Assessment Indicator (WEILAI). The WEILAI approach was specifically designed for application in rural China, to support poverty alleviation project planning, monitoring and evaluation, as well as targeting and prioritization. WEILAI builds primarily on the basic needs framework of poverty alleviation, and on the methodological structure of the Water Poverty Index, to provide a proxy measure of an area's poverty by assessing eight key poverty sectors, with a strong focus on the components of water-poverty. The WEILAI approach was piloted and implemented in 534 households in China's mountainous southwest. This paper describes the indicator construction, weighting schemes, methodology, field sites, and statistical validation of the results. In addition, we discuss the results, feedback from in-country project staff, and the likely utility of the tool for project planning, monitoring and evaluation support. The paper concludes with a discussion of WEILAI's overall utility and ongoing development.

Testing different types of benefit transfer in valuation of ecosystem services: New Zealand winegrowing case studies

- Ecological Economics---2010---Ramesh Baskaran,Ross Cullen,Sergio Colombo

Most ecosystem services (ES) are neither priced nor marketed. Resource managers may fail to take into account degradation of unpriced services in their resource management decisions. Being able to estimate values for ES is fundamental to designing policies to induce resource users to provide (or improve) ES at levels that are acceptable to society. Conducting ecosystem valuation via non-market methods is costly and

time consuming. Benefit transfer (BT) using choice experiment (CE) is a potentially cost-effective method for valuing ES by transferring information from existing valuation studies (and study sites) to a target area of interest (policy sites). The prime objective of this paper is to examine the validity of BT and hence whether it is feasible to conduct the transfer process and assist policy making. The paper focuses on the environmental impact of winegrowing practices in two New Zealand winegrowing regions. The two sites, Hawke's Bay and Marlborough, have similar environmental issues and attributes but are geographically separated. The study estimates Willingness to Pay (WTP) and Compensating Surplus (CS) for ES applying CE and, subsequently, given the preferences of respondents across sites and populations, tests the transferability of unadjusted value transfer (WTP) and benefits function (CS) assessing four different types of BT.

A meta-analysis of contingent valuation forest studies

- Ecological Economics---2010---Melina Barrio,Maria Loureiro

Forest ecosystems provide a variety of valuable goods and services. This paper presents a meta-analysis of forest studies using the Contingent Valuation (CV) method to value the provision of forest values around the world. In this meta-analysis, we estimate the marginal value of different management programs that provide a variety of forest goods and services. Our results show that willingness to pay (WTP) estimates for forest management programs are sensitive to the program's objectives, particularly when linked to the provision of recreational services. Other variables such as the type of forest, location, survey mode, or the type of respondent were also found to significantly affect the WTP estimates.

Reconfiguring an irrigation landscape to improve provision of ecosystem services

- Ecological Economics---2010---Neville D. Crossman,Jeffrey D. Connor,Brett A. Bryan,David M.

Over-allocation of fresh water resources to consumptive uses, coupled with recurring drought and the prospect of climate change, is compromising the stocks of natural capital in the world's basins and reducing their ability to provide water-dependent ecosystem services. To combat this, governments worldwide are making significant investment in efforts to improve the sharing of water between consumptive uses and the environment. Many investments are centred on the modernisation of inefficient irrigation delivery systems and the purchase of consumptive water for environmental flows. In this study, we applied spatial targeting within a cost-benefit framework to reconfigure agricultural land use in an irrigation district to achieve a 20% reduction in agricultural water use to increase environmental flows, and improve the provision of other ecosystem services. We demonstrate a targeted land use reconfiguration policy approach using spatial planning and optimisation models. Our model estimates a potential increase in the net present value of ecosystem services of up to \$A 347 million. The increase in ecosystem services include recovering 62 GL of water for environmental flows, the sequestration of 10.6 million tonnes of CO₂e/year, a 12 EC (μ S/cm) reduction in river salinity, and an overall 9% increase in the value of agriculture. Without a spatially targeted approach to planning, a 20% reduction in water for irrigation could result in the loss of \$A 68.7 million in economic returns to agriculture which may be only marginally offset by the increased value of ecosystem services resulting from the return of 62 GL of water to the environment.

Performance-based environmental index weights: Are all metrics created equal?

- Ecological Economics---2010---Moriah J. Belenger, Alan T. Herlihy

This study estimates the marginal contribution to environmental performance made by six separate macroinvertebrate metrics included in an additive index developed to measure wadeable stream condition. We model the metrics as outputs in a quadratic directional

output distance function, which serves as an alternate measure of environmental performance, and then derive the marginal performance for each metric. We use the resulting estimates of marginal performance to develop a metric weighting scheme that incorporates each metric's marginal contribution to performance, at each site, and then construct a weighted version of the original index. The performance-weighted index provides a similar measure of overall performance in this application, while also adding new information on the relative importance of each of the index metrics. This represents a new application of existing methods to measure productivity, and is closely related to the environmental shadow price literature.

Valuing ecosystem services from wetlands restoration in the Mississippi Alluvial Valley

- Ecological Economics---2010---W. Aaron Jenkins, Brian C. Murray, Randall Kramer, Stephen P. Faulkner

This study assesses the value of restoring forested wetlands via the U.S. government's Wetlands Reserve Program (WRP) in the Mississippi Alluvial Valley by quantifying and monetizing ecosystem services. The three focal services are greenhouse gas (GHG) mitigation, nitrogen mitigation, and waterfowl recreation. Site- and region-level measurements of these ecosystem services are combined with process models to quantify their production on agricultural land, which serves as the baseline, and on restored wetlands. We adjust and transform these measures into per-hectare, valuation-ready units and monetize them with prices from emerging ecosystem markets and the environmental economics literature. By valuing three of the many ecosystem services produced, we generate lower bound estimates for the total ecosystem value of the wetlands restoration. Social welfare value is found to be between \$1435 and \$1486/ha/year, with GHG mitigation valued in the range of \$171 to \$222, nitrogen mitigation at \$1248, and waterfowl recreation at \$16. Limited to existing markets, the estimate for annual market value is merely \$70/ha, but when fully accounting for potential markets, this estimate rises to \$1035/ha. The

estimated social value surpasses the public expenditure or social cost of wetlands restoration in only 1Â year, indicating that the return on public investment is very attractive for the WRP. Moreover, the potential market value is substantially greater than landowner opportunity costs, showing that payments to private landowners to restore wetlands could also be profitable for individual landowners.

Empirical evaluation of agricultural sustainability using composite indicators

- Ecological Economics---2010---José A. Gómez-Limón, Gabriela Sanchez-Fernandez

The aim of this study was to develop a practical methodology for evaluating the sustainability of farms by means of composite indicators, and to apply it to two agricultural systems, the rain-fed agriculture of the Castilla y León countryside and the irrigated systems of the valley of the River Duero. We hope thus to operationalise the concept of sustainability as an element to support the "governance" of this sector. Our methodology is based on calculating 16 sustainability indicators that cover the three components of the concept (economic, social and environmental), and their subsequent aggregation into nine different types of sustainability indices. Our results enable us first to demonstrate the advantages and disadvantages of the various methods used to construct composite sustainability indicators, demonstrating the usefulness of analysing several of these indicators in conjunction, in order to obtain more robust results. They also enable us to visualise farm heterogeneity within a single agricultural system with respect to sustainability as well as to analyse the structural and decision-oriented variables that influence it. Such information could help to improve current agricultural policies (such as income policy, agricultural structure policy and rural development policy), with the aim of improving the sustainability of the sector.

Triple win for trade in renewable resource goods by use of export taxes

- Ecological Economics---2010---Ola Flaaten, Carl Erik Schulz

We challenge the free trade paradigm, in particular for developing countries exporting natural resource goods, by demonstrating positive economic and environmental effects of an export tax for renewable resource goods. The two-sector general equilibrium model designed has an open-access renewable resource industry and a manufacturing industry. The economic, environmental and social effects of using an export tax on goods from the open-access renewable resource industry are analysed. It is demonstrated that the gross domestic product, the steady-state resource stock and the domestic consumption of both products increase with the resource export tax compared to free trade with no trade taxes.

Environmental Kuznets curve for CO2 in Canada

- Ecological Economics---2010---Jie He, Patrick Richard

According to the environmental Kuznets curve hypothesis, the relationship between per-capita GDP and per-capita pollutant emissions has an inverted-U shape. This implies that, past a certain point, economic growth may actually be profitable for environmental quality. Most studies on this subject are based on estimating fully parametric quadratic or cubic regression models. While this is not technically wrong, such an approach somewhat lacks flexibility since it may fail to detect the true shape of the relationship if it happens not to be of the specified form. We use semiparametric and flexible nonlinear parametric modeling methods in an attempt to provide more robust inferences. We find little evidence in favour of the environmental Kuznets curve hypothesis. Our main results could be interpreted as indicating that the oil shock of the 1970s has had an important impact on progress towards less polluting technology and production.

Institutional and ecological interplay for successful self-governance of community-based fisheries

- Ecological Economics---2010---Xavier Basurto, Eric Coleman

The goal of this paper is to improve our understanding

of the role of institutional arrangements and ecological factors that facilitate the emergence and sustainability of successful collective action in small-scale fishing social-ecological systems. Using a modified logistic growth function, we simulate how ecological factors (i.e. carrying capacity) affect small-scale fishing communities with varying degrees of institutional development (i.e. timeliness to adopt new institutions and the degree to which harvesting effort is reduced), in their ability to avoid overexploitation. Our results show that strong and timely institutions are necessary but not sufficient to maintain sustainable harvests over time. The sooner communities adopt institutions, and the stronger the institutions they adopt, the more likely they are to sustain the resource stock. Exactly how timely the institutions must be adopted, and by what amount harvesting effort must be diminished, depends on the ecological carrying capacity of the species at the particular location. Small differences in the carrying capacity between fishing sites, even under scenarios of similar institutional development, greatly affects the likelihood of effective collective action.

Not irrational but habitual: The importance of "behavioural lock-in" in energy consumption

- Ecological Economics---2010---Kevin Maréchal

A substantial body of literature has shown that our behaviour is often guided by habits. The existence of habits -- not fully conscious forms of behaviour -- is important as it contradicts rational choice theory. Their presence thus calls for the setting of new instruments as they make it unlikely that consumers be capable of exercising control over their energy consumption in reaction to given incentives. This is further increased in the evolutionary perspective where the current carbon-based Socio-Technical System constrains and shapes consumers' choices through structural forces. Habits being potentially "counterintentional," they may explain the "efficiency paradox" in energy as well as the continued increase of energy consumption despite the rising environmental awareness among the population. Policies aiming at reducing energy consumption should thus specifically address the performance con-

text of habits. For instance, targeting new residents has proven to be more effective given that their preceding habits have been disturbed. The results of our empirical analysis confirm this idea by showing how a change of context makes people more receptive to a proposed measure. Our analysis of the role played by habits also suggests that individuals do not consider the need to change existing habits as an obstacle even though this is contradicted implicitly in the answers they provided to open questions. This "unconsciousness" is one of the most delicate features of habits and it should thus be accounted for when designing measures. Given the other characteristics of habits, the joint use of feedbacks and commitment strategies appears promising.

Detecting the 'conservation effect' on the maintenance of natural capital flow in different natural parks

- Ecological Economics---2010---Irene Petrosillo, Teodoro Semeraro, Giovanni Zurlini

The identification of areas worthy of protection and their subsequent institution as natural parks are instruments that society uses to preserve biodiversity that, by supporting Natural Capital Flow (NCF), represents a guarantee for the maintenance of human life quality. However, the implemented strategies for the conservation of biodiversity may differ from those adopted for the maintenance of natural capital; consequently, planning for natural capital might require a different strategy from that used in conservation policies. The aim of this paper is to assess the 'conservation effect' of different conservation policies on the maintenance of NCF in three natural parks in Apulia Region (southern Italy). The assessment of natural capital flow variation has been carried out investigating the temporal dynamics of land-use/land-cover mosaics, and using Costanza et al.'s economic coefficients as surrogates of NCF. Results showed that not all environmental conservation management strategies have played an equal role in fostering NCF. This research highlights that the recognition of the natural value of a site according to the European Directives (e.g. NATURA

2000 network) is not sufficiently effective for the conservation of the NCF, while it is necessary to identify a management authority that can appropriately drive landscape transformations, and sets, if necessary, the appropriate limitations. In addition, the management of these areas as part of a network of natural parks seems to be more effective for the maintenance of NCF.

Valuing quality changes in Caribbean coastal waters for heterogeneous beach visitors

- Ecological Economics---2010---Nesha Beharry-Borg, Riccardo Scarpa

The quality of the coastal waters is now a major environmental issue in Tobago due to its role in supporting the economically important tourism sector and for safeguarding public health. In this paper we report the results of two choice experiments designed to estimate willingness to pay (WTP) for an improvement in coastal water quality for two groups of beach recreationists: snorkellers and nonsnorkellers. Responses from 284 respondents were analyzed and included both locals and tourists to the island who participated in beach recreation. Latent class and mixed multinomial logit models were used in the analysis of the responses to explain the presence of any unobserved taste heterogeneity. An additional advantage of using these models was the ability to determine individual-specific WTP estimates for each attribute. The results indicate that individual specific-means of WTP estimates vary significantly between snorkellers and nonsnorkellers. The results from the analysis using the latent class model identified two subgroups with distinct preferences with the snorkeller group. Unobserved taste heterogeneity was better represented for the nonsnorkellers with a mixed multinomial logit model. This study not only addresses the lack of valuation estimates on this island but also demonstrates the importance of using estimation methods that account for individual-specific differences in WTP estimates. The inclusion of individual preferences is especially important in the context of a small-island developing country where there is a need to prioritise policy recommendations due to limited financial resources and conflicting objectives

for natural resource management.

Assessing regional and global water footprints for the UK

- Ecological Economics---2010---Yang Yu, Klaus Hubacek, Kuishuang Feng, Dabo Guan

The concept of the water footprint has been recently introduced as an important indicator for human-induced water consumption. The water footprint is defined as the total volume of water used during production and consumption of goods and services as well as direct water consumption by humans. Water is not only consumed directly but also indirectly in production processes. Therefore, calculating the water footprint enables us to quantify total water consumed along the whole global supply chain. In this paper, we develop a regional input-output (IO) model extended by water consumption coefficients to quantify the respective domestic water footprint for different consumption categories for the South-East and North-East of England and the UK, i.e. the water consumed directly and indirectly along the regional supply chain. In addition, we calculate the total water footprints which include both domestic water consumption and the water required in other countries to produce goods and services imported and consumed in the region under investigation through applying a multi-regional input-output (MRIO) model. Both footprints also include households' direct consumption of water. With regards to the two regions, we can observe a very pronounced regional disparity of regional (domestic and total) water footprints between the relatively water-scarce South-East and the water-rich North-East of England. We find that the domestic water footprint per capita in the South-East is 22% higher than the domestic water footprint per capita in the North-East. The key water consumers include Agriculture, Food Products, Electricity and Gas Production, and Hotel and Catering. The total water footprints per capita in the South-East (1257 m³/year) are more than twice the ones in the North-East (597 m³/year). The domestic water footprint focuses only on the supply chain effects and associated water consumption within the regional

boundaries, which are usually of higher interest to policy makers and water companies concerned with the balance of supply and demand of water resources within their respective administrative boundaries or watersheds. The total water footprint allows assessing global effects and supports global supply chain management and is also introducing notions of fairness and equity in terms of resource consumption.

Global patterns of materials use: A socioeconomic and geophysical analysis

- Ecological Economics---2010---Julia K. Steinberger,Fridolin Krausmann,Nina Eisenmenger

Human use of materials is a major driver of global environmental change. The links between materials use and economic development are central to the challenge of decoupling of materials use and economic growth (dematerialization). This article presents a new global material flow dataset compiled for the year 2000, covering 175 countries, including both extraction and trade flows, and comprising four major material categories: biomass, construction minerals, fossil energy carriers and ores/industrial minerals. First, we quantify the variability and distributional inequality (Gini coefficients) in international material consumption. We then measure the influence of the drivers population, GDP, land area and climate. This analysis yields international income elasticities of material use. Finally, we examine the coupling between material flows, and between income and material productivity, measured in economic production per tonne material consumed. Material productivity is strongly coupled to income, and may thus not be suitable as an international indicator of environmental progress -- a finding which we relate to the economic inelasticity of material consumption. The results demonstrate striking differences between the material groups. Biomass is the most equitably distributed resource, economically the most inelastic, and is not correlated to any of the mineral materials. The three mineral material groups are closely coupled to each other and economic activity, indicating that the challenge of dematerializing industrial economies may require fundamental struc-

tural transformation. Our analysis provides a first systematic investigation of international differences in material use and their drivers, and thus serves as the basis for more detailed future work.

Robust Corporate Social Responsibility investment screening

- Ecological Economics---2010---Filip Van den Bossche,Nicky Rogge,Kurt Devooght,Tom Van Puyenbroeck

Although a priori company screening is a constitutive feature of Socially Responsible Investment (SRI) funds, it is not easy to substantiate that such screening effectively differentiates between companies on the basis of their Corporate Social Responsibility (CSR) calibre. Fundamentally, this is because CSR comprises several dimensions for which an undisputed aggregative model is lacking. We assess the robustness of companies' CSR rankings with respect to several modelling assumptions. We then build on Gini's transvariation concept to select/reject specific companies in the SRI eligible universe of assets. We illustrate our approach with some specific screening issues as confronted by the ethical advisory committee of a large Belgian bank.

An empirical assessment of U.S. state-level immigration and environmental emissions

- Ecological Economics---2010---Jay Squalli

This paper uses U.S. state-level data for CO, NO₂, SO₂, and PM₁₀ emissions and a STIRPAT-inspired model to provide empirical evidence discrediting, at least in part, the restrictionist perspective on the immigration-environment relationship. The paper finds that U.S. states with a larger share of foreign-born residents are associated with lower NO₂ and SO₂ emissions. While these results do not necessarily imply that immigrants mitigate environmental emissions, they emphasize the importance of addressing the relationship between immigration and the environment based on an objective assessment of facts. Hence, it is this paper's contention that it is empirically unjustifiable to call for restrictions on immigration on environmental grounds.

**One solution for cross-country
transport-sustainability evaluation using a
modified ELECTRE method**

- Ecological Economics---2010---Natasa Bojkovic,Ivan Anic,Snezana Pejic-Tarle

Transport is an economic activity having complex interactions with the environment, and since the concept of sustainable development was identified as a global priority, there has been a growing interest in assessing the performance of transport systems with respect to sustainability issues. Although the Ecological Economics literature deals extensively with the strategy of sustainable development, far less attention has been paid to its application in the transport sector as of yet. The main purpose of this study was to introduce the noncompensatory analytical tool, which integrates multidimensional conditions present in the sustainability concept. The focus was on the potential of the outranking approach, namely the ELECTRE (ELimination Et Choix Traduisant la REalité; Elimination And Choice Corresponding to Reality) method for the evaluation of transport sustainability at the macro level, using the indicator set as a starting point. The method has been applied to selected European countries within a case study. As a result, according to transport-sustainability issues, pairwise relations between countries have been established. Based on these relations, and according to the chosen criteria, a set of countries with a better level of performance was selected as the core subset of the relation graph. To control and avoid the appearance of indifference relations between countries, as well as to reduce the subjectivity of decision makers, we propose a modification of ELECTRE I. Finally, we apply both the original and the modified methods, together with the sensitivity analysis. The results are presented in a convenient graph form and then compared.

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- Ecological Economics---2010---David Stern

2010

Economists, time to team up with the ecologists!

- Ecological Economics---2010---Hilde Karine Wam

Bioeconomic modeling is an increasingly relevant meeting arena for economists and ecologists. A majority of the growing literature, however, is written by economists alone and not with ecologists in true interdisciplinary teamwork. Physical distance between research institutions is no longer a reasonable justification, and I argue that, in practice, neither do the more fundamental philosophical oppositions present any real hindrance to teamwork. I summarize these oppositions in order of increasing magnitude as: 1) the axiom, held by many ecologists, of 'irreducible complexity of ecosystem functioning', which is avoided simply because the ecological 'whole' (as opposed to

its 'parts') is not an element of most realistic modeling scenarios; 2) the axiom, also held by many ecologists, of 'the precautionary principle', which mainly surfaces at the applied end of natural resource management, and thereby should not prevent economists and ecologists from jointly building the models necessary for the final decision making; and 3) the economists' axiom of 'the tradability principle', which is harder to overcome as it demands value-based practical compromises from both parties. Even this may be solved, however, provided the economists accept non-marketable components in the model (e.g. by using restriction terms based on ecology), and the ecologists accept a final model output measured in terms of monetary value. The easiest candidates for interdisciplinary teamwork in bioeconomics are therefore researchers who acknowledge ethical relativism. As bioeconomics presently functions mainly as an arena for economists, I say the responsibility for initiating interdisciplinary teamwork rests most heavily on their shoulders.

A conservation industry for sustaining natural capital and ecosystem services in agricultural landscapes

- Ecological Economics---2010---Wanhong Yang,Brett A. Bryan,Darla Hatton Mac-Donald,John R. Ward,Geoff Wells,Neville D. Crossman,Jeffrey D. Connor

Conservation investment in agricultural landscapes has evolved to take a more market-based or business approach. However, current levels of conservation investment are not likely to mitigate degradation to natural capital and ecosystem services. We propose the further evolution of a conservation industry to generate substantially increased investment in conservation in agricultural landscapes, particularly from the private sector. A mature conservation industry is envisaged as comprising of investors, producers, and service providers who produce conservation products and services, exchanged via market transactions. A number of requirements for a viable and effective conservation industry are identified including institutional infrastructure (conservation market institutions and

regulatory systems), information provision (quantifying benefits, business models, and accounting and auditing standards), and facilitation (entrepreneurship incubation and capacity building). A conservation industry requires careful design and planning in order to operate effectively. Whilst it is not without risk, a conservation industry has the potential to increase participation and investment in conservation actions and enhance the sustainability of agricultural landscapes.

Coevolutionary ecological economics

- Ecological Economics---2010---Giorgos Kallis,Richard B. Norgaard

This paper maps a coevolutionary research agenda for ecological economics. At an epistemological level coevolution offers a powerful logic for transcending environmental and social determinisms and developing a cross-disciplinary approach in the study of socio-ecological systems. We identify four consistent stories emerging out of coevolutionary studies in ecological economics, concerning: environmental degradation and development failure in peripheral regions; the lock-in of unsustainable production-consumption patterns; the vicious cycle between human efforts to control undesirable micro-organisms and the evolution of these organisms; and the adaptive advantages of other-regarding, cooperative behaviors and institutions. We identify challenges in the conceptualization of coevolutionary relationships in relation to: the interaction between different hierarchical levels of evolution; the role of space and social power; uneven rates of change and crises. We conclude with the political implications of a coevolutionary perspective based on the premises of pragmatism.

Darwinian coevolution of organizations and the environment

- Ecological Economics---2010---Geoffrey Hodgson

Darwinism offers a highly abstract and general meta-theoretical framework to help understand both natural and social evolution. This framework is of significance

for ecological economics because it addresses the evolution and coevolution of biological systems and sets of human institutions. This paper outlines this framework and charts its historical origins since the time of Darwin. It is suggested that this over-arching framework is useful for ecological economics as a common meta-narrative within which more detailed examinations of both institutional and ecological mechanisms may be placed. Applying Darwinism in this manner does not mean that institutions or organizations are explained in purely biological terms: it means that Darwinian principles are not confined to biology.

Bridging ecological and social systems coevolution: A review and proposal

- Ecological Economics---2010---Miguel A. Gual, Richard B. Norgaard

Social and Natural sciences have, for the most part, ignored the existence of interlinked/interdependent evolutionary processes between cultural and biotic systems, both embedded in an overall dynamic biophysical environment. In this paper, we explore the potential of filling this gap by further developing a common coevolutionary framework based on earlier work in ecological economics. Our main concern is to contribute to the understanding of socioecological coevolution in two ways: (1) to find a general framework that accommodates advances in the explanation of sociocultural evolution in social sciences and, (2) to identify the specific mechanisms that could link this knowledge to what is known in the biological sciences.

New evolutionary foundations: Theoretical requirements for a science of sustainability

- Ecological Economics---2010---Timothy M. Waring

Ecological economics stands in theoretical and ethical opposition to many aspects of neoclassical economic theory. Despite their sound critiques of that theory, ecological economists have not settled on an alternative theory of human behavior. As a potential alternative, Norgaard's socioecological coevolutionary framework

remains underspecified in terms of variation, heredity, and selection. I review concepts and insights on human behavior from evolutionary biology and evolutionary social science in order to supply new theoretical tools for ecological economic problems, and help refine the coevolutionary framework. I argue that a synthetic evolutionary theory of human behavior provides a sufficient alternative to the neoclassical perspective, and that cultural evolutionary theory is a necessary prerequisite of a mature economic science, ecological, coevolutionary or otherwise. Finally, I suggest some potential topics that such a mature theory might begin to tackle.

Niche construction, co-evolution and biodiversity

- Ecological Economics---2010---Kevin N. Laland, Neeltje J. Boogert

Many organisms modulate the availability of resources to other species, in the process changing the selection to which they and other organisms are exposed (niche construction). Niche construction drives co-evolutionary episodes, and builds connectance between the biotic components of ecosystems. Organisms have significant non-trophic impacts on ecosystem structure, function, and biodiversity. Based on a review of the most recent literature, we propose measures that could be employed to manage environments and enhance conservation efforts.

Coevolution, Symbiosis and Sociology

- Ecological Economics---2010---Myra J. Hird

Most sociological analyses adhere to the Western bifurcation of nature and culture, hampering analyses of ecology. Pressing ecological crises invite sociologists to engage with ecology in new ways. This commentary explores how sociologists might utilize coevolutionary theory to explore the complex intra-actions of matter, culture and sociality. My research suggests that bacteria are a superb example of coevolutionary processes within the biosphere. Through symbiosis, bacteria effectively challenge the conception of autonomous individual organisms interacting with their environment,

the salience of humans in biospheric regulation, and collapse the distinction between nature and culture.

Evolving power and environmental policy: Explaining institutional change with group selection

- Ecological Economics---2010---Karolina Safarzynska, Jeroen van den Bergh

This paper presents a theory of institutional change that builds upon a synthesis of theoretical insights from the literatures on group selection and socio-economic power. Based on a critical reading of relevant studies in sociology, political science and philosophy, we propose a taxonomy of power comprising different sources and mechanisms of exercising power. We discuss how these can be incorporated in a group selection framework to explain the evolution of environmental institutions and policies. This may improve our understanding of the feasibility, effectiveness and dynamics of the latter.

The evolution of social and moral behavior: Evolutionary insights for public policy

- Ecological Economics---2010---Mikko Manner, John Gowdy

This paper explores the evolution of humans as social beings and the implications of this for economic theory and policy. A major flaw in Walrasian economics is the assumption of "self-regarding" agents--economic actors make decisions independently of social context and without regard to the behavior of other consumers and firms. Truly other-regarding behavior, such as altruism and altruistic punishment, cannot be fully captured in the standard economic model. Standard economic assumptions about human behavior make pure altruism an irrational "anomaly" that cannot survive the evolutionary selection process. However, recent findings from neuroscience, behavioral economics evolutionary game theory and animal behavior have paved the way for a realistic, science-based, and policy-relevant foundation for economic theory. Other-regarding emotions such as altruism, love, and envy are an essential part of the human experience. We use the Price equation,

showing the feasibility of the evolution of group selection of altruistic preferences, to explore some of the implications of this phenomenon for economic theory and policy. We explore evidence that the human capacity for empathy evolved from primates and suggest that this was the precursor for human morality. We suggest that if we drop the assumption that fitness is equated with the consumption of market goods, pure altruism is no longer fitness reducing, particularly in western societies. We also examine individual preferences for altruism in terms of their effect on well being.

Notes from the greenhouse world: A study in coevolution, planetary sustainability, and community structure

- Ecological Economics---2010---Lee Worden

This paper explores coevolution and governance of common goods using models of coevolving biospheres, in which adapting populations must collectively regulate their planet's climate or face extinction. The results support the Gaia hypothesis against challenges based on the tragedy of the commons: model creatures are often able to work together to maintain the common good (a suitable climate) without being undermined by "free riders." A long-term dynamics appears in which communities that cannot sustain Gaian cooperation give way to communities that can. This result provides an argument why a Gaia scenario should generally be observed, rather than a tragedy of the commons scenario. Second, a close look at how communities fail reveals failures that do not fit the tragedy of the commons framework and are better described in terms of conflict between differently positioned parties, with power over different aspects of the system. In the context of Norgaard's work, all these observations can be read as narratives of coevolution relevant to social communities as well as ecological ones, contrasting with pessimistic scenarios about common governance and supporting respect for traditional arrangements and restraint in intervention.

A coevolutionary understanding of agroenvironmental change: A case-study of a rural community in Brazil

- Ecological Economics---2010---Raquel Moreno-Peñaranda, Giorgos Kallis

This paper studies the coevolutionary ecological-economic dynamics of agro-environmental change. The case study is Santa Rosa (Brazil) and the modernization of subsistence agriculture followed by the more recent emergence of organic farming. We use coevolution as an integrative framework for explaining how and why economic production changed over time in Santa Rosa in interdependence with the ecosystem resulting in a mosaic of diverse farm practices. A coevolutionary framework expands the explanatory breadth of prevailing accounts of agro-environmental change that rely on a notion of shifts from one singular, homogeneous production economy to the next. It unveils the complex processes driving agro-environmental change, instead of focusing on the structures resulting from it.

The Buddha mushroom: Conservation behavior and the development of institutions in Bhutan

- Ecological Economics---2010---Jeremy S. Brooks

Common pool resource management institutions can be an effective means by which communities can regulate resource use. While we are gaining a greater understanding of the characteristics that are associated with successful institutions, we know less about why and how such institutions emerge and what role individual behaviors play in this process. The bottom-up emergence of institutions may depend on the patterns of heterogeneity in the cooperative behaviors of individual resource users. Likewise, the emerging institutions serve to constrain subsequent resource collection behaviors and alter those patterns. Because institutions both emerge from, and alter, the behaviors of individual resource users, it is useful to view the relationship between the two levels from a coevolutionary perspective. Here, I focus on the motivations for the adoption of conservation behavior and discuss how these behaviors can impact emerging institutions.

This study is based on the harvest of a newly utilized, commercially valuable mushroom in two communities (geogs) in Bhutan. I examined which collectors exhibited each of two cooperative conservation behaviors, willingness to reduce one's harvest and punishment of non-compliant harvesting techniques and determined the traits associated with these behaviors. Using logistic regression I found that predictors from each of four domains, namely, economic factors, attitudes/values, knowledge/perceptions of resource scarcity, and social capital, are important for fostering conservation behavior. Other regarding values, high and low levels of wealth, perceptions of resource scarcity, and education are positively associated with a willingness to reduce ones harvest. Selfish values, high and low levels of wealth, and low levels of trust are associated with punishment. Changes in these individual characteristics may affect the frequency of cooperative acts and subsequently influence the success of the emerging institutions. As such, identifying the traits associated with the behaviors exhibited by individuals is an important step in understanding the dynamics of institutional evolution. Because this study captures perceptions and behaviors in the early stages of the harvest it can be used as the baseline for a longitudinal study exploring the coevolutionary dynamics between individual level behaviors and community level resource management institutions.

Coevolution in water resource development: The vicious cycle of water supply and demand in Athens, Greece

- Ecological Economics---2010---Giorgos Kallis

This paper adopts a coevolutionary perspective to criticize the dominant narratives of water resource development. Such narratives of progress portray a sequence of improving water technologies that overcame environmental constraints, supplying more water to satisfy the demands of growing populations for better living. Water supply appears as the response to an insatiable demand, exogenous to the water system. Instead, as the history of water in Athens, Greece illustrates water supply and demand in fact coevolve, new supply

generating higher demands, and in turn, higher demands favouring supply expansion over other alternatives. This vicious cycle expands the water footprint of cities degrading environments and communities in the countryside. Far from being predetermined and inevitable, as progressive narratives wants it, water resource development has been contingent on geographical and environmental conditions, institutional struggles, accidents, experiments and external geo-political and technological forces. In the last part of this paper, I discuss the policy implications of this coevolutionary reframing with respect to a the transition to a "soft water path".

Measuring sustainable welfare: A new approach to the ISEW

- Ecological Economics---2010---Pedro Beça,Rui Santos

Sustainability and welfare assessment is a contemporary theme of major scientific and policy relevance, requiring the consideration of multiple dimensions and diverse perspectives. The economic approach to sustainability and welfare assessment has frequently relied on alternatives, or adjustments, to GDP, widely used as an indicator of macroeconomic performance. Several authors have proposed alternative indicators, such as the ISEW, which intend to measure sustainability and economic welfare in a way that avoids the limitations of GDP; namely accounting for the value of externalities, the distribution of income and natural resources depletion. Since Daly and Cobb (1989) there have been proposed improvements to the ISEW, however, its aptitude to represent a sound alternative to GDP is still the subject of scientific debate. This paper presents a new approach to the ISEW (named Modified ISEW), including new components and methodological changes for the estimation of the index. These have the purpose of avoiding some of the index shortcomings and allow for a direct comparison with the GDP, which are advantages over previous studies. An application is developed for the US case, taking advantage of wide data availability and the possibility of comparing the results with previous works. The results obtained provide a

clearer picture of the success or failure of environmental and social policies, namely by avoiding the tampering effect resulting from the cumulative accounting of environmental externalities. This work also emphasizes the inadequacy of GDP as a welfare indicator, as well as the need to develop and adopt alternative indicators.

Stream ecosystem service markets under no-net-loss regulation

- Ecological Economics---2010---Martin W. Doyle,Andrew Yates

We analyze interactions between economics and ecology for ecosystem service markets under no-net-loss regulation. Previous studies of no-net-loss regulation address the ecological efficacy and valuation of restoration but largely ignore the effects of market dynamics. We link an economic model of free-entry equilibria with an ecological model that includes returns to scale and inefficiency of restored ecosystems and apply the result to stream mitigation banking in North Carolina. Intuition from ecology alone must be modified to account for economic processes, and vice versa. To implement no-net-loss regulation, one must not only account for ecological differences between restored and natural ecosystems, but also consider the effect of market entry on the number and size of restoration projects. In a purely economic model, free-entry equilibria are characterized by excess entry: the equilibrium number of firms is greater than the welfare maximizing number. Ecological considerations may exacerbate or ameliorate this, so that either excess entry or insufficient entry may occur, depending on the specific ecosystem services sought.

An ex ante ecological economic assessment of the benefits arising from marine protected areas designation in the UK

- Ecological Economics---2010---S. Salman Hussain,Alexandra Winrow-Giffin,Dominic Moran,Leonie A. Robinson,Abdulai Fofana,Odette A.L. Paramor,Chris L.J. Frid

This paper presents an estimate of the benefits of the

proposed designation of a network of marine conservation zones (MCZs) in English territorial and UK offshore waters. This ex ante analysis was undertaken as part of a cost-benefit evidence base to inform implementation of the proposed UK Marine and Coastal Access Bill. This Bill is part of an ambitious plan to designate and manage UK marine areas using an Ecosystems Approach. Benefits are measured in terms of anticipated increases in the value of ecosystem goods and services provisioned by MCZs relative to the counterfactual, i.e. no designation. The principal valuation and thus policy challenge is presented by the need to use benefits transfer in a context where biophysical provisioning functions are not well-developed, where there are gaps in the valuation literature related to temperate marine ecosystem goods and services, and where values (where available) are presented in aggregate terms. This paper develops and applies a methodology that first apportions these aggregate benefits across the diverse range of marine landscapes and habitats and then estimates the marginal benefit of protection. The value of benefits was calculated for three different configurations of MCZs under two different management regimes. We estimate a benefit range from designation of between £10.2 billion and £23.5 billion in present value terms, applying a 3.5% discount rate. The study questions the extent to which a defensible policy evidence base can be developed in the absence of primary valuation data and where benefit estimates are reported in aggregate terms.

Assessing the economic viability of alternative water resources in water-scarce regions:

Combining economic valuation, cost-benefit analysis and discounting

- Ecological Economics---2010---Ekin Birol,Phoebe Koundouri,Yiannis Kountouris

This paper demonstrates a comprehensive methodology for assessing the viability of an environmental management plan that has long-run economic and ecological impacts. The case study under consideration is the implementation of a water-resource management plan in a water-scarce region of the world, namely Cyprus.

Specifically, this plan proposes to replenish a depleting aquifer with treated wastewater. The proposed methodology first identifies the key stakeholder groups (farmers and the general public) who are hypothesized to derive economic values (benefits) from implementation of this plan, and then uses stated-preference methods to capture the total economic value of these benefits. Benefits are aggregated over the relevant populations of these stakeholder groups and weighed against the total costs of implementing the plan in a long-run cost-benefit analysis (CBA). An econometrically estimated time-declining trajectory of discount rates is used for the CBA in order to assess the long-run sustainability of the plan. The results reveal that the net benefit trajectory estimated with the time-declining discount rate takes one and a half to three times as long to come to a plateau compared to the constant discount rates of 3.5 and 6%, emphasizing the importance of using declining discount rates and capturing the entirety of the benefits generated by such plans. This methodology is particularly recommended for providing much needed information to support the implementation of the EU Water Framework Directive, which advocates the use of CBA with consideration of the notion of sustainability for achieving the "good water status" for all European waters.

What determines the inclusion in a sustainability stock index?: A panel data analysis for european firms

- Ecological Economics---2010---Andreas Ziegler,Michael Schröder

This paper empirically examines the determinants of the inclusion of European firms in the Dow Jones Sustainability World Index and the Dow Jones Stoxx Sustainability Index. While a restricted econometric analysis implies a positive effect of corporate financial performance, this impact becomes ambiguous in more flexible panel probit models. Our estimation results therefore strengthen the importance of the use of panel data and the incorporation of unobserved heterogeneity. Furthermore, our analysis shows that the sustainability assessment and selection process for the composition

of the Dow Jones sustainability indexes and thus factors that need not necessarily be directly connected to corporate environmental or social activities also have an influence.

Valuing cattle on mixed smallholdings in the Eastern Amazon

- Ecological Economics---2010---M. Siegmund-Schultze,B. Rischkowsky,J.B. da Veiga,J.M. King

Cattle on smallholder farms are kept for socio-economic reasons, rather than physical production, which explains why farmers favour low input and discontinuous management. To find out how this form of livestock husbandry relates to the other main farming sub-systems, cattle-keeping was compared with cassava and black pepper production. Data was collected from 37 cattle-keeping, mixed smallholdings, during 15 visits, at monthly intervals. The three sub-systems were studied in terms of productive efficiency of resource use, socio-economic contribution, and ecosystem-friendliness, using cash flow, non-market output and non-parametric rankings. Their relative performances in each domain were ranked and put on an AMOEBA diagram, "a general method of system description and assessment". The markings connected across functions produced an outline of a polygon, reminding the shape of an amoeba. It was found that productive efficiency was lowest in cattle, benefit:cost ratio was highest in cassava, while return to labour was especially strong in black pepper production. The highest status, lowest production risk, highest liquidity and ease of sale, related to cattle. Cattle and pastures ranked worst in terms of biodiversity, damage to and pollution of water courses. Nutrient losses were highest in cassava, due to the large amount harvested. The differences in function meant that the three polygons occupied different segments of the circular diagram. Nevertheless, together they formed a well-rounded shape. The amoeboid nature of these polygons can be used to predict the effect of a shift of activity on the farm, making the diagram a useful illustrative tool for planning and teaching.

What is the role of openness for China's aggregate industrial SO2 emission?: A structural analysis based on the Divisia decomposition method

- Ecological Economics---2010---Jie He

Having observed the weaknesses in previous structural analyses on the role of Environmental Kuznets Curve (EKC), the author proposes a detailed analysis using a rich data set of provincial level production and SO2 emission intensity of 13 industrial sectors. The latter represent more than 98% of the total industrial production in each Chinese province for the period 1991-2001. Through the use of the log-mean Divisia Index Decomposition method, the variations in province-level industrial SO2 emissions with regard to the 1990 base-line level are decomposed into the contribution from three components: scale, composition, and technical effects. The following analysis seeks to explain how trade openness affects aggregate industrial SO2 emission through its impact on the structural determinants for these three components of region-specific environmental variations.

Strategic importance of green water in international crop trade

- Ecological Economics---2010---M.M. Aldaya,J.A. Allan,A.Y. Hoekstra

Virtual water is the volume of water used to produce a commodity or service. Hitherto, most virtual water 'trade' studies have focused on its potential contribution to saving water, especially in water short regions. Very little, however, has been said about the opportunity cost of the associated water. The present research critically evaluates the strategic importance of green water (soil water originating from rainfall) in relation to international commodity trade. Besides having a lower opportunity cost, the use of green water for the production of crops has generally less negative environmental externalities than the use of blue water (irrigation with water abstracted from ground or surface water systems). Although it is widely known that major grain exporters - the USA, Canada, France, Australia

and Argentina - produce grain in highly productive rain-fed conditions, green water volumes in exports have rarely been estimated. The present study corroborates that green water is by far the largest share of virtual water in maize, soybean and wheat exports from its main exporting countries (USA, Canada, Australia and Argentina) during the period 2000-2004. Insofar virtual water is 'traded' towards water-scarce nations that heavily depend on their blue water resources, green virtual-water 'trade' related to these commodities plays a role in ensuring water and water-dependent food security and avoiding further potential damage to the water environments in both importing and exporting countries. This potential of international green virtual-water 'trade', however, is constrained by factors such as technology, the potential for further increases in the productivity of soil and irrigation water, the level of socio-economic development, national food policies and international trade agreements.

The effect of Africanized honey bees on honey production in the United States: An informational approach

- Ecological Economics---2010---Grigorios Livanis, Charles Moss

The arrival of Africanized Honey Bees in the United States in the 1990s raised a host of economic and ecological concerns. Agriculture is potentially affected both directly by the reduction in honey production and indirectly by the loss of pollinators. This study examines whether the arrival of this invasive species generated a measurable impact on the production of honey using a measure of change in information. The results provide no reason to believe that Africanized Honey Bee has significantly affected the production of honey in the United States or changed the investment behavior of beekeepers.

A further inquiry into the Pollution Haven Hypothesis and the Environmental Kuznets Curve

- Ecological Economics---2010---Aaron Kearsley, Mary Riddel

Empirical research on the relationship between economic growth and its impact on the environment often tests the Environmental Kuznets Curve (EKC), a hypothesis that rising national output leads to increases in pollution emissions until an economy reaches a certain size, and decreases thereafter. This paper addresses a branch of EKC literature focused on the role international trade plays in shaping this relationship. In particular, we test the Pollution Haven Hypothesis, which posits that emission reductions observed in developed nations are partly the result of shifting "dirty" production to developing nations with lax environmental standards. We estimate EKCs for seven oft-studied pollutants and find little evidence that pollution havens play a significant role in shaping the EKC. We also find that confidence intervals around EKC turning points are very wide, often including values well above the range of the data. This leads us to be skeptical of the optimistic view that economic growth naturally leads to improvements in environmental quality.

International trade and Austria's livestock system: Direct and hidden carbon emission flows associated with production and consumption of products

- Ecological Economics---2010---Olga Gavrilova, Matthias Jonas, Karlheinz Erb, Helmut Haberl

The Kyoto Protocol created a framework of responsibilities and mechanisms to mitigate climate change by reducing the emissions of greenhouse gases (GHGs) into the atmosphere. The Protocol stipulates accounting and reporting of GHG emissions and removals, such as energy use, industrial processes, agriculture, waste and net emissions resulting from land use, land-use change and forestry (LULUCF) activities. Emissions reported according to the rules set by the Kyoto Protocol do not include GHG emissions outside a country's boundaries resulting from the production of imported goods or services. As a result, GHG accounts constructed according to the Kyoto Protocol reflect the GHG emissions resulting from the production system of a country, but not all the emissions resulting from the

consumption of goods and services within the country. However, as previous studies demonstrate, a country's emission balance changes remarkably if emissions related to goods or services imported and exported are taken into account. Here, we go beyond the aforementioned studies which mainly focus on GHG emissions from fossil fuel combustion. We assess, in a first-order approach, upstream emissions that result from LULUC activities outside a country while the produced goods are consumed within the country. In our study we focus on Austria's livestock system to elucidate the difference between production and consumption-related emissions accounting approaches. We study direct and 'hidden' (embodied) GHG emissions associated with Austria's bilateral trade in livestock and livestock-related products, based on the integration of full carbon accounting (FCA) and life cycle analysis (LCA).

What is sustainability economics?

- Ecological Economics---2010---Stefan Baumgärtner, Martin Quaas

While economists have been contributing to the discussion of various aspects of sustainability for decades, it is just recently that the term "sustainability economics" was used explicitly in the ecological, environmental, and resource economics community. Yet, the contributions that use the term "sustainability economics" do not refer to any explicit definition of the term, and are not obviously joined by common or unifying characteristics, such as subject focus, methodology, or institutional background. The question thus arises: what is "sustainability economics"? In this essay, we systematically define and delineate "sustainability economics" in terms of its normative foundation, aims, subject matter, ontology, and genuine research agenda.

Private valuation of carbon sequestration in forest plantations

- Ecological Economics---2010---Adriana Bussoni Guitart, L.C. Estraviz Rodriguez

Approval of the Clean Development Mechanism, provided for in the Kyoto Protocol, enables countries with

afforested land to trade in carbon emissions reduction certificates related to carbon dioxide equivalent quantities (CO₂-e) stored within a certain forest area. Potential CO₂-e above base line sequestration was determined for two forest sites on commercial eucalyptus plantations in northern Brazil (Bahia). Compensation values for silvicultural regimes involving rotation lengths greater than economically optimal were computed using the Faustmann formula. Mean values obtained were US\$8.16 (MgCO₂-e)-Â 1 and US\$7.19 (MgCO₂-e)-Â 1 for average and high site indexes, respectively. Results show that carbon supply is more cost-efficient in highly productive sites. Annuities of US\$18.8Â Mg C-Â 1 and US\$35.1Â Mg C-Â 1 and yearly payments of US\$4.4Â m-Â 3 and US\$8.2Â m-Â 3 due for each marginal cubic meter produced were computed for high and average sites, respectively. The estimated value of the tonne of carbon defines minimum values to be paid to forest owners, in order to induce a change in silvicultural management regimes. A reduction of carbon supply could be expected as a result of an increase in wood prices, although it would not respond in a regular manner. For both sites, price elasticity of supply was found to be inelastic and increased as rotation length moved further away from economically optimal: 0.24 and 0.27 for age 11Â years in average- and high-productivity sites, respectively. This would be due to biomass production potential as a limiting factor; beyond a certain threshold value, an increase in price does not sustain a proportional change in carbon storage supply. The environmental service valuation model proposed might be adequate for assessing potential supply in plantation forestry, from a private landowner perspective, with an economic opportunity cost. The model is not applicable to low commercial value forest plantations.

Sustaining Human Carrying Capacity: A tool for regional sustainability assessment

- Ecological Economics---2010---M.L.M. Graymore, Neil G. Sipe, Roy E. Rickson

Regional sustainability is an important focus for natural resource management. Measuring how social and

economic systems are progressing to sustainability is therefore a critical need. But it is dependent upon the development of analytical and methodological tools to measure progress, particularly, we argue, at the regional level. Achieving sustainability at the regional scale is important since it's at this scale where social institutions and ecological functioning are most closely linked. However, our recent study that evaluated the effectiveness of current sustainability assessment methods at the regional scale found methods developed for the global, national and state scales are not entirely effective at assessing sustainability at this spatial scale. Following on from this critique, we developed and tested a new method for assessing sustainability, which we believe is applicable at the regional scale. The framework, Sustaining Human Carrying Capacity (SHCC), evaluates the sustainability of regional human activities by considering the pressures these activities have on regional ecosystems. SHCC was tested and evaluated at the regional scale, demonstrating its potential to be an effective method for monitoring sustainability. It also has potential to be used to inform the community and decision makers about the sustainability of their region, and help guide strategic planning to progress sustainability.

Analysis of the carbon sequestration costs of afforestation and reforestation agroforestry practices and the use of cost curves to evaluate their potential for implementation of climate change mitigation

- Ecological Economics---2010---Arturo Balderas Torres, Rob Marchant, Jon C. Lovett, James C.R. Smart, Richard Tipper

Carbon sequestration in forest sinks is an important strategy to remove greenhouse gases and to mitigate climate change; however its implementation has been limited under the Clean Development Mechanism of the Kyoto Protocol which has not created the incentives for widespread implementation. The objective of this paper is to analyze the sequestration costs of agroforestry afforestation and reforestation projects (ARPs) following a partial market equilibrium using

average cost curves and economic break even analysis to identify the supply costs. The modelling done in this work contrasts the voluntary and clean development mechanism transaction costs. Data is based on the voluntary project, Scolel Té, being implemented in Mexico. Cost curves are developed for seven different sequestration options considering transaction and implementation costs; information from agricultural production in Chiapas Mexico is used to integrate opportunity costs of two agroforestry practices suggesting that sequestration costs may follow a "U" shape, with an initial reduction due to economies of scale and a subsequent increase caused by high opportunity costs. The widespread implementation of agroforestry options not requiring complete land conversion (e.g. living fences and coffee under shade) might be cost effective strategies not generating high opportunity costs. Results also suggest that payments in the early years of the project and lower transaction costs favour the development of ARPs in the voluntary market especially in marginal rural areas with high discount rates.

The ecological importance of species and the Noah's Ark problem

- Ecological Economics---2010---Neil Perry

Using the Noah's Ark problem - the problem of efficiently allocating limited funds to conserve biodiversity - the standard economic approach to endangered species conservation constructs a human-centered biodiversity by favoring species directly valuable to humans. I analyze this approach and draw on the functional ecology literature to offer an alternative emphasizing the role species play in their ecosystems. The aim is to create a working ecosystem on the Ark rather than a collection of charismatic and distinct species. To do so, I construct a new measure of a species' ecological importance and an ecological objective appropriate for cost-effective resource allocation. The ecological approach fundamentally changes the notion of species-value from a direct value based on a species' appearance or taxonomic difference to an indirect value based on a species' ecological role in its ecosystem. In the process, 'populations' of species become the fundamental

unit of biodiversity rather than 'species', and abiotic processes also possess value. When compared to the economic approach, the ecological approach prioritizes different species for the Ark and achieves superior economic outcomes in all but the mythical Noah's Ark scenario where interactions are non-existent. The analysis challenges the approach of US endangered species legislation and I call for a reformulation based on endangered ecological interactions.

The Four-Sector Diagram of Benefits (FSDOB) as a method for evaluating strategic interactions between humans and the environment: The case study of hydrogen fuel cell buses

- Ecological Economics---2010---Corrado Giannantoni, Mariangela Zoli

In this paper we propose to adopt a new multi-criteria methodology, termed as the Four Sector Diagram of Benefits (FSDOB), to evaluate potential benefits generated by new energy options. This method allows us to account for a multiplicity of economic, social and environmental indicators, but especially for a particular form of benefits, termed as Ordinal Benefits. These Benefits can never be reduced to a monetary value, nonetheless they can be estimated in Emergy terms, albeit such estimations only represent simple "ciphers" of their real values. On the basis of the FSDOB Method we evaluate all the various forms of benefits provided by the introduction of hydrogen fuel cell buses. The case-study shows that our benefit-oriented approach tends to favor the adoption of environment-friendly technologies, as a consequence of the huge amount of social and environmental benefits they provide. The same solutions would result as non profitable from a traditional financial point of view. In such a perspective, they would never be realized, by losing, in actual fact, the opportunity of taking advantage of all the associated benefits.

The joint discourse 'reflexive sustainable development' -- From weak towards strong sustainable development

- Ecological Economics---2010---Heidi Rapp Nilsen

The purpose of this paper is to contribute towards moving the predominant situation of weak sustainable development (WSD) in the direction of strong sustainable development (SSD). More people - academics, politicians, bureaucrats and laymen alike - need to recognize SSD as an alternative to WSD. A joint discourse of WSD and SSD is suggested, called reflexive sustainable development. Here, advocates of WSD and SSD must argue for each specific case why their solution is better. This will expose, amongst other things, the ethical foundations which form part of resulting policy advice. Reflexive sustainable development is to be framed in discourse ethics, thereby remedying the power imbalance and allowing for substantial discussion. Reflexive sustainable development builds on a common theoretical base but will not lead to consensus in all matters. A family metaphor is introduced to inspire a discourse of both consensus and compromise.

Conceptualising uncertainty in environmental decision-making: The example of the EU water framework directive

- Ecological Economics---2010---Katja Sigel, Bernd Klauer, Claudia Pahl-Wostl

Uncertainty is highly relevant in environmental policy because on the one hand environmental problems are regarded as complex and require a long-term perspective and on the other hand the knowledge available to practitioners and policy makers alike is often fragmentary and not systemised. One key issue arising from this is the challenge to develop scientific decision support methods that are capable of dealing with uncertainty in a systematic and differentiated way, integrating scientific as well as practical knowledge. This paper introduces a conceptual framework for perceiving and describing uncertainty in environmental decision-making. The conceptual framework consists of a general definition of uncertainty along with five complementary perspectives on the phenomenon, each highlighting one specific aspect of it. By using the conceptual framework, decision-makers are able to reflect on their knowledge base with regard to its completeness and reliability and to gain a broad picture of

uncertainty from various standpoints. The theoretical ideas presented here are complemented by two empirical studies looking at how uncertainty is dealt with in the implementation process of the EU Water Framework Directive. The rather abstract differentiations are illustrated by a number of examples in the form of interview statements and excerpts from the directive and official EU documents.

Estimating land degradation risk for agriculture in Italy using an indirect approach

- Ecological Economics---2010---Luca Salvati, Margherita Carlucci

This paper illustrates a two-step procedure for measuring land degradation (LD) risk in agriculture. The procedure estimated the potential costs of LD from a standard index of land sensitivity to degradation (ESAI) by calculating, over 784 local districts covering the entire Italian territory, a 'depletion factor' in relation to the agricultural value added. The procedure was based on changes in the ESAI (1990-2000) and ancillary variables (i.e., per capita value added, share of agriculture in the total production, and agricultural profitability). On average, the estimated costs of LD in Italy amounted to nearly 0.5% of the agricultural value added (which corresponded to 12[euro]/ha of cultivated surface). These figures are comparable to those presented in the literature for regions with similar environmental conditions. This paper contains descriptions of the assumptions under which the proposed scheme works and comments on their empirical plausibility.

Cost-effective management of invasive species using linear-quadratic control

- Ecological Economics---2010---Julie Blackwood, Alan Hastings, Christopher Costello

The removal of invasive species is the first step toward restoring an ecosystem following invasion. We develop spatially-explicit, dynamic optimal control strategies for a large class of invasion problems using linear-quadratic control. This approach allows us to produce new insights that help guide policy that

could not have emerged from existing models. We assume adults are sedentary, and heterogeneous patches are connected via dispersal of offspring. We develop a generalized approach to optimally manage species across time and space and apply the framework to several examples, primarily based on *Spartina alterniflora*. General conclusions are drawn and we show that strong connectivity makes invasive control much more costly, demonstrating that reducing connectivity can be a cost-effective part of invasive species control.

Heterogeneous preferences for water quality attributes: The Case of eutrophication in the Gulf of Finland, the Baltic Sea

- Ecological Economics---2010---Anna-Kaisa Kosenius

This paper examines the preference heterogeneity of the general public regarding water quality attributes and provides welfare estimates (WTP) for three nutrient-reduction scenarios that would improve the water quality in the Gulf of Finland, part of the Baltic Sea. In the choice experiment (CE), the improvement is described in terms of four water quality attributes: water clarity, abundance of coarse (non-attractive) fish, status of bladder wrack (a type of seaweed), and mass occurrences of blue-green algae blooms. The data are analysed with multinomial logit (MNL), random parameters logit (RPL), and latent class (LCM) models. The results from MNL and RPL show that, on average for Finns, clear water is, relatively speaking, the most important water quality characteristics followed by desire for fewer occurrences of blue-green algae. The results also show that the probability of expressing willingness to contribute to improvement of the water quality increases with residential or recreational contact with the Gulf of Finland, a higher income than average, a younger than average age, and lack of dependent children in the household. The LCM reveals that opinions about the order of relative importance of attributes depend on age, household income, coastal residence, and vacation home ownership. The present values for three nutrient reduction scenarios of different intensities ranging from 28,000 million euro to

54,000 million euro were calculated using mean welfare estimates, discounted for perpetuity with a 2% rate.

Regionalization of climatic factors and income indicators for milk production in Honduras

- Ecological Economics---2010---Peter Lenten, Michael Peters, Federico Holmann

The temporal and spatial distribution of dry and wet seasons is drastically limiting forage and agricultural production in Honduras. A regional overview on how these patterns influence the income of different types of milk producers was non-existent and would be a beneficial tool for targeting policies and development interventions. This paper examines the regionalized incomes derived from milk production by relating dry season length to milk production parameters for dairy farms. Cattle farms were assessed using two samples. Milk production in the dry and wet seasons was characterized by monthly net income from milk per cow. Sample A (97 farms) was classified according to a) herd size classes and b) performance in dry season milk production. Sample B (30 farms) assessed advanced farms that used more forage technologies than the others. The income from milk was related to environmental conditions by means of a countrywide map based on dry season length. The map was created by estimating the water balance for each month in a GIS. Yearly income from milk/cow was regionalized for the farm classifications and combined with agricultural census data. Results of the GIS analysis show a detailed zoning of dry season length and yearly income per cow from milk. Climate-income maps quantify the income ranges of the examined groups of farms. Climate change models predict temperature rise and decreasing precipitation for Honduras. In view of these trends the results can be used for an interpretation of farm vulnerability and resilience to climate change.

Modelling regional markets for co-produced timber and biofuel

- Ecological Economics---2010---A. Korobeinikov, P. Read, A. Parshotam, J. Lermitt

It has been suggested that the large scale use of biofuel, that is fuel derived from biological materials, instead of traditional fossil fuels, especially in combination with reforestation of large areas, can lead to a low-cost reduction in atmospheric carbon dioxide levels. In this paper, we attempt to estimate the cost of a policy aimed at the reduction of carbon in the atmosphere. We model an economical system of n geographical regions with inter-regional trade, with the aim of evaluating the impacts of large scale biofuel production and forestry on regional and global energy, wood and land markets. It is shown that the costs under these policies are lower than has been previously expected.

The determination of optimal climate policy

- Ecological Economics---2010---Asbjørn Aaheim

Analyses of the costs and benefits of climate policy, such as the Stern Review, evaluate alternative strategies to reduce greenhouse gas emissions by requiring that the cost of emission cuts in each and every year has to be covered by the associated value of avoided damage, discounted by an exogenously chosen rate. An alternative is to optimize abatement programmes towards a stationary state, where the concentrations of greenhouse gases are stabilized and shadow prices, including the rate of discount, are determined endogenously. This paper examines the properties of optimized stabilization. It turns out that the implications for the evaluation of climate policy are substantial if compared with evaluations of the present value of costs and benefits based on exogenously chosen shadow prices. Comparisons of discounted costs and benefits tend to exaggerate the importance of the choice of discount rate, while ignoring the importance of future abatement costs, which turns out to be essential for the optimal abatement path. Numerical examples suggest that early action may be more beneficial than indicated by comparisons of costs and benefits discounted by a rate chosen on the basis of current observations.

Cost of potential emerald ash borer damage in U.S. communities, 2009-2019

- Ecological Economics---2010---Kent Kovacs,Robert G. Haight,Deborah G. McCullough,Rodrigo J. Mercader,Nathan W. Siegert,Andrew M. Liebhold

Emerald ash borer (*Agrilus planipennis* Fairmaire), a phloem-feeding beetle native to Asia, was discovered near Detroit, Michigan and Windsor, Ontario in 2002. As of March 2009, isolated populations of emerald ash borer (EAB) have been detected in nine additional states and Quebec. EAB is a highly invasive forest pest that has the potential to spread and kill native ash trees (*Fraxinus* sp.) throughout the United States. We estimate the discounted cost of ash treatment, removal, and replacement on developed land within communities in a 25-state study area centered on Detroit using simulations of EAB spread and infestation over the next decade (2009-2019). An estimated 38 million ash trees occur on this land base. The simulations predict an expanding EAB infestation that will likely encompass most of the 25 states and warrant treatment, removal, and replacement of more than 17 million ash trees with mean discounted cost of \$10.7 billion. Expanding the land base to include developed land outside, as well as inside, communities nearly double the estimates of the number of ash trees treated or removed and replaced, and the associated cost. The estimates of discounted cost suggest that a substantial investment might be efficiently spent to slow the expansion of isolated EAB infestations and postpone the ultimate costs of ash treatment, removal, and replacement.

Q methodology to select participants for a stakeholder dialogue on energy options from biomass in the Netherlands

- Ecological Economics---2010---Eefje Cuppen,Sylvia Breukers,Matthijs Hisschemöller,Emmy Bergsma

Stakeholder dialogues are proposed as a method for assessing complex ecological and environmental problems. Stakeholder dialogues aim to enhance mutual

learning by generating and evaluating divergent knowledge claims and viewpoints, i.e. problem structuring. Problem structuring requires that the diversity of perspectives is represented in the dialogue. We argue therefore that stakeholder dialogues should involve procedures for stakeholder selection that allow for the identification of the diversity of perspectives as well as of stakeholders identifying with those perspectives. We explore the use of Q methodology as a tool for pursuing this goal. Q methodology can be used to uncover perspectives that exist within a particular (policy) field. We applied Q methodology to a stakeholder dialogue on energy options from biomass in the Netherlands to identify stakeholder perspectives on energy from biomass and to select stakeholders for the dialogue. In order to discuss the use of Q methodology for stakeholder selection, we compare this stakeholder selection with a hypothetical selection based on actor type (NGOs, knowledge institutes, industry, etcetera). Our analysis shows that, although often implicitly assumed, actor type is not a good proxy for perspective: the actor types appeared to be heterogeneous in terms of perspectives. This means that a stakeholder selection procedure based on perspectives will very likely result in a different group composition than a selection based on affiliation or actor type. The analysis however also shows that some actor types were more heterogeneous than others and that some perspectives are dominated by particular actor types. We conclude that Q methodology is a useful method for stakeholder selection in stakeholder dialogues and wrap up with a discussion of the results and the implications for the design and preparation of a dialogue process.

Household income strategies and natural disasters: Dynamic livelihoods in rural Nicaragua

- Ecological Economics---2010---Marrit van den Berg

This paper assesses the impact of hurricane Mitch on livelihood strategies of rural households in Nicaragua. Through destruction or distress sales of productive assets, a hurricane or another natural hazard could induce people with relatively remunerative livelihoods

to choose more defensive strategies which allow them to survive, but at a permanently lower welfare level than before. Using panel data from before and after hurricane Mitch, we find that livelihood strategies can be grouped into three welfare categories. Annual farming and farm employment generate low incomes, whereas nonfarm wage employment and livestock farming result in relatively high incomes. Perennial farming, nonfarm self-employment and annual cropping with nonfarm employment take an intermediate position. High welfare strategies were associated with high levels of capital, and the number of people involved was very similar between different years, suggesting that households following low-welfare strategies were trapped in poverty. However, many households moved actively between strategies of different welfare levels. This indicates that there was no absolute poverty threshold, but also that being able to initiate a relatively profitable livelihood strategy was no guarantee that this strategy could be maintained. There is no evidence that hurricane Mitch affected livelihood strategy transitions: livelihood mobility was similar for households inside and outside Mitch-affected areas.

Externalities in an endogenous growth model with social and natural capital

- Ecological Economics---2010---Catarina Roseta-Palma,Alexandra Lopes,Tiago Sequeira

Models of economic growth are typically based on the use of one or more stocks of productive assets to create goods for utility-generating consumption. The roles played by man-made capital, natural capital, and human capital have been explored in the literature, and more recently the notion of social capital has been brought to the fore. This paper provides an attempt to construct an inclusive model of growth, analyzing externalities and distortions due to market failures linked with social capital and environmental problems.

Public participation and willingness to cooperate in common-pool resource management: A field experiment with fishing communities in Brazil

- Ecological Economics---2010---Carina Cavalcanti,Felix Schlöpfer,Bernhard Schmid

The primary evidence about the factors determining successful self-governance of common-pool resources (CPR) has come from case studies. More recently, this observational evidence has been complemented by insights from economic experiments. Here we advance a third approach in which the role of local deliberation about the management of a fishery resource is investigated in a field experiment. Using three control and three treatment communities in a freshwater fishery, we tested whether participation in developing specific measures for community-based sustainable CPR management increased the willingness to contribute to the implementation of these measures. Each community was also exposed to information about their community leaders' advice about the proposed measures. Both participation and leader advice affected the willingness of participants to contribute in one of three proposed measures. However, the strongest influence on individual willingness to contribute was exerted by the individual beliefs about the cooperation of others in CPR management.

Sulfur dioxide allowances: Trading and technological progress

- Ecological Economics---2010---Surender Kumar,Shunsuke Managi

The US Clean Air Act Amendments introduce an emissions trading system to regulate SO₂ emissions. This study finds that changes in SO₂ emissions prices are related to innovations induced by these amendments. We find that electricity-generating plants are able to increase electricity output and reduce emissions of SO₂ and NO_x from 1995 to 2007 due to the introduction of the allowance trading system. However, compared to the approximate 8% per year of exogenous technological progress, the induced effect is relatively small,

and the contribution of the induced effect to overall technological progress is about 1-2%.

Invasive species and delaying the inevitable: Valuation evidence from a national survey

- Ecological Economics---2010---Christopher McIntosh, Jason Shogren, David C. Finnoff

A survey was designed to elicit donations for delaying inevitable aquatic invasions of inland water bodies within a respondent's region. Surveys were distributed throughout the United States. Assuming all aquatic species groups invade simultaneously, our results suggest that the average person was willing to make a one-time payment of \$48 to delay low to high impacts one year (aggregates to nearly \$4 billion for all U.S. households). By comparison, the federal government currently (2006) invests \$394 million annually for all invasive species (aquatic and terrestrial) prevention and early detection/rapid response.

On the non-convergence of energy intensities: Evidence from a pair-wise econometric approach

- Ecological Economics---2010---Yannick Le Pen, Benoît Sévi

This paper evaluates the convergence of energy intensities for a group of 97 countries in the period 1971-2003. Convergence is tested using a recent method proposed by Pesaran (2007) [Pesaran, M.H., 2007. A pair-wise approach to testing for output and growth convergence. *Journal of Econometrics* 138, 312-355] based on the stochastic convergence criterion. An advantage of this method is that results do not depend on a benchmark against which convergence is assessed. It gives more robust results. Applications of several unit-root tests as well as a stationarity test uniformly reject the global convergence hypothesis. Locally, for Middle East, OECD and Europe sub-groups, non-convergence is less strongly rejected. The introduction of possible structural breaks in the analysis only marginally provides more support to the convergence hypothesis.

Accounting for cultural heritage -- A theoretical and empirical exploration with focus on Swedish reindeer husbandry

- Ecological Economics---2010---Göran Bostedt, Tommy Lundgren

The aim of this paper is to explore some of the theoretical and empirical aspects of an economy which includes cultural capital. We use a simple dynamic growth model and the concept of a social accounting matrix (SAM) to illustrate how the addition of income flows and net changes of various natural and cultural resources can be incorporated into a broader measure of welfare. The Swedish reindeer industry, managed by the indigenous Sami people, is used as an example since it is generally regarded to have significant cultural heritage value, beyond its contribution to conventional national accounts. We discuss a theoretically correct compensation to a cultural sector for preserving and maintaining a cultural heritage. Furthermore, we attempt to estimate the cultural value of the Sámi Reindeer sector in Sweden using a CVM survey. The results suggest that the willingness to pay (per year) to maintain cultural heritage at least at the current level may be quite substantive, estimates showing it can be several times the industry's turnover per year.

The economics of global light pollution

- Ecological Economics---2010---Terrel Galaway, Reed N. Olsen, David M. Mitchell

This paper is the first analysis of the economic factors of global light pollution. Light pollution commonly refers to excessive or obtrusive artificial light caused by bad lighting design. Light pollution generates significant costs including negative impacts on wildlife, health, astronomy, and wasted energy--which in the U.S. amounts to nearly 7 billion dollars annually. Current scientific models of light pollution are purely population based. The current paper utilizes unique remote sensing data and economic data from the World Bank to quantify the economic causes of light pollution globally. Fractional logit models show that, similar to

other types of pollution, both population and GDP are significant explanatory variables.

The cost of carbon abatement through community forest management in Nepal Himalaya

- Ecological Economics---2010---Bhaskar Singh Karki, Margaret Skutsch

This paper estimates the economic returns to carbon abatement through biological sequestration in community managed forest under future REDD policy, and compares these for three possible management scenarios. For the estimation, the research relies on forest inventory data together with other socio-economic and resources use data collected from forest users in three sites of Nepal Himalaya. The paper estimates the incremental carbon from forest enhancement on a yearly basis over a five-year period using the value of \$ 1 and \$ 5 per tCO₂ for conservative analysis. The results based on the three sites indicate that community forest management may be one of the least cost ways to abate carbon with a break-even price under Scenario 2 which ranges from \$ 0.55 to \$ 3.70 per tCO₂. However, bringing community forests into the carbon market may entail high opportunity costs as forests provide numerous non-monetary benefits to the local population, who regard these as the main incentive for conservation and management. An important finding of the research is that if forest resources use by local communities is not permitted, then carbon trading will not be attractive to them as revenue from carbon will not cover the cost foregone by not harvesting forest resources.

Outliers: the story of success, Malcom Gladwell, 2008, Little, Brown and Company, ISBN: 0316017922, 320 pp

- Ecological Economics---2010---Marjan van den Belt

2010