Decision-making and valuation for environmental policy requires improving decision-making and understanding diverse values in environmental policy and related public issues. This is required to enable advances in valuing environmental quality and economic growth and in improving environmental decision-making. Theoretical and empirical research in mathematics, social and behavioral sciences, and environmental ethics provides a number of useful frameworks and tools for organizing information on the economic and social influences on, and consequences of, alternative environmental policies. Benefit-cost analysis, multi-criteria decision analysis, cost-effectiveness analysis, and consensus modeling represent well-known approaches in environmental decision-making.



There is a need to support research that advances the scientific basis of valuation and decision analysis as it contributes to the formulation and evaluation of environmental policy. The lack of generally accepted methods for identifying and/or valuing many important economic, environmental and social benefits, costs, and interactions limits the use of decision-analytic frameworks, particularly for community based environmental problems and issues dealing with ecosystem variability. We need to address key theoretical, empirical and methodological needs associated with the development and use of these frameworks.

Organizations and institutions responsible for policy analysis, regulatory decision-making, priority setting for environmental actions, and assessment have an interest in advancing research to help develop practical, systematic and credible approaches to identifying economic, environmental and social interactions, estimating their benefits and costs, and improving decision-making about environmental issues.

**Innovations and Improvements in Environmental Decision Making**

**A. Methodological Innovations and Improvement**

Developing acceptable and efficacious environmental policy requires improvement of the assumptions, concepts, and methods in relevant research and implementation. It requires continuing refinement of accepted approaches to environmental decision? Making, as well as exploration of innovative alternative methodologies for accomplishing policy goals, especially in the areas of pollution prevention and sustainable development. Research on innovative approaches to environmental decision? Making and on refinement of existing approaches is expected to be theoretically and methodologically sophisticated and to contain an empirical component. Some of the issues involved include:

Developing alternative approaches to environmental decision making (including those focused on decision-making as a negotiation process, or use of decision analytic approaches) and comparative analysis and assessment of the effectiveness of different models of environmental decision making.

Improving methods of assessment (including social impact analysis) and cost/benefit analysis considering consequences of delayed resolution of uncertainty, the public goods aspects of environmental amenities, and the conflicting objectives of groups impacted by regulation.

Improvements in methods for accurately and consistently evaluating consequences of various regulatory and none? Regulatory options, and making tradeoffs between gains occurring through different environmental policy interventions.

Development and analysis of tools to identify and assess nonmonetary values and value systems affected by and affecting environmental change.

**B. Advances in Understanding Values and Perceptions Relevant in Environmental Decision-making**

Public concern over environmental resources and degradation is at an all-time high, but public mistrust and misunderstanding of environmental risk assessment and decision-making is also very high. Many risk managers are also bewildered by the complexities and uncertainties in the assessment and decision making process. Research has provided information about the factors that affect the development and use of environmental policy: psychological attitudes; sociocultural, legal, and ethical norms; economic forces; and politics and the media. Better understanding of these factors and the role they play in social negotiations about environmental issues is needed. This area encourages research to identify and examine behavioral, social and institutional factors that influence the development, implementation, acceptance, and evaluation of environmental policies. Some of the key issues in understanding values and perceptions include:

Advances in understanding how perceptions of environmental problems and solutions and approaches to their resolution differ across individuals and groups within society.

Examination of how framing of issues and means of communicating information influence attitudes toward environmental problems and solutions; and how differences in the way individuals and groups discount future events impact attitudes toward environmental problems and solutions.

Identification and analysis of ethical factors relevant to environmental problem? Solving, and their similarities and differences in different groups, communities, countries or geographical regions. Examination of adjudication of norms when policies must cross national boundaries; identification of mechanisms that are effective in addressing Tran’s jurisdictional problems.

Identification and analysis of cultural, inter? Organizational and interpersonal values that can impede or improve the establishment, implementation and evaluation of environmental policies and regulations.

**C. Procedural Innovations and Improvements in Environmental Decision-making**

Government, business and industry, and citizens have an interest in expediting the consideration and enactment of environmental policies and regulations. They have an interest in understanding what factors constrain or limit effective implementation of environmental policies (both regulatory and voluntary policies and programs) and how these constraints might be eliminated or minimized through changes in the decision-making process. Besides the need for improvement in understanding of the role of values in environmental decision-making, cost-effective ways by which to foster communication, resolve issues and implement new programs are needed. This component identifies several areas where research could assist decision? Makers and communities to address these needs. Some of the key issues in procedural innovations and improvements include:

Assessment of economic and social incentives for pollution prevention by industry and government.

Examination of the wide variety of social constraints on the environmental decision making process that may impede implementation of sound environmental policy or environmental justice especially in the areas of pollution prevention and sustainable development; development of options to overcome these impediments.

Development and assessment of effective methods for tailoring environmental policy procedures to account for characteristics of the primary group(s) (e.g., large corporations or concentrated industries versus small business versus the public) impacted by potential regulation.

Identification and assessment of options by which to address the implications of cognitive and none? Cognitive factors in development and implementation of environmental policies.

Analysis of factors affecting democratic processes and community or public participation in environmental decision making.

**Benefit-Cost Analysis**

Benefit-cost analysis (BCA) (also known as cost-benefit analysis) is a widely used, well-documented tool for assessing the net economic effects of policies. BCA provides a systematic process for calculating, monetizing, and comparing the economic benefits and costs of a particular action, process, regulation, or project by putting benefits and costs in a common metric. The results of a BCA can be used in two key ways: to provide insight into whether a project or policy provides a net economic benefit or cost to a company or society; and, to compare the outcomes of different project or policy alternatives.

BCA is based on economic theory and techniques. Specifically, BCA draws on peer-reviewed economic literature both to identify and define categories of benefits and costs and to help estimate benefits and costs that are not directly bought and sold in markets. BCA has been an important component of regulatory analysis at the EPA for over three decades. Documentation of the EPA’s use of BCA to assess the economic impact of federal policies and programs is extensive. EPA’s 2010 Guidelines for Preparing Economic Analyses provides detailed guidance on the proper use of BCA (and other forms of economic analyses) to assess regulations and policies.

**How can Benefit-Cost Analysis contribute to sustainability?**

Benefit-cost analysis can inform an assessment of sustainability in two key ways. In a general sense, applying a rigorous analytic BCA framework can help ensure that a sustainability assessment clearly describes and accounts for different economic, social, and environmental impacts in a way that addresses analytic concerns such as double counting and the treatment of varying time frames. The BCA framework can also help identify areas where other types of analysis may be complementary.

BCA also provides an approach for measuring and valuing some environmental and social impacts that are not market goods. A key aspect of BCA is correctly measuring and valuing environmental and social goods such as effects on human health and environmental integrity (e.g., the value of visibly clean air). In some cases, BCA can provide quantified, monetized benefits for these non-market goods. In other cases, BCA can describe or quantify effects that are not able to be monetized.

In the economy, many impacts central to sustainability (e.g., reduction in toxic chemicals) function as externalities because the market does not have a direct mechanism for paying for the goods (e.g., paying the public for releasing a chemical). In these cases, BCA methods for estimating non-market values can provide insights, either through revealed preference or stated-preference data from consumers.

Revealed preference methods use data on human behavior (e.g., money spent visiting parks or the premium on home values near parks) to infer values for natural resources and associated services. In contrast, stated-preference methods use sophisticated survey designs and modeling methods to ask individuals to explicitly state their value for a resource or service. Both revealed preference and stated preference methodologies depend on the population and markets surveyed, and typically focus on national averages or responses. In some cases, however, more local-scale or more international-scale evaluations may be appropriate for assessing sustainability.

The challenge of conducting a BCA that correctly accounts for the full economic, social, and environmental benefits and costs of projects, programs, or policies has spurred development of methodologies and valuation tools that may be used in conjunction with BCAs to incorporate specific sustainability-related factors. Ecosystem service valuation is one tool that provides a measure of additional non-market, environmental inputs. Other methods under development include full cost accounting, true cost accounting, life-cycle costing, total cost assessment, and green accounting. Together, these methods may help BCA better account for all transactional costs and benefits (e.g., resource depletion) that result from economic production or policy implementation, as well as identify the hidden costs of specific alternatives (e.g., maintenance and fuel costs associated with specific processes).

**SOLVING ENVIRONMENTAL PROBLEMS USING ECONOMICS**

**Cap-and-trade**

In emissions trading, or cap-and-trade schemes, a limit is governmentally imposed on the total amount of a pollutant that can be emitted. Permits are distributed to companies and other entities, each representing the right to emit specified quantity of the pollutant. Entities must hold a number of permits equivalent to their pollution output. Permits can be traded between entities, re-sulting in polluters paying for their emissions whilst non-polluters are rewarded through sale of their unused permits.

Emissions trading aims to produce the largest reduction in pollution at the lowest possible cost, internalizing previously external environmental costs (Ti-etenberg, 2006). Technological innovations are driven by the high cost of polluting and the rewards of selling unused allowances (Ti-etenberg, 2006; Stern, 2006). Ideally these innovations provide cleaner technology which pollutes less (Woodman, 2000). Many emissions trading schemes are already in place at regional and national levels (Hansjurgens, 2005), with some international schemes such as the EU ETS working towards a global carbon trading scheme (Kellerman and Buchner, 2007).

The linking of regional, national and international schemes has potential to help prevent a climate catastrophe (Stern, 2006). Resistance from some key nations such as the U.S.A. (Stavins, 2008) and China (Zhang, 2003) has prevented the goal of global cooperation, although the latest U.S. budget describes looks forward to a carbon trade scheme (Whitehouse, 2009). A key bent of emissions trading schemes is the potential to implement them in the very near future, without the need for a very gradual transition. Problems have been highlighted regarding how to distribute the initial allowances (Freeman and Kolstad, 2006). It has also been suggested that the expense of regulating a global emissions market could be extremely high (Woerdman, 2000), although Stern (2006) conclude that the cost of not implementing such a system would be far greater.

**Green Tax**

Green tax involves directly taxing pollution and the use of land and non-renewable resources. Green taxes can be applied at both production and consumption levels: taxes are levied on production of pollutants and on products containing them. The purpose is to create a strong incentive to avoid pollutants by rewarding the use of less environmentally damaging alternatives. It is commonly proposed that green taxes should replace income tax (e.g. Harper, 2007; Tindale and Holtham, 1996), with taxation based primarily upon environmental impact rather than income. The movement to green taxes should be revenue neutral, although large scale investment in greener technologies would be required by government in order to facilitate the transition to a cleaner economy (Koskela et al., 2001). By contrast to emissions trading schemes, movement to a fully green taxation system must be a gradual process - businesses, individuals and infrastructures need time to adjust. If the requisite acclimatization was not catered for, economic and social chaos (Harper, 2007) would inevitably result.

Green taxes are already implemented in varying measures by many countries including the UK and Germany, especially via taxes on petrol (ONS, 2008), but to date there has been no commitment by any nation to make a full transition to a green taxed economy (Brown, 2003). Where green taxes have been implemented, they have been shown to punish households to a greater extent than businesses (Svendsen et al., 2001; JRF, 2004). Solutions have been suggested, including using revenue from green taxes to compensate individuals (Tindale and Holtham, 1996). A more prohibitive problem is that the lobbying powers currently wielded by many industries could present a barrier to truly effective green taxes on businesses (Carraro and Metcalf, 2001).

**Privatization of the commons**

Free-market environmentalists would argue that governmental interference in the markets can never be the solution to environmental problems. Instead, the markets could seek to solve the problem of externalities such as the commons by bringing them under private control. In this way, private entities would be responsible for the maintenance of resources. Over-exploitation would be detrimental to the interests of the owner, who should therefore restrict the use of the resource in a sustainable fashion (Hahnel, 2005). Organizations such as the Nature Conservancy have taken a full privatization approach to the commons problem by buying vast areas of wilderness around the globe and calling a halt to any use by industry (Goldman, 1998). Rothbardian economic thinkers argue that assigning Locke and property rights to

The commons maximizes social utility provided there are no limits governmentally imposed on the system (Anderson and Leal, 2001). Even so, implementing such a system on a global scale would involve deconstructing the entire global economy to rebuild it from rust principles - layered governmental economic controls and a long history of protectionism in international markets have ensured this (Kahn, 1988).

In practice, it may be impossible to assign property rights to the numerous forms of commons. This is especially true of the air and water which circulate in global currents (Anderson and Leal, 2001). In a fully privatized world it is unlikely that the conservation of those species with little economic value would be effective - commercially uninteresting nature would be driven out by the value of alternative land use (Brown, 2003). However, the example of the Nature Conservancy shows that conservation organizations might successfully enter the markets on the side of these species.

**Conclusions**

It is clear that in order to tackle climate change a synthesis of ideas is required.

As the Stern Report (Stern, 2006), the IPCC (Solomon et al., 2007) and GEO4

(UNEP, 2007) all conclude, we need to use every method at our disposal. Privatization of the commons has its place, especially where the other methods fail to protect individual species which are already threatened by human interference. At the local level, land purchase might be the only option to prevent direct habitat destruction. Nationally, green taxes as direct action can produce measurable effects (Koskela al., 2001), but the requisite transitional period means that they cannot work alone. Individual taxes on energy and pollution could complement trading schemes and speed up the delivery of sustainable technology if the revenue is properly invested in research and development (Brown, 2003). In terms of implementing an international system, carbon trading programmes are expected to yield significant results even without the cooperation of China and others (Ellerman and Buchner, 2007; Convery, 2009). If China do take part, this method alone could avert the worst effects of climate change (Stern, 2006).