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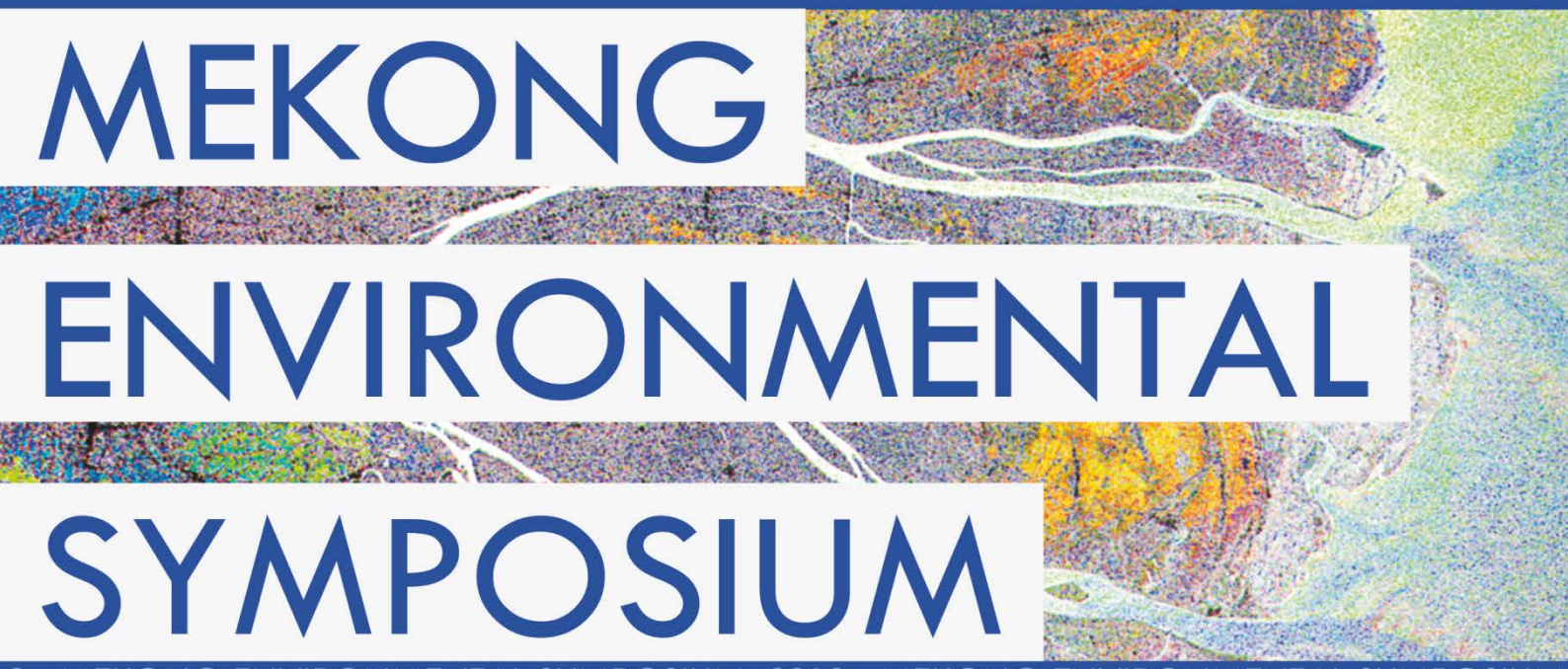
5th to 7th of March 2013 - Ho Chi Minh City - Vietnam

MEKONG ENVIRONMENTAL SYMPOSIUM



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ABSTRACT VOLUME

A b s t r a c t V o l u m e

Mekong Environmental Symposium 2013

Ho Chi Minh City / Vietnam
5th – 7th of March 2013

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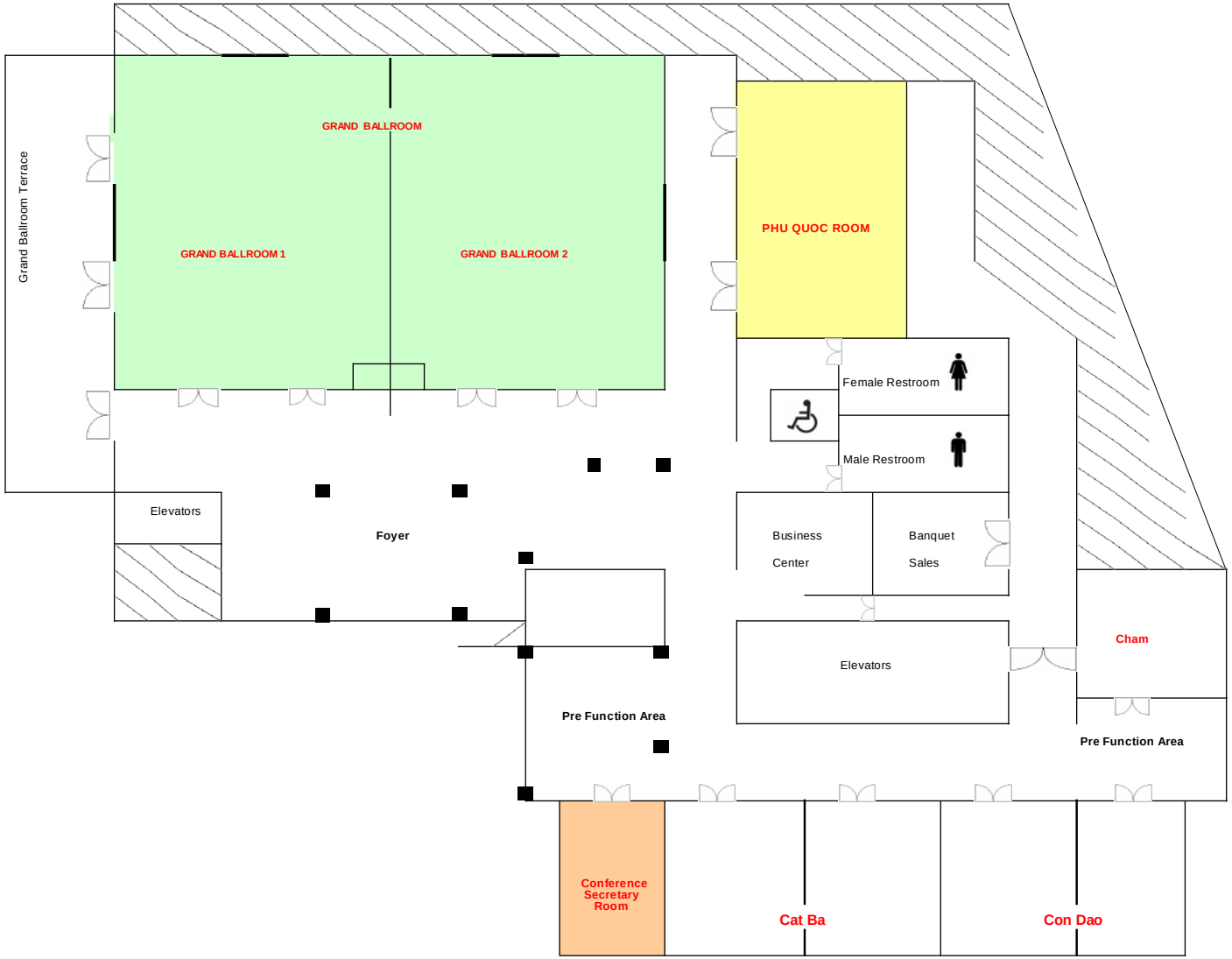
Conference Layout



Conference Schedule

Day I - I: 5th of March 2013

		Grand Ball Room 1	Grand Ballroom 2	Phu Quoc Room	Foyer
		Topic	**Speaker**		
07:30	8:30	**Welcome Coffee and Registration**			
9:00	09:10	Welcome Note of Organizers	**Dr. Claudia Kuenzer** – WISDOM Project Leader, German Earth Observation Center of the German Aerospace Center (DLR)		
09:10	09:20	Welcome Note of BMBF and Opening	**MinDirig. Wilfried Kraus** – Deputy Director General "Provision for the Future – Basic and Sustainability Research", German Federal Ministry of Education and Research (BMBF)		
09:20	09:30	Welcome Note of MOST	**Dr. Tran Viet Thanh** - Vice Minister of Ministry of Science and Technology Vietnam (MOST)		
09:30	09:40	Welcome Note of MONRE	**Dr. Nguyen Thai Lai** - Vice Minister of Ministry of Natural Resources and Environment of Vietnam (MONRE)		
09:40	09:50	Welcome Note of MARD	**Dr. Hoang Van Thang** - Vice Minister of Ministry of Agriculture and Rural Development Vietnam (MARD)		
09:50	10:15	The Mekong Basin: Impulse Speech	**Prof. Ed Grumbine** – Northern Arizona University, USA		
10:15	10:45	**Coffee Break**			
10:45	10:55	Country Statement Cambodia	**Dr. Saumura Tioulong** - Elected Member of Parlament of Cambodia	**WISDOM ROOM - Movies and Hands on the System**	**Exhibition**
10:55	11:05	Country Statement Laos	**Ms. Bouangeun Oudomchit** – Deputy Director of the Department of Water Resources, Ministry of Natural Resources and Environment, Laos		
11:05	11:15	Country Statement Thailand	**Dr. Pithaya Pookaman** - Vice Minister of the Ministry of Natural Resources and Environment, Thailand		
11:15	11:25	Country Statement Myanmar	**Mr. Hla Maung Thein** - Deputy Director-General of the of Environmental Conservation Department of the Ministry of Environmental Conservation and Forestry		
11:25	11:35	Country Statement China	**Prof. Shen Lei –** Vice Director of the Institute for Geographic Sciences and Natural Resources Research (IGSNRR), China		
11:35	12:15	**Group Picture**			
12:15	13:45	**Lunch Break**			

Day I - 2: 5th of March 2013

		Grand Ball Room 1	Grand Ballroom 2	Phu Quoc Room	Foyer
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13:45	14:05	Summary of Morning Statements and MRC Perspective	**Dr. Hans Guttman** – Chief Executive Officer, CEO, of Mekong River Commission (MRC), Laos	**WISDOM ROOM - Movies and Hands on the System**	**Exhibition**
14:05	14:25	WISDOM Project results of the last 6 years	**Dr. Trinh Thi Long** – Southern Institute for Water Resources Research (SIWRR) & **Dr. Claudia Kuenzer** – Earth Observation Centre / German Aerospace Center (DLR)		
14:25	15:00	Life demonstration of the WISDOM Information System	**Florian Moder** – Integrated Expert at the Southern Representative Office of the Vietnamese Ministry of Science and Technology, MOST-SRO, and **Dr. Claudia Kuenzer**– Earth Observation Centre of the German Aerospace Center (DLR)		
15:00	15:20	User Statement: Experiences with the WISDOM Information System and Outlook	**Mr. Vinh Ky Quang** - Can Tho Climate Change Coordination Office, (CCCO), Can Tho		
15:20	16:00	**Coffee Break**			
16:00	21:30	**Social Event** Bus Transfer to the Harbour, Boat Cruise on the Saigon River and Dinner at 18:45 in Thao Dien Village 189 – 197, 197/1 Nguyen Van Huong Street, Thao Dien Ward, District 2, Ho Chi Minh City, in case of problem: +84 (0)903708860			

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Abstracts of Oral Presentations

Grand Ballroom I

06.03.2013

08:00 - 09:45

Session 111 - 01. Hydropower development and imapcts on river ecology

Session Chairs:

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&

Prof. Ed Grumbine, ed.grumbine@gmail.com

Session: 111 - 1

Topic: 01. Hydropower development and imapcts on river ecology

Impact assessment of upstream development on downstream flow regimes and local livelihoods: Preliminary results of a case study in the Srepok river basin, Central Highlands of Vietnam

Author: **Dr. Ty Tran Van - tvty@ctu.edu.vn**
Can Tho University

Co-Authors: **Ms. Tran Thi Trieu**

The objective of this study is to review the current state of water resources management (WRM) situation and to assess the impacts of dam construction on flow regimes for a case study in the Srepok river basin, Central Highlands of Vietnam. Firstly, current state of WRM at different levels (top-down) was reviewed to understand the advantages and limitations on stipulating the implementation of Law on Water Resources and its corresponding decrees. Survey was carried out to find the gaps between policy and practices by interviewing Key Informant (KI) who are currently responsible for the WRM upstream and downstream of cascade dams along Srepok river at provincial level (DARD and DONRE). Flow regime changes were then assessed using historical data of streamflow before and after dam construction and operation at some representative locations along the river using the Indicator of Hydrologic Alteration (IHA) and Range of Variability Approach (RVA) methods. The preliminary results of document reviewing show that there are overlaps in the roles of DARD and DONRE in WRM, and weak co-ordination and co-operation among sectors, between central and local governments. The results of four KI show that there are poor co-ordination and co-operation among administrative entities (province, district, commune), and between sub-sectors; unclear responsibilities in WRM among departments; lack of human resources in WRM at all levels, both qualitatively and quantitatively; water demand are increasing leading to more pressures putting on water resources, especially in the context of climate change. In addition, assessing changes in flow regimes shows that flow regimes have been altered along the river under the accumulated impacts of the operations of cascade dams, especially the low flow and extreme flow. Therefore, the time series data at existing stations along the river become meaningless due to the intervention of dams' operations. It is indicated that there are still gaps, overlaps and unjustified regulations when comparing policy and policy implementation in WRM. It is recommended that more survey (household interview – bottom-up) should be carried out to fully understanding the changes in livelihoods, and flow regimes due to the impacts of future multiple factors to find out the best practices on water governance for the study basin. Particularly, analysis of impacts on different groups of local people (rich, medium, poor) will be the base for recommendation of measures of adaptation to changes in the future.

Session: 111 - 2

Topic: 01. Hydropower development and imapcts on river ecology

Flow changes in the Mekong from Hydropower Development and Climate Change in the Sre Kong, Se San and Sre Pok Rivers

Author: **Dr. Thanapon Piman - thanapon.piman@canterbury.ac.nz**
University of Canterbury

Co-Authors: **Mr. Thomas Cochrane, Mr. Mauricio Arias, Mr. Anthony Green, Mr. Ornanong Vonnarart**

The Srepok, Sesan and Sekong (3S) Rivers provide the largest tributary water flow contribution to the Mekong River and are responsible for an important contribution of aquatic biodiversity and fish production. The 3S basin provides critical ecosystem services to the Tonle Sap and the Mekong delta downstream. The basin is undergoing accelerated hydropower development and may be subject to future extreme events from climate change. This presentation provides an assessment of the impact of dam development and climate change on the natural flow patterns within the 3S basin and in the Mekong. Hydropower production and operations were simulated through hydrological and reservoir simulation models based on calibrated historical data sets. Full hydropower development coupled with energy focused operations in the 3S Rivers system could increase dry season flows and reduce wet season flows by 96% and 25% respectively at the basin outlet as compared to the historical baseline conditions. The impact on flow of the Mekong River from a full development scenario in the 3S is comparable in magnitude to the impact of the hydropower dam cascade in the upper Mekong River in China. Spatial and temporal varied results were observed at countries boundaries within the 3S basin under the various hydropower development scenarios. The impact of potential climate change scenarios in the 3S basin is opposite and lower in magnitude. The operation ranges of the proposed large hydropower dams are sufficient to overcome changes in flows with little loss in energy generation. Climate change, however, will result in significant changes in the magnitude and frequency of extreme flood events, which could impact how dams can be operated in the future. Coordination of hydropower operations within the 3S basin will be critical to maximize development benefits and reduce negative environmental flow impacts at the local, national and transboundary levels under a scenario of full hydropower development and climate change. Uncertainties of climate change modelling, as well as impacts on sediment flows, dam trapping, water quality, ecosystems, and social and economic resilience need further study to provide more comprehensive strategic options for dam development and operation as well as strategic adaptation to climate change.

Session: 111 - 3

Topic: 01. Hydropower development and imapcts on river ecology

Observed changes in water flow in the Sesan River, Lower Mekong Basin: an example at Voeurnsai in Cambodia

Author: **Mr. Oeurng Chantha - oeurng_chantha@yahoo.com**
Institute of Technology of Cambodia

Co-Authors: **Mr. Sok Ty**

Dams have major impacts on river hydrology, primarily through changes in the timing, magnitude, and frequency of low and high flows, ultimately producing a hydrologic regime differing significantly from the pre-impoundment natural flow regime. Dammed rivers reduce flood rates, and this has negative consequences on biodiversity and environment. The Sesan River, originated from the Central Highlands of Vietnam, is one of the largest tributaries of the Mekong River Basin. The river currently encounters a cascade of hydropower dams which are currently commissioned in the upstream of Vietnam. The increased flows during the dry season, along with changes in the hydrology of the Sesan River through water release from the dams, have reportedly affected people livelihoods and ecosystems at the downstream Cambodia. Therefore, the main objective of this study is to assess the changes in water flow of the Sesan River from dam impacts. The unpredictable and rapid changes in river flow and water level in Sesan River at Voeurnsai can be an example of significant hydrological impacts from the upstream hydropower dams. Temporal change of water level in the river shows large differences during three different periods (1960s, 2000-2005 & 2009-2011) at Voeurnsai. Before the dam construction, maximum water level reached nearly 7 meters but after starting the operation, it has been remarkably decreasing. During the recent period (2009-2011), peak water level was significantly low if compared to previous periods. In addition, low flow also revealed sharp decline particularly during 2009-2011, attributed to more water impoundment by dams at the upstream areas in Vietnam. During the dry season from January to April, recent water level in the river is very relatively low if compared to that of other years. The analysis of Flow Duration Curves (FDCs) at Voeurnsai was also conducted for two different hydrological periods before and after the dam construction in order to assess the change of flow duration. According to the analysis, it showed a huge reduction of flow duration at Voeurnsai in particular from the percentage of time from 5 % to 70% during the period 2001-2005. In addition to this, more reduction of flow duration from 2009-2011 has been continuing since 2005, mainly attributed to more water impoundments. This clearly indicated that water resources availability in the Sesan River has been more and more used for hydropower production in the upstream areas in Vietnam.

Session: 111 - 4

Topic: 01. Hydropower development and imapcts on river ecology

Flow alterations caused by hydropower projects in two Mekong tributary basins: the livelihood implications

Author: **Mr. Jory Hecht - joryhecht@yahoo.com**
International Water Management Institute (IWMI)

Co-Authors: **Mr. Matthew McCartney, Dr. Guillaume Lacombe, Prof. Richard Vogel**

There is increasing concern over projected changes in the magnitude and timing of streamflow due to the construction of hydropower dams in the Mekong basin and elsewhere. We compare a suite of indicators for their ability to reflect changes from pre-dam flow regimes. Using two case studies, we illustrate the differences in hydrologic alteration that take place downstream of dams that are used for (i) in-stream power production (Nam Ngum 1 Dam) and (ii) diverting water to off-stream production sites (Nam Theun-Hinboun Project). We show that dams for in-stream power production reduce wet season flows, increase dry season flows and attenuate both high- and low-flow extremes. In contrast, dams constructed for off-stream power production mildly reduce flood peaks when diversions are possible during extreme high flow conditions while dry season streamflow declines sharply due to the priority placed on hydropower production. Our analysis summarizes the effects of dams on the frequency, duration, timing and rates of change of discharge at sites downstream of dams. We then review the relevance of metrics of hydrologic alteration for assessing impacts of hydropower dams on livelihoods dependent upon the natural variability of the flow regime in monsoonal climate zones.

Session: 111 - 5

Topic: 01. Hydropower development and imapcts on river ecology

Hydropower development, its implications and changes in hydrology, morphodynamics and ecology: Review and impact assessment from Germany

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Co-Authors: **Dr. Nils Goseberg, Prof. Daniel Bung**

The application of hydroelectric power is one of the most reliable as well as optimized renewable energy resources and technologies in place. In 2010, worldwide more than 16 % of the electricity generated came from hydropower (IPPC, 2011). However, it is noted that many countries as of today have reached the limits of their natural capacities while much hydropower potential is still unexploited in South-East Asia and Central Africa (IRENA, 2012). In Germany, electricity from hydropower accounted for 3.3 % of the final energy consumption in 2010, the same as in the previous year and for that reason assigns one of the main pillars of renewable energy resources. While hundreds of millions have been invested in the construction of hydropower plants in the past decades, today tens of millions of Euros are being spent to maintain and gradually upgrade hydropower infrastructure each year. In this overall framework, the present paper reviews the hydropower development in Germany reflecting history and present state of this important renewable energy resource. It also draws attention to the implications on the environment, i.e. often irreversible changes in hydrology, morphodynamics and ecology. This review and impact assessment from Germany finally presents newly derived management concepts of rivers and catchments and highlights measures and novel technologies to adapt to these changes that help alleviating the detrimental impacts of the application of hydroelectric power. In this regard, examples from research and development of optimized hydrodynamic operation routines of individual dams and, more important, on cascades of operated dams following a multi-criteria operation and decision analysis for meeting both energy demands and ecological needs while also securing as much biodiversity are pointed out. Furthermore, morphodynamic alterations and varied sediment net budgets are discussed. Emphasis is put on how to help establishing intelligent operational schemes and innovative sediment management routines and technologies to overcome sediment trapping in reservoirs. Concerning emerging environmental demands, i.e. migratory fish species, practical and suitable design studies are introduced. Feature fish lifts and ladders that are appropriate for the diversity and magnitude of fishery in order to swiftly and safely pass hydropower dams are illustrated. In addition, experiences from long-term operation and maintenance of hydropower infrastructure are given asking for innovative strategies and smart (technological) solutions. In this regard, live-time management of existing and future infrastructures is considered crucial. Finally, examples from flood water release structures are presented that are known to be susceptible to excess magnitudes of river discharges and sediment-laden run-offs, i.e. hydroabrasion, and, subsequently have to be operated and managed with caution and sensitivity.

Session: 111 - 6

Topic: 01. Hydropower development and imapcts on river ecology

Mainstream dams in Cambodia and their impact on food security

Author: **Dr. Eric Baran - e.baran@cgiar.org**
World Fish Centre

Co-Authors: **Mr. Phen Chheng, Ms. Rouja Johnstone, Dr. Thouk Nao, Dr. Nam So, Mr Bunthang Touch**

We present here the results of a recent multidisciplinary study on food security vulnerability to mainstream hydropower dam development in Cambodia (Sambor and Stung Treng projects). The study, carried out during 15 months and involving surveys in 1200 households nationwide, consisted of three components: i) assessment of the food consumption in rural households nationwide; ii) assessment of the impacts of Cambodian mainstream dams on fish yield and iii) assessment of the impacts of Cambodian mainstream dams on fish consumption and food security in Cambodia. The nutrition component shows that aquatic resources are currently the second largest dietary component after rice, accounting for 18% of the total food intake and 76% of animal intake. The fisheries component shows that the current yield of inland fish amounts to 570,000 tonnes per year (+55,000 tonnes of other aquatic animals). The integrated modelling component concludes that even in absence of mainstream dams fish consumption would decline from 63 kg/person/year per in 2011 to 44 kg/person/year by 2030, mainly due to population growth, and that the construction of Stung Treng and/or Sambor dams would reduce yields of fish and other aquatic animals by 6 to 34% depending on the scenario considered, which would result in a fish consumption dropping down to 29-41 kg/person/year.

Session: 111 - 7

Topic: 01. Hydropower development and imapcts on river ecology

The Nature of the Mekong _ Enviromental flow indicator for a large tropical monsoonal river system

Author: **Mr. Peter Adamson - peter@mrcmekong.org**
Mekong River Commission (MRC)

At the basin scale there is as yet no statistical evidence of man induced change to the hydrological regime of the Mekong mainstream, which can therefore be considered to be in its natural state. However, the cumulative impacts of the planned levels of resource development, specifically with regard to hydropower, are expected to modify the regime over the coming decades. A need is therefore recognised to develop benchmark hydrological indices against which these anticipated changes can be measured, the consequent ecological, environmental and socio-economic impacts assessed and practical management and mitigation measures developed. Here a parsimonious family of such flow indices is presented which summarises the structure and function of the flow regime in terms of both its quantitative and temporal characteristics. Their selection is cognizant of issues relating to the geographic scale of the basin, the nature of the hydrological regime and the types of planned resource development. Broadly applicable to Monsoonal regimes within large river basins in South and South East Asia the indices are arguably also appropriate for assessing the regional hydrological consequences of climate change.

Grand Ballroom I

06.03.2013

10:15 - 12:00

Session 112 - 01. Hydropower development and imapcts on river ecology

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Topic: 01. Hydropower development and imapcts on river ecology

Study on the effects of hydromorphological change on fish habitat in the High Rhine River

Author: **Dr. Minh Duc Bui - bui@tum.de**
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Co-Authors: **Prof. Peter Rutschmann, Mr. Shokry Abdelaziz, Mr. Johannes Abegg, Dr. Christian Marti, Mr. Armin Fust**

Hydropower projects in the High Rhine River produced impact on the hydromorphological characteristics of the river regime. Among the negative effects, this variation can present harmful environment conditions to fish, either by interrupting their migration routes or through changes to their natural habitat. Stream conditions such as water depth, current velocity, substrate, and temperature combine to form unique habitats which facilitate the survival and growth of fish. In order to reduce this negative effect in this river, several measures are proposed. Beside the technical aspects regarding economy, engineers responsible for the design of such measures have to quantify the impact on river regime and ecology. Hydromorphological investigations and fish habitat study in the river are required in order to be able to choose an optimal solution for planning. The computer program system FAST has been developed at the Institute for Hydromechanics (University of Karlsruhe) and the Institute of Hydraulic and Water Resources Engineering (Technische Universitaet Muenchen) to simulate morphological processes and fish habitat in alluvial rivers. After analyzing the status quo, this paper presents the results of the model application for long-term hydro-morphological simulation and habitat in a long reach of the High Rhine with several barrages. The purpose of the modeling study is to provide necessary information for design and evaluate the impact of various technical alternatives on hydromorphology and fishhabitat in the river reach.

Session: 112 - 2

Topic: 01. Hydropower development and imapcts on river ecology

Review current Environmental Impact Assessment (EIA) system in Cambodia on Hydropower Projects.

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IDEC/ Hiroshima University

Co-Authors: **Associate Prof. Higashi Osamu**

Environmental Impact Assessment (EIA) is expected to mitigate potential negative impacts of a large-scale development project. In 1969, this was established in United States and had applied in many countries: of Japan, in 1972; of Cambodia, 1996. Almost 20 years after the civil war completely ended, Cambodian's Law on Environmental Protection and Natural Resource Management was first established in 1996. According to overview of Cambodia's EIA, this regulation was set in a very broad concept, where the core procedure is mainly adopted from the Asia Development Bank (ADB) guideline rather than design for a suitable version for its country's condition. Recently, the high commitment of the Government of Cambodia as well as the growth of demand of energy usage nationwide; large numbers of hydropower and expansion of energy networking projects are implementing and committed to be implemented in near future. Answering the above challenging situation, this research objective is to review Cambodia's environmental protection system, EIA, specifically focusing on energy projects to assure its acceptable efficiency. In this study, current governmental and private sectors' activities associated with EIA of large hydropower projects are reviewed based on bibliographic and interview surveys. Then, to seek more suitable EIA process in Cambodia, we focus on the advanced EIA system in Japan. Furthermore, this study also discussed about transboundary governance and conflicts of hydropower projects along the Mekong river system, since major water resources are transnationalism management. Finally, from the perspective of NGO's activities regarding to stakeholder conflicts of the projects, governance for good water management is discussed. As the result, it is clarified the problems of Cambodia's EIA system on hydropower projects such as poor public participation, limitation of decision maker's capacities, political and economic bad influent issues and so on. Moreover, this paper has also recommended the system amendment to achieve its uniqueness framework, such as rearrange the original procedure to enable more public partition, which is possibly maximize benefit to all stakeholders while the idea of sustainable development is firmly remained. Last but not least, the discussion also concern international environmental law adoption concept to the system.

Session: 112 - 3

Topic: 01. Hydropower development and imapcts on river ecology

Monitoring water quality by remote sensing in Mekong River

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Co-Authors: **Mr. Bing Zhang, Mr. Junsheng Li, Ms. Li Zhang**

As a transboundary river, Mekong River flows through riparian people from six countries as China, Laos, Thailand, Burma, Cambodia and Vietnam. With economic development and urbanization in recent years, water quality monitoring will help identify climate change and environmental degradation. Three typical water quality parameters in inland waters are chlorophyll-a, total suspended matter, and color dissolved organic matter (CDOM), which are closely related to eutrophic status, sediment , salinity respectively. Remote sensing is a fast, wide, and periodic method to monitor water quality of inland water. The purpose of this paper is to provide a comprehensive overview and presentation of spatial and temporal variation of water quality along Mekong River. Also, we will show some preliminary results from remote sensing images as MODIS and HJ-CCD. MODIS has about 1-kilometer resolution, and HJ-CCD has about 30-meter resolution. HJ-CCD is a Chinese sensor with 4-day return visit. The atmospheric correction method we chose is 6S with AERONET (AErosol RObotic NETwork) data. Then, cloud removal was done. The separation of water and land was made to extract study area. The retrieval methods we tried to use are empirical methods published in other papers which studied other rivers and lakes. The results showed the distribution of water quality in Mekong River. The suspended matter may help to evaluate sediment and describe the effects of Mekong dam. The chlorophyll-a concentration distribution may help to find phytoplankton distribution and algae bloom. The atmospheric correction is complex for case 2 water. Therefore, we will try to find some more effective atmospheric correction method appropriate for Mekong River in our next work. To retrieve typical water quality parameters in water with higher accuracy, we will pioneer to measure IOPs to retrieve water quality concentration by semi-analytic models. This paper is funded by a project between 2013 and 2015 supported by Ministry of Science and Technology (MOST), China. In future, we will carry out some in-situ experiments and validate empirical models or semi-analytic models we had built to calculate water quality parameters. The collaboration with groups from other countries along Mekong River will be welcome.

Session: 112 - 4

Topic: 01. Hydropower development and imapcts on river ecology

Spatial and seasonal dynamics of suspended matter in the Mekong river and in hydropower dams using multi year satellite observerations

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EOMAP GmbH Co.KG

Satellite retrieved suspended matter concentrations in the Mekong basin from China to the Mekong delta were generated over a time period of ten years with up to 100 records processed per year. This was performed using multiple satellite sensor resources including MODIS, MERIS, Landsat and Rapideye imagery and with the operational Modular Inversion and Processing System MIP. Retrieved concentrations represent a Mekong wide harmonized data set with spatial resolutions from 5, 30, 250 to 500m. The time series analysis of various locations in the river and the damns show interanual, seasonal trends, spatial patterns in the damns and the impact of damns on the suspended matter budget in the river system.

Session: 112 - 5

Topic: 01. Hydropower development and imapcts on river ecology

Constructing wetlands in reservoirs to re-establish ecological diversity

Author: **Mr. Peter-John Meynell - peterjohn.meynell@gmail.com**
ICEM

The drawdown areas of large storage reservoirs for hydropower are often rather barren and unproductive with low habitat diversity and fish production. A feasibility study on the Nam Gnouang hydropower reservoir in Lao PDR showed that it is possible to construct small earth dykes and spillways below the full supply level that will retain water as the water level is drawn down. This will create permanent wetlands that can serve as fish refuges and breeding areas and add to the habitat diversity of the reservoir. Such wetlands can contribute to conservation, increasing the fish species diversity and productivity, or they may be used directly as fish ponds harvested for livelihoods of local people. The Theun Hinboun Power Company is interested to trial some of these constructed wetlands with IWMI monitoring the ecological development of the wetland, and impacts upon fisheries.

Session: 112 - 6

Topic: 01. Hydropower development and imapcts on river ecology

The Improvements in Hydropower Decision-Making in the Mekong: Cases from 3S Rivers Cambodia

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Life With Dignity

Hydropower in the Mekong reduces natural resources and ecosystem and impact on the livelihood of million people who rely on this river as their jobs. For Cambodia, the impacts of hydropower are severe due to many of the proposed hydropower projects are located in environmentally sensitive regions and shortage of local capacity in identifying needs, project planning and operation for sustainable hydropower development. Thus, the decision-making for building the dam in the Mekong Cambodia is often inadequate attention for its impact. As the result, the hydropower management and decision making do not reduce the negative impact of this sector. However, while hydropower helps to make the economic growth, it impacts on the environment and social. According to the decision making focus on the economic growth rather than environment and social, the measure for mitigating these impact is not applied. The impacts of the scheme including reduce the amount of fish, risk of dam failure, damage the natural habitat, pollute the water quality and involuntary resettlement. Hydropower decreases the migrating fish due to reduce access to spawning grounds and rearing zones and to cause mortalities or injuries. In fact, the downstream community in Andoung Meas district stopped fishing because of the decrease amount of fish broadly in the river. In general, the main severe accident risk of hydropower is the risk of dam failure which make serous flood. For the water quality, the change condition of water in the reservoir subsequently affects both the quality of water in the reservoir and downstream as many heavy metals were occurred. The dam damages the natural habitats and causes degradation of the environment which depleted of flora and fauna. Besides these impacts, the involuntary resettlement is the big concern for the affected communities as it makes them lost of their livelihood, resources and potential impoverishment. In general, the economic growth is the priory of the Royal Government of Cambodia, therefore, the decision making related to the development of hydropower focus on economic rather than environment and social. The way of this decision making has made the affected communities and environment suffer. Therefore, the government and company should accountable for the effected community and environment for what they have lost. To minimize the impact of hydropower dam on the effected community, the well design of hydropower scheme, good management of dam construction and well hydropower project operation should be applied. The multi use of reservoir particularly for irrigation, fishing and fish raising should be considered during design phase and should be applied during operation. The participation from community and civil society should be encouraged and taken into account for preparing EIA and making decision of hydropower development.

Grand Ballroom I

06.03.2013

13:30 - 15:15

Session 113 - 02. Hydropower development and impacts on economy

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Session: 113 - 1

Topic: 02. Hydropower development and impacts on economy

Increasing Economic Value of Water in Hydropower Reservoir Through Multiple Use Scheme

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Allocation of water during water shortages is an important decision, which not only needs to be better coordinated across the possible multiple water users within any given legal jurisdiction, but needs to be better coordinated across provincial jurisdictions in the case of the Yali Reservoir, a trans-boundary reservoir located across 2 provinces of Kon Tum and Gia Lai in Viet Nam. Such decision must also be based on clear allocation criteria including economic criteria with the aim of optimizing the economic value of the water resource. The Yali Reservoir, in Central Viet Nam, is located in a trans-boundary watershed across the Kom Tum and Gia Lai provinces. Water allocation decisions made independently by these two provinces thus impact water use in the basin and consequently water flow into the reservoir. In a context of water abundance, water use by different sectors is non-competitive and does not necessarily warrant careful and clear planning and allocation. The presentation provides research result of a CPWF- MK2 project on the assessement of the economic benefits of multiple-use of reservoir water. It aims to provide decision-makers with information pertaining to the value of water in the reservoir and to consider alternative allocation. Moving to a world of increasing water scarcity (resulting from both increased water demand and changes in water supply brought upon by climate change), allocation of the water resources based on clear criteria becomes of utmost importance. Allocation decisions based on the recognition of the economic value of water, both use and non-use values, is increasingly recognized by policy-makers as being important. As such, economic efficiency is one of these important criteria which may guide the allocation of the water resources. The use of such criterion indicates that multiple-use of the water of the reservoir would optimize the economic value of water as opposed to its existing single-use. The paper indicates that multiple-use of the water of the reservoir would provide not only greater economic benefits in aggregate, but would also entail a more equitable distribution of these benefits in favour of local rural communities. However, this would need a more coordinated water management mechanism among local authorities. The paper recommends that a regional steering committee of Gialai and Kontum provinces should be established.

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Topic: 02. Hydropower development and impacts on economy

Hydropower dams as driving forces for land use change: case study in Northern Vietnam

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In the Great Mekong Region, to meet the energy demand to fuel industrialization and urbanization, public and private sectors are currently making significant investments in large dam construction on many of the regions' suitable rivers, leading large threats on water management, livelihoods of the poorest smallholders and on environmental issues, both for downstream and upstream parts. Besides the combination of population growth and increasing demand of agricultural products calls nowadays for an economic focus on development of upland regions highlighting soil erosion process such as one of the most severe threat for smallholders livelihood and life span of hydropower dams. Despite of a willingness to leverage the commonality of upstream-downstream objectives to create sustainable solutions for water and land-use management problems, the accompanying policies for hydropower dam projects mainly concern the downstream part. Then while the uplands supply much of the water from which lowlands prosper, upland residents tend to suffer most from poverty, low productivity farms and environmental degradation, with the latter also significantly affecting downstream water use and users. The challenge is reformulating the relationship between hydropower dam management and agricultural upland management. This study seeks to facilitate institutional and economic frameworks for transformational change within downstream-upstream land-use policy in the Great Mekong Region, based on a concrete study of the impact of three large hydropower dams in building since 2004 inside an area of less than 100 km long in Northern Vietnam. This study was built on diachronic analysis of remote-sensing images from Landsat over 35 years: 1973, 1993, 2000 and 2009. The RUSLE model has been used at regional scale to perform the consequences of land use changes on regional erosion budget from 1973 till nowadays, and to discuss the driving forces leading to the land use change. Since the new wave of dam construction in the region could be seen as an opportunity to meet the regional economic development with a direct impact on the farmers' livelihood, our study underlined that beside the changes in land use, another major problem is the increasing erosion process due to the expansion of cash crops for large agricultural companies, such as mainly tea plantation and planted forest. This change led not only the increase of agricultural surface instead the fallows area, but it occurred before period of the dam building. Clearly in the study zone, the risk of erosion is increasing by more than 20% on the last 15 years and the main land use change started before the hydropower dam building. The land use change has been driven by the indirect impact of the hydropower dam planning. Then it is argued that appropriate land use policies accompanying the hydropower dam projects are required largely before the starting period of the dam building, mainly in term of land distribution.

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Topic: 02. Hydropower development and impacts on economy

Payments of Ecosystem Services in Vietnam: Market-based Incentives or State Control of Resources

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We question whether payments for ecosystem services (PES) programs have the potential to enhance natural resource management in Vietnam, where the state essentially designs and implements the programs. In such settings, the welfare gains achieved through PES programs will be determined by how the state incorporates the programs into national development strategies and aligns them with other land use and environmental policies. We consider also whether PES programs can be relied on to reduce poverty and enhance livelihoods, either alone or in combination with other policy interventions. To these ends, we trace the development of PES programs within the context of forest conservation policies and in relation to watershed management. Taking Vietnam as our case study, we illustrate how PES programs are implemented within the context of a monopsonistic, non-competitive market. We conclude that in the absence of a competitive market structure and with appropriate regulations governments can reshape PES programs so that they function primarily as tools for strengthening state control over natural resources.

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Topic: 02. Hydropower development and impacts on economy

Vulnerability of the Mekong Delta Pangasius catfish industry to development and climate change in the Lower Mekong Basin

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The culture of Pangasius catfish has been practiced in the Mekong Delta of Vietnam for centuries. Now it is based almost exclusively on the intensive pond culture of striped catfish (Pangasianodon hypophthalmus) exploiting its rapid growth, omnivorous diet, low dissolved oxygen tolerance, and white flesh. During the last decade, output from the sector, mostly exported to the EU and USA, has grown almost exponentially to more than a million tonnes per year with a value approaching $2 billion making a significant contribution to the country's GDP and supporting the livelihoods of an estimated 180 000 - 200,000 people in the Delta, predominantly the rural poor. To date, surprisingly little attention has been paid to the vulnerability of the sector to exposure to changing biophysical conditions caused by planned development in the Mekong River basin during the foreseeable (20 year) future under changing climatic conditions. This paper examines this vulnerability based upon a comprehensive review and analysis of the most recent relevant literature and modelling studies including those undertaken by the Mekong River Commission (MRC) as part of its basin development planning process. During the foreseeable future (to 2030), an additional 56 tributary dams and 11 mainstream dams may be constructed in the LMB. A major expansion of intense irrigated agriculture in the basin is also planned which has the potential to further modify flows. Waste water from domestic and industrial sources from a rapidly growing population will also combine with these developments and to affect water quality in the Delta. Changes in temperature, sea level, precipitation and storm frequency are also expected. Our assessment suggests that water quality-related impacts on the sector are expected to be relatively insignificant except locally because of the diluting effects of increasing flows expected in the future, particularly during the dry season, and the trapping of nutrient-rich sediments in upstream dam reservoirs. We conclude that the sector is more vulnerable to rising feed costs in response to diminishing supplies of raw materials particularly wild-caught fish, and fishmeal and oil. Regional supplies of fish and related products are likely to be significantly impacted by dams acting as: (i) barriers to fish migrations and (ii) sediment traps diminishing the transport of nutrient-rich sediments to coastal fisheries. Global fishmeal and oil markets are also threatened by climate change-related impacts. Opportunities for adaptation appear limited and impacts might be sudden in response to mainstream dam construction unless international market demand for Pangasius products is highly elastic to rising farm-gate prices. Further consolidation of the sector towards more efficient and adaptable large-scale, vertically-integrated operations with the loss of livelihoods for small and medium-scale operators is therefore expected.

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Topic: 02. Hydropower development and impacts on economy

Hydropower Development Impact on Household Livelihood and Economy: A Case Study in Laos

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The growing regional demand for electricity in Southeast Asia has made Laos a key player in hydropower development since the 1990s. The country's rivers contribute around 35% of the Mekong's flow and have been estimated to have 18,000 MW of exploitable hydropower potential (International Rivers, 2008). While the projects provide revenue for the government of Laos from electricity exports to neighboring countries such as Thailand, Vietnam and China, the hydro boom has not necessarily been good news for Lao villagers affected by these dam constructions. Among others, displacement, land shortages, lack of livelihood opportunities, fisheries losses, flooding and erosion are the main negative impacts that Lao villagers reported in past studies. Thus far, little attention has been given to the impact of hydropower dam constructions on the changes of livelihood activities of affected households. This study contributes to filling this gap by looking into the livelihood changes of villagers residing upstream and downstream of the Nam Gnouang Dam in Laos. After several focus group discussions in the study site, an in-depth livelihood survey was conducted in 2011 covering 110 households living upstream of the Nam Gnouang Dam project and 100 households living immediately below the dam (headpond). Based on households' perceptions, we identify what households considered to be the major positive and negative impacts to their livelihoods brought about by the hydropower development. Using logit/probit regression analysis, we further determine the factors that bring negative or positive changes in the livelihoods of the affected households. A comparative analysis of the effects of the two areas, upstream and headpond, is tested. It is important to investigate the different facets of impact from hydropower dam constructions on affected households. Negative or positive changes in the livelihoods of affected households may depend on the household composition and past livelihood activities. Location of the resettlements may also be an important factor. By taking into account these different factors, we will contribute to the existing literature on hydropower dam interventions. Enhanced, improved or alternative livelihood options with strong adoption potential may well be identified by looking into the determinants of the impact of hydropower dam projects.

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Topic: 02. Hydropower development and impacts on economy

Impacts of Multinational Companies' Foreign Direct Investment in Hydropower Development on the Livelihood of Project Affected People: A Case Study of Nam Ngum 2 Dam in Lao PDR

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Developed countries' Foreign Direct Investment (FDI), which is usually, but not always, made by Multinational Companies, is increasingly flowing to developing countries. In the meantime of increasing MNCs' FDI inflows, the role MNCs' FDI in fostering or undermining development in developing countries has been a subject of intense disagreements and debates within development studies. Moreover, doubts have been raised whether or not MNCs' FDI is contributing to development in host countries is far from clear. This paper, as an empirical evidence to the abovementioned contentiousness, intended to study the impacts of MNCs' FDI in dam construction on livelihood of Project Affected People (PAP) in Lao PDR. To achieve this objective, the study applied case study approach; thus, Nam Ngum 2 hydropower development project, which is situated in Vientiane province of Lao PDR, was selected. Participatory wealth being assessment conducted among 1053 direct affected families; meanwhile key informant interview carried out to explore related factors explaining livelihood before and after investment. The research revealed that, in overall, the direct project affected people's wealth being improved compared to the wealth being before MNCs' investment, whilst a small number of PAPs were not able to recover from the impacts; this was due to several driving factors. As a contribution to the aforementioned literatures, the study concluded that the contribution of MNCs' FDI to development, regardless other factors, which were not in the scope of this study, was significant, but it relatively depended the behavior of MNCs and host country government.

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Topic: 02. Hydropower development and impacts on economy

Fisheries valuation in Cambodia: a welfare approach

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We present here the principles and the methodology of an ongoing project entitled “Assessing economic and welfare values of fish in the Lower Mekong Basin”. In this innovative approach, welfare results from a combination of economics (assets, farming activities, fishing, aquaculture, tertiary activities, borrowing and lending), food security (use of aquatic and terrestrial natural resources, role of fish in diet and nutrition) and resilience (health, income and expenditure shocks, coping strategies). The objective of this project is to assess, after two years of stratified sampling nationwide, i) the welfare value of fish for rural populations in Cambodia, and ii) the market value of fish species in the country. The methodology presented here allows quantifying the absolute and relative contribution of fish to wellbeing (compared to that of agricultural and business activities), and constitutes a framework for a more comprehensive assessment of the socio-economic impact of dams on rural communities.

Grand Ballroom I

06.03.2013

15:45 - 17:15

Session 114 - 02. Hydropower development and impacts on economy

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Topic: 02. Hydropower development and impacts on economy

Local Participation on Benefit Sharing of Nam Lik 1-2 Hydropower Project in Lao PDR

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Lao PDR is located in the lower Mekong River Basin with great potential for hydropower because of its topography and climatic conditions. Rapid developments of hydropower projects have been taking place since the 1990s. Along with these developments, there is heightened interest in using ongoing dam development as an opportunity to generate viable institutional and economic mechanisms to promote equitable incentives of households affected by dam constructions for food security and poverty reduction, and sustainable watershed management. Benefit sharing schemes in the hydropower industry are still very new in Asia, especially in Lao PDR. It is important to look into recent hydropower dam projects with benefit sharing schemes and how this affects the households in the area. One of the recent developments in Lao PDR is the Nam Lik 1-2 hydropower project which started in 2007 with 100 percent investment coming from the China International Water Electric Corporation (CWE). This research focuses on local participation on benefits sharing in 7 villages affected by the dam construction. It investigates the implementation of policy and regulations for the development of the impacted villages including the provision of compensation for the loss of property as well as socio-economic activities. It also aims to explore the changes of local livelihood and adaptive strategies of affected people and to identify current and potential local participation on sustainable natural resources management in both the upstream and the downstream of the reservoir. Primary data were collected from September to October 2012 through qualitative and quantitative surveys. The research reveals that prior to the start of the hydropower project, the environment impact assessment, social impact assessment and social action plan, and watershed management plans were conducted in order to provide appropriate compensation to the affected communities. However, households expressed dissatisfaction towards the compensation payout mostly due to the timing and land valuation. On the other hand, the dam construction has changed local livelihoods because accessibility to sources and market improved with the new roads. New opportunities for income generation emerged such as trading, cash crop production, hybrid animal production and fishery. Although hydropower has been generated since 2010, the implementation of the land use plan with regulations for shifting cultivation, extracting timber, fishing, and collecting forest products has been slow and lenient. It lacks financial support and local participation. Households have little knowledge of their community's role in natural resources management. Sustainable natural resource management requires local participation and close monitoring. At the same time, training courses for stable alternative livelihood are necessary to reduce pressure on natural resources in the area.

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Topic: 02. Hydropower development and impacts on economy

Analyzing Economic Tradeoffs of Water Use in the Nam Ngum River Basin, Lao PDR

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This paper develops a hydro-economic optimization modeling framework for assessing the economic consequences and potential trade-offs of various infrastructure development and policy pathways in the Nam Ngum Basin (Lao PDR). Such modeling techniques are most often used in regions suffering from water scarcity and/or over-allocation of existing water resources, where marginal changes in water availability or demand induce important economic trade-offs. The contribution of this study is to assess the implications of various levels of development that would increase water resource demands in a relatively water abundant watershed by a large amount (e.g, up to a six-fold increase in irrigated area, or large inter-basin transfers). We consider whether such shifts in water resource demands could induce meaningful economic trade-offs among water uses, including hydropower generation, irrigation expansion, flood control, and transboundary water transfer objectives. We constructed a series of sensitivity scenarios under dry, average, and wet hydrologic conditions using a range of projections from Lacombe, Douangsavanh et al. 2012, with varying levels dam development, irrigated agricultural expansion, agricultural returns, flood control storage restrictions, and water diversions to Northeast Thailand. We also consider how flows into the Mekong would be affected by these collective developments to place our results for this basin in the wider context of Mekong Basin development (Ringler 2006, Lauri, de Moel et al. 2012). In general, results indicate that tradeoffs between hydropower production, irrigation, and flood control are modest. Hydropower and agricultural expansion are found to be complimentary under high levels of water availability, even with the most ambitious level of irrigation expansion. Allowing for flood control by maintaining reduced storage levels in the reservoir that is largest and furthest downstream on the Nam Ngum (NN1) has a minimal effect on economic output and decreases total system hydropower by less than 1%. However, economic outcomes are highly dependent on water availability and economic returns to irrigated agriculture. System hydropower was greatly reduced, and inter-basin transfer projects induced large economic costs under dry conditions. These results illustrate the importance of accounting for climate variability and potential hydrologic change in cost-benefit analysis of infrastructure projects, even in watersheds that are relatively water abundant. Additionally, results are sensitive to assumptions regarding economic returns to irrigated agriculture, thus we provide policy recommendations for effectively promoting new dam development and irrigation expansion conjunctively. Finally, we comment on the implications of various development pathways on total basin outflows to the Mekong, which are significantly altered under a subset of the development scenarios evaluated.

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Topic: 02. Hydropower development and impacts on economy

Distribution of water value trade-offs in hydropower affected communities in Lao PDR

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Hydropower development alters local communities' livelihoods in many different ways, including changes in water access and use. In this paper, the example of the Theun Hinboun Expansion Project (THXP) in Lao PDR is used to assess the changes for relocated local communities upstream of the dam in their access and use of water. A unique feature of this study in the region is that the assessment is based on two household surveys conducted both before and after the relocation of the 4 villages. The surveys were conducted to understand the relative importance of water resources and habitat within the household livelihood portfolio and quantify the changes in the pattern of direct water uses, both consumptive and non-consumptive. Quantitative socio-economic information was collected on household livelihood portfolio. Qualitative information about changes in livelihood activities and access to water were documented during focus group discussions. Results show that access to domestic water use was improved with new private and public well after resettlement. However, the change of habitat from a free-flowing river to reservoir significantly modified access to fisheries, riverbank gardens and grazing area for livestock. The change in fisheries includes numerous components. First, access to fishing grounds was modified with some resettled villages being located farther away from the reservoir now than the distance to the river use to be pre-resettlement. Second, access to the reservoir fisheries requires that a fee be paid to the newly created fishery management committee. Third, access to the fisheries requires from the villagers new investments in boats and fishing gears. Finally, the changes of water regime and habitat modified fish species composition in the catch and access to other aquatic animals. In addition to the above changes in fishing activities, the resettlement of the villages also involved the loss of riverbank gardens, which represented up to 60% of household income generated from agriculture activities before resettlement. The study also shows that the distribution of these impacts varies across households. While the loss of riverbank gardens was common to all households, impacts resulting from changes in access to fisheries were different across households depending not only on the distance to the reservoir after resettlement, but mostly on the capacity of any individual household to newly invest in the necessary assets to undertake reservoir fishing activities. Comparison between the pre- and post-hydropower development provides a quantification not only of the various trade-offs (losses and benefits) involved but of the distribution of these trade-offs across households. A comparative analysis of these trade-offs helps to build a more holistic understanding of livelihood changes due to hydropower development, and provides new insight for appropriate intervention that integrates multiple water uses for decision-makers.

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Topic: 02. Hydropower development and impacts on economy

Exploring the feasibility of potential livelihood opportunities in a relocation area , in the Theun Hinboune Expansion Project site, Lao PDR

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Dam construction often obliges local people to relocate or resettle in new areas chosen jointly by the government and the dam companies. The resettled communities have to adapt to their new environment and to the new livelihood opportunities proposed by the company, which can be very different from what they had engaged in previously (e.g. changing from cultivating wet season rice to cultivating dry season irrigated rice). The communities therefore need to adapt and adjust to major changes in their livelihoods portfolios. This is the case of Phoumakneng, a relocation site dowmstream of the Nam Gnouang Dam where five villages, Done, Khen, Khengkot, Nasakong and Phakonko merged into one in 2010. This study uses participatory methods to understand the main livelihoods related issues of the resettlement, such as not being self-sufficient in rice production, over exploitation of fish and forest resources and the lack of vegetables. We invited communities to think about different solutions to these issues in addition to assessing the feasibility of piloting a rice-fish integrated agriculture and aquaculture system. The feasibility of this pilot was discussed with twenty farmers who have suitable paddy fields. We also explored other livelihood opportunities to tackle the other issues of the site such as creating a common policy to share the forest resource and setting up a common garden to increase vegetables supply. These two solutions were discussed with the women organization. Our findings are based on several focus group discussions with farmers, authorities of the village, youth organization and women organization. THPC, the company that managed the resettlement and the district official were also involved. As many pilots, the integrated rice-fish agriculture-aquaculture pilot poses the problem of targeting the better-off farmers instead of affecting the poorer farmers for whom food security is a greater challenge. The main challenge for MK1 will be, once this livelihood opportunity is tested in-situ and analyzed, if it is considered worth to upscale, to adapt the technique to ensure that poorer farmers can also benefit from it and adopt this new promising technology.

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Topic: 02. Hydropower development and impacts on economy

Safety and reliability of movable closures in river hydropower stations using examples from practice

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Mobile closures in a river hydropower station comprise weirs, lock gates and other types of gates. These represent both the functionally critical and the safety-relevant components of a hydropower plant per se. They may be in the open as well as in the closed condition. This means that these components must meet the safety and reliability requirements of immobile structures, but at the same time the operational availability requirements of machines. The safety, reliability and operational availability are to be assessed against the background of the investment sum on the one hand and of the damage potential of a hydropower plant on the other hand. In this regard, the closures' mechanical equipment and control systems have to be designed so that they safely ensure proper operation in all potential kinds of operation scenarios. The entire lifetime of the systems has to be taken into account in this respect. The conditions to be considered include all construction, maintenance and inspection states as well as those where plant components are removed. As regards operation conditions, both the situation at commencement of operation including all start-up conditions and the operation towards the end of the plant's lifetime taking account of wear have to be considered. A general contemplation regarding the safety and reliability of various conditions in course of the lifetime of a system are presented. Safety facilities always have to be designed with respect to operational availability, and reciprocally, the control system determining operational availability always has to be designed in consideration of safety. Effects on the economic efficiency must always be taken into account in design. A Pareto optimality must always be strived for among all imaginable possibilities. On rivers with high bedloads such as Mekong River, wear has to be assessed as especially critical. In this regard, all components moved in relation to each other are to be considered. They have to be designed in a manner so that any malfunction is avoided even under high floating debris loads. Particular attention has to be directed to corrosion under the given general climatic conditions. Wear, fatigue and corrosion usually result in a decline of both operational availability and the safety of these movable components. The safety and operational availability of a system must still be ensured even after wear, fatigue and corrosion have occurred in course of its operational life. In this paper, practical examples will systematically be addressed. A general safety-related contemplation based on the practical experience from the design and design review of navigation locks, dams and weir systems such as Xajaburi (Laos), Rheinfelden (Germany), Picote (Portugal), Venda Nova (Portugal), Berg-River-Dam (South Africa), and Viereth (Germany) will be presented.

Session: 114 - 6

Topic: 02. Hydropower development and impacts on economy

Paying the forest for electricity: a modelling framework to market forest conservation as payment for ecosystem services benefiting hydropower generation

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The operation and longevity of hydropower dams are often negatively impacted by sedimentation. Forest conservation can reduce soil erosion, and therefore efforts to maintain upstream forest cover within a watershed contribute to the economic life span of a hydropower facility. The cost of forest conservation can be viewed as an investment in hydropower and be financed via a payment for ecosystem services (PES) scheme. A novel modelling framework is used to estimate payments for forest conservation consisting of: (1) land-use change projection; (2)watershed erosion modelling; (3) reservoir sedimentation estimation; (4) power generation loss calculation; and (5) PES scheme design. The framework was applied to a proposed dam in Cambodia (Pursat 1), but in this presentation we will also explore the feasibility of this methodology in multiple dams throughout the Lower Mekong. The estimated net present value of forest conservation in Pursat 1 was US$ 4.7 million when using average annual climate values over 100 years, or US$ 6.4 million when considering droughts every eight years. This can be remunerated with annual payments of US$ 4.26ha−1 orUS$ 5.78ha−1, respectively, covering forest protection costs estimated at US$ 0.9 ha−1 yr−1. The application of this type of PES represents a rational option that allows for conservation and development of hydropower watersheds susceptible to erosion and sedimentation.

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Topic: 02. Hydropower development and impacts on economy

The Mekong River Commission between Hydropower Development and Climate Change – Analyzing the Role of River Basin Organizations in managing Environmental Change

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The Mekong River Basin is currently facing a number of challenges, ranging from ensuring food security for its growing population to countering the effect of climate change and from mitigating the potential negative impacts of hydropower developments on the basin's environment and its people to the management of flood risks threatening people's lives and livelihoods. Given the transboundary nature of the Mekong River Basin, these challenges transcend the spheres of influence of individual Mekong riparian states. The successful management of Mekong challenges can therefore only be successful if pursued at a transboundary governance level. In such transboundary water resources management, River Basin Organizations (RBOs) play a crucial role. They provide room for discussions and negotiations among riparian actors, ensure the exchange of data and information across national borders, initiate research with a basin-wide perspective and develop joint visions and plans for the integrated management and development of the basin. RBOs thus have a technical as well as a political dimension to their work – the combination of them making them most effective. Similarly to other transboundary basins, riparian states to the Mekong have acknowledged this need for cooperative management through a joint institution and cooperate through the Mekong River Commission (MRC). With member states' commitment to "cooperate in all fields of sustainable development, utilization, management and conservation of the water and related resources of the Mekong River Basin" under the framework of the MRC, the MRC fulfills an important role in addressing water resources management challenges in the Mekong River Basin and ensuring that the transboundary nature of the basin is taken into consideration. Drawing on the experiences of the MRC as well as Germany's support to the MRC, this paper will discuss the important role of RBOs in managing and mitigating environmental change in transboundary river basins. It will address the question to what extent and under which circumstances RBOs can contribute in the most effective way to sustainable river basin management – from a technical as well as from a policy perspective. The paper will thereby focus on two of the most important challenges many river basins, including the Mekong River Basin, face: climate change and hydropower development. In addition to general discussion on the role of RBOs in such transboundary water resources governance processes, it will – in particular – focus on the MRC as the RBO mandated to address the Mekong's water resources challenges. Therefore, the paper will discuss not only MRC's role in transboundary water resources management but will also assess MRC's Climate Change Adaptation Initiative (CCAI) and MRC's Initiative on Sustainable Hydropower (ISH) in more detail.

Grand Ballroom II

06.03.2013

08:00 - 09:45

Session 121 - 06. Hazards and disaster risk reduction in the Mekong Basin

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Session: 121 - 1

Topic: 06. Hazards and disaster risk reduction in the Mekong Basin

Analysis of Trends in Extreme Flood Events and Mitigation Strategies in South East Asia

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Co-Authors: **Dr. Paul Pavelic, Dr. Vladimir Smakhtin**

Floods are one of the most frequent and widespread natural hazards in the world. A recent example is the 2011 floods in three of the four Lower Mekong Basin Countries (Thailand, Cambodia and Vietnam) that caused severe impacts in terms of loss of life and damage to infrastructure. Several studies have highlighted the increasing importance of developing spatio-temporal flood hazard databases to understand flood dynamics more systematically at a range of spatial scales within South East Asia (SEA). This study is proceeding on two distinct fronts: the first focusses on ranking and prioritization of impacts across SEA, whilst the other examines an approach to flood monitoring that evaluates the feasibility of implementing possible mitigation strategies that still provide for the degree of flow variability needed to maintain ecosystems. Firstly, long-term time-series data from multiple sources (e.g. EM-DAT, DFO, Sentinel Asia) was used in identifying flood hotspots including their frequency, intensity/severity and societal impacts. This will also help in evaluating and improving hydrological modeling predictions and provide better information for more effective flood hazard, flood risk and preparedness studies. Flood hotspots were further investigated taking into account of agricultural extent loss, populations at risk and economic loss. The results from the hotspot analysis suggest more climate risk investments are needed to minimize risk and are likely to have the biggest payoff in terms of reduced losses. The nature of those investments and the associated cost-benefits are being revealed. Secondly, a new approach is being developed for flood monitoring from time-series MODIS data acquired from 2000 to 2012. This approach will help in identifying basin to regional-scale temporal changes in inundated area; duration of inundation cycles between large-medium-small scale floods. Thus satellite-based mapping of flood risks areas will help in identifying prospective areas for floodwater harvesting in the upstream areas to reduce negative impacts downstream.

Session: 121 - 2

Topic: 06. Hazards and disaster risk reduction in the Mekong Basin

Vulnerability assessment of livelihoods in Lower Mekong Basin: adaptation options for enhancing capacity of people living in the flood-prone areas in Kandal Province, Cambodia

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The paper examines assessing the vulnerability of livelihoods of the people living in flood prone areas of Mekong river in selected communes of Kandal province like Prek Khemg commune in Lvea Em district, and Kaam Samnar commune in Leuk Dek district bordering Vietnam. People living in flood prone areas mostly are among the poorest and highly vulnerable to unusual or extreme floods. Most are farmers engaged in paddy rice cultivation and cash crops which largely depend upon soil nutrients and water provided by the Mekong River. During the past 20 years, Cambodia encountered serious flood events in 2000 and 2011 both of which had major impacts on the studied communes. The most recent flood (2011) seriously damaged paddy and cash crops as well as rural infrastructure. However, people residing within these communes have encountered normal and more severe flood events before and as a result have substantial experience and some skills and capacity to cope and adapt. The better-off group of households shows high proportion of accessing to livelihood assets, but the poor shows less. There were a number of coping strategies for flood disaster risk management was captured at different levels. People's coping strategies include strengthening their houses with support of bamboo and wooden poles, building cement pillars with appropriate height to raise above the water level during severe flood, relocating valuable assets to safe place, and food and medicine preparation. These coping strategies are closely linked to resilience capacity and provide clues for seeking adaptation options to floods and ways of improving disaster risk management. Strategies of households to cope with floods are closely linked with their livelihood's contexts. The paper also highlighted the approaches of Royal Government's flood management programs, including early warning system, adaptation and preparedness.

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Topic: 06. Hazards and disaster risk reduction in the Mekong Basin

Assessing social flood vulnerability in the Mekong floodplain (Cambodia) through household surveys and district statistics

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As part of an ADB financed project a study was executed to identify indicators for social vulnerability in the floodplains of the Mekong river in Cambodia. What makes this vulnerability study rather unique is that flooding is a regular occurring phenomenon to which the local population is more or less adapted. Living with floods is practiced throughout many parts of Cambodia as well as in the Mekong Delta in Vietnam. Normal floods provide many benefits, such as habitats for fish, agricultural production and biodiversity conservation. The average annual value of flood benefits is estimated at US$ 8-10 billion. However, in some years the flood timing, extent and duration is such that people speak of a bad flood. From agricultural statistical data it was concluded that the impact of such bad floods is higher in those districts that are normally not flooded than in those that have annual floods. This points towards specific adaptations in agricultural practices in areas that are regularly flooded. In order to understand how and which people can cope with both good and bad floods, a household survey has been executed among 480 families in three provinces in Cambodia. The household survey was designed to test three hypotheses that cover the three main components of vulnerability, i.e. exposure, basic susceptibility and recovery potential. The first hypothesis focuses on the frequency of flooding which largely determines the rate of exposure. The second one centres on the household characteristics that shape the susceptibility of individuals and households to flooding. This includes housing conditions, livelihood and income situation. And the third hypothesis takes remoteness as a key determinant for recovery potential. Isolated areas tend to be less developed, have public services further away and cannot easily be reached by outside help. The results of the household survey show that flood vulnerability is not primarily the result of exposure to recurrent flooding. Instead, vulnerability is to a large degree determined by the household characteristics. The lower the income, the more households and their members suffer from high flood waters. Poorer households, whatever the reason for their poverty is, are more vulnerable than better off households. Also female headed households are significantly more vulnerable. Also distance to the nearest year-round road has an effect. The more remote a village is, the more we find people considering themselves highly vulnerable. These conclusions fit very well in the general descriptions of vulnerability to flooding men-tioned for instance in previous focal group meetings and in the definition of vulnerable people given by local villagers as those who are belonging to the poor and destitute category and some of those medium and/or well-off households whose house located opposite to water direction during flooding.

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Topic: 06. Hazards and disaster risk reduction in the Mekong Basin

Disaster Risk Reduction and Management Practices in North-East Cambodia: Policy Insights and Implications for Indigenous Peoples

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In recent years, Cambodia has been supportive of disaster risk reduction in achieving its overall development targets. As a newly developing country, Cambodia struggles with the twin goals of sustaining economic growth and protecting environment and other natural resources as strategies to its long term poverty reduction targets. There is a strong institutional view, though recent in the context of decentralization, that natural resource management (NRM) serves to support disaster risk reduction and enhance adaptive capacities to climate change. However, the current fragmented sectoral institutional arrangements for NRM and DRRM underscore the difficulties faced by national and sub-national implementing bodies in integration and enforcement, exacerbated by weak institutional and technical capacities at both levels. The paper discusses how present policy practices are shaping local policy and planning insights and interventions on disaster risk reduction and management, and consequently changing landscape of North-East Cambodia's largely indigenous population. Significant interfaces have been identified in the areas of land management, water resource management and forest conservation and protected areas. Analyses of DRRM context and issues as they affect indigenous populations (particularly in terms of shift in access and power relations to natural resource management) will be drawn from the vulnerability assessments to natural hazards in the three provinces - Ratanakiri, Mondulkiri and Stung Treng - in the north-east region of Cambodia and informed by recent policy developments. Aside from implications on indigenous populations in the region, issues of shared provincial boundaries of protected areas and forests as well as trans-boundary waters with the Central Highlands of Viet Nam in the Mekong River Basin will be explored.

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Topic: 06. Hazards and disaster risk reduction in the Mekong Basin

Integrated flood risk assessment for the Mekong Delta through the combined assessment of flood hazard change and social vulnerability

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Low lying estuaries as the Mekong Delta in Vietnam are among the most vulnerable areas with respect to climate change impacts. While regular floods are not a threat but an opportunity for livelihoods and income generation, extreme flood events can pose considerable risks to the people living in Deltas. Climate change is expected to increase the frequency of extreme floods globally, which in combination with sea level rise and a likely intensification of cyclone activity creates increased and/or entirely new hazard exposure in the Deltas. Yet, in line with the risk literature and especially the recent IPCC SREX report, flooding risk needs to be understood as deriving from the interaction of physical hazards and the vulnerabilities of exposed elements. Therefore, the paper aims for an integrated risk assessment through combining the most up to date estimates of flood hazard projections under climate change conditions in the Mekong Delta with the assessment of vulnerability patterns. Projections of flood hazard are estimated based the modulation of the flood frequency distribution by atmospheric circulation patterns. Future projections of these patterns are calculated from an ensemble of climate models. A quasi two-dimensional hydrodynamical model of the Delta is then applied to estimate water levels and flood extension. This model is fed with a set of hydrographs which are based on both the derived climate model uncertainty and the bivariate nature of flood. Flood peak is coupled with flood volume in the probabilistic framework to derive synthetic extreme future floods with associated probabilities of occurrence. This flood hazard analysis is combined with static sea level rise scenarios, which alter the lower boundary of the hydrodynamic model and give estimates of the impact on sea level rise on inundation extend and depths. The vulnerability assessment is based on a three step approach. Firstly, vulnerability profiles are developed for different agro-ecological zones and socio-economic population profiles. The focus herein is particularly on understanding the causal constellations and trajectories of vulnerability patterns. Secondly, key vulnerability parameters identified in step one are translated into quantitative indicators and aggregated into a vulnerability index, allowing for spatial analysis. Thirdly, ways to assess future vulnerability trajectories in the context of the ongoing socio-economic transformation in the Mekong Delta are explored. In effect, this analysis generates an integrated risk assessment that is based not only on an advancement of current flood hazard assessments but also on a detailed vulnerability assessment that goes beyond the mapping of exposure. The study thereby contributes knowledge of great relevance for informing disaster risk management and adaptation policies. In addition, the analysis allows for a dynamic perspective and the examination of key trends in the Mekong Delta's flood risk.

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Topic: 06. Hazards and disaster risk reduction in the Mekong Basin

The 2011 flood in the Mekong delta: preparedness, response, damage, and recovery of private households and small businesses.

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Co-Authors: **Mr. Philip Bubeck, Dr. Viet Dung Nguyen, Dr. Heidi Kreibich**

Vietnam is severely affected by hydro-meteorological hazards like floods, storms, droughts and heavy rainfall as well as by geophysical hazards such as landslides, and less importantly earthquakes (Nhu et al., 2011). Among the various hazards, storms and in particular floods are the most important natural hazards in respect to damage to people and assets. In the future, flood losses are expected to further increase due to changes in hazard and vulnerability related to global change. In order to effectively mitigate current and future flood impacts, an efficient flood risk management is required, which needs to be based on a sound analysis of the flood hazards, potential losses and the effectiveness of different mitigation measures (Merz et al., 2010; Ganoulis, 2003; Hall et al., 2003; Sayers et al., 2002). However, despite the high flood risk in Vietnam, detailed damage data as well as information related to the risk management cycle (preparedness, response and recovery) are often lacking (Bubeck et al., 2012). Moreover, damage assessments usually focus on direct damage, and do not consider other cost types, such as losses due to the disruption of business processes (Meyer et al., 2012). To gain detailed insights into flood preparedness, early warning and emergency measures, flood impacts and recovery, which can be used for the development of risk mitigation strategies, data from face to face interviews with 480 flood-affected households and 380 small businesses in Can Tho city in the Mekong Delta are presented. Amongst other things, we find that losses due to the disruption of production processes account for a considerable share of overall losses to small business. This highlights the importance to consider these types of losses in risk management. Recommendations for the development of sound risk management strategies in Can Tho city will be provided.

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Topic: 06. Hazards and disaster risk reduction in the Mekong Basin

Drought Policy and its Implication on Rural Household Livelihoods:a case study in the Lancang River Basin

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Co-Authors: **Mr. Van dijk Meine Pieter, Prof. Gupta Joyeeta**

In order to deal with increasing serious drought, Chinese government has crafted and implemented a series of policies. In this study, we examine how China is developing policies to help rural households in the Lancang River Basin to cope with the problems of drought, and then reveal the implications of these policies on household livelihoods. In doing so, (1)the content analysis has been applied to reveal unfolding of the relevant policies at multiple administrative levels; (2) the household survey was conducted to observe the farmers' strategies on drought relief, find the interactions among policies, livelihoods assets and their strategies, and explore the implications of drought policies on the farmers with different livelihoods conditions. The paper concludes that (1)the successful implementation of a policy depends on the choice of appropriate incentives that are relevant to the local biophysical and social conditions;(2) the retreat of governmental organizations from many social issues at the local level has reduced the close connection between government bodies and farmers, which makes it harder for farmers to access and benefit from national policies; (3) the transformation of local institutions in recent years has changed farmers' behavior in drought management; (4) the livelihoods assets highly impact on the farmers' strategies choosing; (5) the households with various kinds of livelihoods assets could help them effectively adopt the strategies and benefit from the drought policies.

Grand Ballroom II

06.03.2013

10:15 - 12:00

Session 122 - 06. Hazards and disaster risk reduction in the Mekong Basin

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Topic: 06. Hazards and disaster risk reduction in the Mekong Basin

Impact of climate change and reservoir development in the sediment yield of the Nam Ou River basin of the Lower Mekong

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This paper evaluates the model based predictions of impacts of climate change and reservoir development on the sediment yield of the Nam Ou River basin located in Northern Laos. Future climate (temperature and precipitation) from a regional circulation model (PRECIS) is downscaled using a delta change approach. In general, the results indicate increase in both annual and seasonal temperature and precipitation in future. The Soil and Water Assessment Tool (SWAT) is used to assess future changes in sediment flux attributable to climate change and reservoir development. The simulation results exhibit 18-32% increase in both annual and wet season sediment yields and 4-20% increase in dry season sediment yield in the basin due to climate change. In contrast the development of reservoirs in the basin will reduce the annual and wet season sediment yields by 70-85% and the dry season sediment yield by 72-89% due to trapping of sediments. It is estimated that around 0.3-0.4% of the reservoir storage volume will be lost each year due to sediment trapping. Further the sediment deposition in the basin will increase by 48-118%. In conclusion, the reservoir impact is much larger than the impact of climate change in sediment yield of the basin. Hence, there is a need to investigate appropriate reservoir sediment management strategies.

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Topic: 06. Hazards and disaster risk reduction in the Mekong Basin

Balance of the erosion due to exceptional rain events and land use within agricultural hilly landscapes of the Great Mekong Region

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One-third of typhoons generated in the world occurred in Southeast Asia. They lead to huge disasters in terms of human and economic losses with social consequences. In Vietnam, the exceptional rain events, i.e. the typhoons, are the most frequent natural hazard occurring. Even if they occur especially on coastal areas of the Central Vietnam, typhoons cause also large rainfall events reputed to drive large soil losses in Northern Vietnam. However their environmental impact is not yet well documented. The aim of this paper was to clarify the importance of the exceptional events on soil erosion assessment in small, sloppy and cultivated watersheds in mountainous areas of the Great Mekong Region. The study has been set up on a 12 years long term period of erosion monitoring, from1999 to 2011, coupled with meteorological and hydrological continuous records, within an agricultural hillslope watershed. The studied area has been affected by the typhoon Koni (21st to 23rd of July, 2003). This paper presents the hydrological and erosion analysis of this typhoon Koni in regard with 1999 to 2011 rainfall, runoff and erosion data records. First, rainfall and flood due to the typhoon Koni are characterized and a frequency analysis is performed. Then the contribution of the typhoon Koni on soil erosion budget is estimated. Finally the impact of the typhoon Koni on soil erosion is compared with erosion leaded by agricultural practices in order to evaluate the importance of exceptional rainy events on sediment discharge assessment in a perspective of the increase of exceptional events due to the climate change. The results show that this typhoon led to an exceptional rain event with a rainfall return period of 20 years, whereas a flood return period estimated to 32 years. The estimation of the sediment discharge reached 247 Mg (i.e. 4.9 Mg/ha) mainly exported through suspended matters. Compare to the global erosion assessment measured and estimated for the 12 years long time period, it appears that since the annual contribution of erosion due to the typhoon reach 80% at annual scale, the importance is less than 10 % over 32 years. This result demonstrates the low impact of this exceptional event on soil losses over a long term period. By consequence, this result underlines the importance of the agricultural practice management on the erosion budget over a long period. We underline the relative importance of agricultural practices compared to the exceptional events on notably the dam lake siltation. Moreover, the comparison between the soil erosion saving by the change of land use and the soil loss due to typhoon reveals that land use have a stronger importance over a long-term period. This underlines the benefits of conservation agriculture policies in order to provide a relevant issue in the integrated management of the mountainous areas of the Great Mekong Region.

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Topic: 06. Hazards and disaster risk reduction in the Mekong Basin

Mountain hazards distribution characteristic and danger assessment in Langcang River

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Because of special geographical environment, complex geological tectonic backgrounds, huge differences in climate, Langcang River (upstream of Mekong) basin are famous for beautiful landscapes, living environment and serious mountain hazards, which have uneven spatial and temporal distribution. Based on field surveys and remote sensing data, 986 debris flow valleys and 605 landslides have been found in the area. Danger assessment is an important non-engineering step in the identification mitigation measures in that it can highlight of hazard -prone areas and in the mitigation of potential disasters. Quantification of assessment indices of mountain hazards is a difficult process because of complex background factors, but it is one of the important prerequisite of hazards danger area identification. Systematic assessment of the dangers posed by a complex of hazards at the regional scale is an important step in hazard mitigation and disaster prevention. Some factors, including geology, terrain, climate and human activities were selected to establish hazard or danger assessment model, which is then compared with the distribution of mountain hazard locations (points), including landslides, debris flows. Assessment results were divided into five degrees: extremely low, low, middle, high, extremely high, it will be helpful during improvement of human settlement environment and also useful to decision-making in order to avoid blindness of regional development plan and construction.

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Topic: 06. Hazards and disaster risk reduction in the Mekong Basin

LESSONS LEARNED FROM HEAVY CROP DAMAGES BY 2011 SALINITY INTRUSION IN THE LOWER MEKONG DELTA

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Despite some achievements from agricultural development thanks to sluice gate and dyke investments to prevent sea water intrusion in the coastal areas of Mekong delta, crops always face with highly risky to salinity intrusion. Recent years, there were heavy crop damages by salinity intrusion in 2011. Lessons learned from this hazard showed that the crops were destroyed depending not only by natural factors as high salinity concentration or dry weather but also by other socio-economic drivers like high product market prices fostering rice expansion and intensification, saline water leakage problem, and improper sluice gate operation. Therefore, one can conclude that salinity intrusion is a slow-onset hazard but difficult to predict then the damages are often huge in case of abnormal years. Under the contexts of social, economic and environmental changes at regional as well as global levels, the salinity related problems will increase in the coastal areas. Hence, it is important to pay more attention to this new hazard and rethink about adaptation measures including both structural and non-structural options instead of focusing on dyke constructions for crop development purpose.

Session: 122 - 5

Topic: 06. Hazards and disaster risk reduction in the Mekong Basin

Probabilistic coastal flood hazard due to storm surges with sea-level rise in Mekong-Delta

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In past 60 years, only four typhoons (tropical cyclones) made a landing in or made an approaching to Mekong-Delta, where is comparatively near the equator. The typhoon as Linda in the year of 1997, however, informed that we cannot ignore a risk of storm surges even in Mekong delta. The one of authors have implemented hindcasting storm surges during past 60 years by use of a numerical simulation of shallow water equations and best track data of north-west Pacific Ocean including along the coast of Mekong delta. In this presentation, the possibility of higher storm surges, which means probabilistic heights of storm surges along the coast of Mekong-delta, is shown comparing with those in other Vietnamese coasts. These probabilistic values were calculated by extreme value statistics with the above hindcasted values. Then, the hazard area of coastal flood is shown due to the several heights of return period those are 10 to 1000 years. The results of expanding hazard area and increase in affected population due to the probabilistic storm surges with sea level rise confirm us coastal flood is also serious problem in Mekong delta in this century. Acknowledgments This study was partly supported by the Grant-in-Aid on Comprehensive Research on Climate Change Impact Assessment and Adaptation Policies (S-8, FY2010-FY2014, Ministry of the Environment, Japan)

Session: 122 - 6

Topic: 06. Hazards and disaster risk reduction in the Mekong Basin

A Concept for Possible Adaptive Measure in Mekong Delta against Climate Change-induced Disasters

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Among the effects caused by global warming, sea-level rise (SLR) poses the greatest threat to the stability of human settlements along coastlines. Areas along coasts as well as rivers have been affected by SLR, underscoring the need to assess the vulnerability of coasts and the effectiveness of riverbanks as infrastructure. It is therefore necessary to develop countermeasures to mitigate the influences of strong and persistent SLR not only for coasts but also for river levees. Among possible countermeasures, the application of geosynthetics is a promising measure not only in coastal structures but also in river levees encountering wave action, which is sometimes so severe as to produce storm surges. Geosynthetics can be designed according to natural, social, and economic circumstances in each region. For example, low-cost construction materials such as jute are available as natural geosynthetics for the construction of infrastructure where greater strength and resilience are needed. Artificial geosynthetics should be selected to meet the requirements of each infrastructure project. After summarizing the adaptation strategy and the possible adaptive measures, this paper proposes a procedure for selecting natural and artificial geosynthetics, particularly for adaptive measures against increasing erosion and inundation due to SLR. In addition, the paper also discusses the application of traditional and advanced geosynthetics as adaptive measures against coastal and river erosion. Finally, the paper emphasizes the importance of multiple protection concept against climate change-induced events at Mekong Delta.

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Topic: 06. Hazards and disaster risk reduction in the Mekong Basin

Navigation Channel Improvement Project (NCIP)

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Upper Mekong river Channel Improvement is one of the effective tools for drought management During the years 2002 to 2004, Navigation Channel Improvement Project - NCIP of Upper Mekong river was carried out with three working seasons. Dredging and blasting at the shoals and rapids are the major implementation of the project. Due to this improvement, 300 DWT vessels can ply along the Upper Mekong river. This project was undertaken since years ago. In addition, certain parts of the river channel have become shallower by several causes including climate change impacts. Mekong river is under the influence of monsoon winds. Flow is governed by the climate and its morphology and catchment area. Some artificial activities are also involved. In recent years, significant drought and low flow appeared in the Upper Mekong region. In view of this, drought management should consider as an important issue for this region. We improved the river channels mostly for navigation purpose. At the same time, improved river channels assist its river system and environment in several ways including mitigating the impacts of severe drought. Proper river channel improvement leads to advantages not only for the navigation improvement but also for extreme events mitigation. River training consists of channel improvement and bank protection. In principle, for the monsoon driven river system, additional water depths can be provided by one, or a combination, of the three proven methods, ie., bed regulation, water level control and discharge control. Mekong flows through the six riparian states. Bed regulation method should consider for the channel improvement of its upper reach. Key words: Navigation Channel Improvement Project, Drought management, navigation improvement, extreme event mitigation, bed regulation method. Scientific topic: Natural hazards in the Mekong Basin.

Grand Ballroom II

06.03.2013

13:30 - 15:15

Session 123 - 05. Mekong Basin hydrology and hydrography

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Session: 123 - 1

Topic: 05. Mekong Basin hydrology and hydrography

Paleoclimatological perspective on the hydrometeorology of the Mekong Basin

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During recent decades the Mekong River has experienced substantial interannual variations between droughts and major floods . Recent research have shown that variation, especially in flows, have increased during the last quarter of the 20th century and this variation has been linked at least to Western North Pacific Monsoon and El Niño Southern Oscillation . However, so far little research has addressed whether these recent variations are significantly different to long-term variations in the past. Hence, the aim of our paper is to place the recent variations between droughts and floods into a historical and paleoclimatological context . To achieve this we analysed the Mekong's meteorological conditions over the period 1300-2005 with a basin scale approach by using the Monsoon Asia Drought Atlas (MADA), which is a Palmer Drought Severity Index (PDSI) dataset derived from three tree-ring growth records and global PDSI dataset . The correlation analyses, both in time and frequency domains, showed correlation between MADA and the Mekong's discharge over the period 1910-2005 which suggests that MADA can be used as proxy for the hydrometeorology of the Mekong Basin. We found that the meteorological conditions of the Mekong varied at multi-annual, decadal and centennial scales over the study period. We found two especially distinct features: firstly, multi-annual and decadal variation between prolonged wet and dry epochs; and secondly, epochs with higher or lower interannual variability between very dry and wet years. Furthermore we found two epochs with exceptionally large interannual variability, one at the beginning of 17th century and the other in the post 1950 period. Both epochs are characterized by distinct increases in variability between very wet and dry years. The variability in the post 1950 epoch is much higher compared to any of the other epochs examined in this study. Thus, during recent decades the climate in the Mekong has exhibited features that have not been experienced for at least several centuries. These findings call for further climate research, particularly regarding increased climate variability, and resilient adaptation and development approaches in the basin.

Session: 123 - 2

Topic: 05. Mekong Basin hydrology and hydrography

Possible link between global warming and rainfall trends in the Mekong Basin

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Assessing the impacts of global warming on rainfall is crucial in the Mekong region where food production mostly relies on rainfed agriculture. Changes in rainfall in recent decades, and their possible associations to climate change, remain poorly understood in Southeast Asia. Spatial and temporal rainfall variability, observed at various scales, often explain the apparent inconsistencies between previous rainfall trend analyses. To address these problems, we used a trend detection test able to discriminate multiyear variability and long-term unidirectional trends in rainfall time series. Regional testing enabled the detection of significant synoptic disturbances that remain insignificant at the local level because of the high variability of small-scale rainfall events. Regional and local trends in rainfall intensity, frequency, seasonality, and extremes were analysed in the central Mekong Basin over the period 1953-2004. Our results indicate that dry season rainfall has significantly increased in frequency (more rainy days) and intensity (higher cumulative rainfall depths). A significant positive trend was also observed in the annual number of rainy days. Although statistically insignificant, wet season rainfall followed the same pattern of change. These regional changes were found to be consistent with rainfall alterations already observed in the neighbouring south-eastern part of China and attributed to the weakening of the East Asia Summer and Winter Monsoons. Consistency in rainfall changes observed in Continental Southeast Asia and in South-Eastern China, suggests that these two neighbouring regions have been subject to the same alterations in large-scale atmospheric circulation previously attributed to global warming. These observations suggest that human-induced climate change has started to alter rainfall patterns in the Mekong Basin, confirming the need to account for a non-stationary climate when assessing the water resource availability in this region.

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Topic: 05. Mekong Basin hydrology and hydrography

Annual mean runoff of Lancang (Upper Mekong) River in response to climate change and variability

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Co-Authors: **Prof. Stefan Uhlenbrook, Prof. Suxia Liu, Dr. Raymond Venneker**

Climate change altered the patterns of precipitation, evaporation and runoff, inducing the shifts of global and regional water cycle. In this study, the change of climatic variables and their effects on annual runoff were assessed in Lancang (Upper Mekong) River basin. Based on Fu's equation (Budyko-type equation) and Penman-Monteith model, the contributions of climate factors to annual runoff change were estimated with multiplying their partial derivatives by the slopes of trends in climatic variables. The results showed that daily mean, maximum and minimum temperature rose obviously, whereas annual mean wind speed reduced distinctly and sunshine duration, precipitation, potential evapotranaspiration and streamflow varied without significant trend for their large variability during the period from 1956 to 2007 in the Lancang River basin. The spatio-temporal variation of relative humidity indicated a great humidification in the upper-middle reach and a pronounced aridization in the lower reach of Lancang River in recent 50 years. Annual runoff was estimated by Fu's equation with a constant w. Significant bias appeared under extremely humid conditions because w, the only parameter in Fu's equation, would logarithmically increase when the actual evapotranspiration trended close to the potential evapotranspiration. It was found that annual mean runoff was more sensitive to precipitation than potential evapotranspiration, and potential evapotranspiration was most sensitive to vapor pressure, followed by daily maximum temperature, wind speed, sunshine duration, and minimum temperature. At annual time scale, the contribution of precipitation to runoff change was more significant than that of potential evapotranspiration in the Lancang River basin; and the factors contributing to potential evapotranspiration variation were sorted as wind speed, vapor pressure, daily minimum temperature, daily maximum temperature and sunshine duration.

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Topic: 05. Mekong Basin hydrology and hydrography

Variations of runoff in the upper Lantsang River basin under climate change

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Lantsang River, known as oriental “Danube” in the world, has a total length of 4880 km. In China, the length is 1612 km. According to the Yunjinghong hydrological station in Yunnan province, the mean annual runoff was approximately 56.77 x 108m3. The upper Lantsang River basin was located in Qinghai above Nangqian hydrological station, with the total area about 17909 km2. In this study, the features of time-space distribution of precipitation and runoff and the variations of runoff in Lantsang River basin were analyzed, based on the natural runoff data in Nangqian hydrological station and monthly precipitation data from 1956 to 2000. The results indicated that the variation of inter annual precipitation was stable, with the coefficient of variation (Cv) between 0.12-0.21. In addition, the wavelet analysis was applied to analyze the periodicity and frequency of concurrency of runoff in the upper Lantsang River basin at different time scales and discuss the contribution of different links in water cycle to runoff variation. Moreover, the runoff geographical distribution characteristics in the upper Lantsang River basin were related to the water vapor transmits from the Bay of Bengal and the passing-obstructing effect of LRGR. Accordingly, the effects of regional underlying surface and main climate factor such as precipitation and temperature on runoff variation in the upper Lantsang River basin were discussed in the study.

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Topic: 05. Mekong Basin hydrology and hydrography

Monitoring soil moisture with Earth observation satellite radars in the Mekong Basin

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Soil moisture is an essential climate variable and of key importance for the exchange of water and energy between land and atmosphere (Legates et al., 2011; Seneviratne et al., 2010). Soil moisture also controls the partitioning of precipitation into infiltration and runoff and is therefore important environmental information for flood forecasting. In 2010, the Group on Earth Observation ranked soil moisture as the second most important observable for social benefit among 146 prioritised parameters (Group on Earth Observation, 2010). As soil moisture content varies strongly in both space and time, frequent and spatially dense observations are required. In situ stations can provide continuous measurements but are often only useful for representing limited areas. The only economically and logistically feasible tool for monitoring soil moisture over regional to continental scales is Earth observation satellite technologies. Satellite radars are sensitive to the water content of the observed target and can provide cloud-penetrating, day-and-night observations. Soil moisture maps can be obtained e.g. with the use of the spaceborne scatterometers and Synthetic Aperture Radars (SAR) (Hornacek et al., 2012; Naeimi et al., 2009; Pathe et al., 2009; Wagner et al., 2007). This presentation demonstrates the capabilities of C-band scatterometer and SAR technologies for monitoring soil moisture conditions in the Lower Mekong Basin. The temporal evolution of soil moisture conditions at 25 km resolution are presented based on multi-year measurements from scatterometers on board the ERS-1, ERS-2 and METOP satellites. SAR imagery complements the coarse spatial resolution scatterometers by providing finer spatial detail, albeit with longer revisit times and higher retrieval errors. The capability of SAR to measure soil moisture was demonstrated by generating 1 km resolution soil moisture maps for the Lower Mekong Basin for the period 2005 through 2011, based on imagery from the ENVISAT satellite's Advanced Synthetic Aperture Radar. The potentials as well as challenges of monitoring soil moisture with spaceborne scatterometer and SAR systems over the Lower Mekong Basin are presented.

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Topic: 05. Mekong Basin hydrology and hydrography

Accuracy Validation of TRMM Multisatellite Precipitation Analysis (TMPA) Daily Precipitation Products in Lancang River Basin of China

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At both spatial scale of sub-basin and grid point (0.25°×0.25°), by using the statistical method and Contingency Table method, through comparing with 35 rain gauges, this work assessed the accuracy of 12 years (1998-2009) TMPA daily accumulated precipitation products within year, dry season, and rainy season in Lancang River basin. This study indicated TMPA daily precipitation estimates tend to underestimate rain gauges daily precipitation at any spatial and time scale, especially at middle stream in dry season. The accuracy of TMPA basin and grid averaged precipitation deteriorated with the increase of elevation, with upstream and downstream having the worst and best accuracy. Daily TMPA accumulations in detecting rainy events are fair at drizzle rain and this capability improved with the increase of elevation. However, the capability dropped with the increase of precipitation accumulations. The accuracy of TMPA precipitation estimate products in rain season is better than that in dry season at any spatial and time scales. The time bias and elevation are the main impact factors to the accuracy of TMPA daily accumulated precipitation products.

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Topic: 05. Mekong Basin hydrology and hydrography

Multi-Media monitoring and assessment in the Lower Mekong Basin 2011

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Mekong River Commission Secretariat

In 2011 MRC conducted a multi-media monitoring and assessment program (MMMAP) to assess levels of persistent micro-pollutants in water, sediment and biota in the Lower Mekong basin (LMB). The long-term objectives of this program were to: (i) describe the status of ambient environmental quality in the LMB, (ii) provide a baseline for detecting trends of persitstent micro-pollutants in the environment over time, and (iii) better discern changes in environmental quality due to point and non-point contaminant sources to the Mekong River mainstream and its major tributaries.
A total of 28 stations were included in the MMMAP 2011 field survey; 25 of these stations are regularly monitored under the MRC water quality monitoring programme; 3 additional stations were monitored downstream of potential contaminant sources.
At each station, water and sediment samples were collected during mid-May through June. At 20 stations also biota (fish or/and molluscs) samples were collected between March and May. Samples were analyzed for basic water quality parameter (temperature, pH, conductivity, salinity, chlorophyll, oxygen, BOD, COD, suspended solids, oil & grease), nutrients (N, P), heavy metals (Hg, Cd, Pb, As, Cr, Ni, Cu) and organic toxic substances (DDT, PCB, HCB, Endrin, Endosulfan, Heptachlore, HCH, CHL, phenols and CN)
Overall it can be concluded the Mekong River and its tributaries are still fairly unpolluted. The water quality in Northeast Thailand, Tonle Sap, the Mekong Delta and northern Laos close to Thailand, seems to be more impacted than in other sections of the lower Mekong River, partly because of more intensive agriculture and higher population densities in these areas. Also urban areas, such as Luang Prabang, Vientiane and Phnom Penh show trends of increasing levels of some contaminants, indicating the importance to continue monitoring these pollutants close to urban centres. The water and sediment in tributaries tend to have higher contaminants levels than that of the mainstream. Due to lack of pollutant loadings on a catchment basis, indications of significant basin-wide trends of any parameters cannot be directly linked with contaminant loadings from agricultural, urban and industrial sources. Lead and mercury levels seem to be of anthropogenic origin is probably of highest concern among the different micro pollutants measured and should be considered in future monitoring activities.

Grand Ballroom II

06.03.2013

15:45 - 17:15

Session 124 - 05. Mekong Basin hydrology and hydrography

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Topic: 05. Mekong Basin hydrology and hydrography

The Northeast Thailand Futures - The Nexus of Water, Food and Energy Investments

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The Northeastern Thailand is already facing water shortages and uncertainty in agricultural production. An assessment of the catchment's ability to satisfy its future water demand is essential for future development planning. Together with a continually increasing energy and food demands, it is driving a marked change in land-use in Northeast (NE) Thailand, especially in the cultivation of rice, sugarcane, cassava, and rubber. As the long-term national energy policy continues to promote ethanol and biodiesel production, there is a trend of local farmers altering their food cropping regimes and switching to either sugarcane or cassava. This study piloted the integrated quantitative analysis using a combination of physical and social science models, developed to identify uncertainties for plausible changes in the future of Huai Sai Bat (HSB), a study site. WEAP-Water Evaluation and Planning Systems was applied in exploring the effects of different drivers on future water demand and availability in the HSB from 2010 to 2030. The anticipated changes in the sub-basin chosen for this investigation are land-use change, climate change, and the development of water resource infrastructure. Results from WEAP show that streamflow and unmet water demand are not significantly affected in these scenarios. The modeling of climate change effects was based on the A2 (high greenhouse gas (GHG) emissions) and B2 (low GHG emissions) regional emission scenarios shows that both climate change scenarios double annual streamflow in the HSB catchment, especially increasing it from June to August, with a higher possibility of substantially increased catchment runoff. The potential large-scale diversion of water to the HSB catchment for irrigation under the Kong-Loei-Chi-Mun project demonstrated that with additional water transferred from the diversion scheme, it can significantly affect the water balance and fully satisfy the increased water demands from the expansion of the irrigation by transforming all rainfed areas (rice, sugarcane and cassava) into irrigated areas and increasing the irrigation to reach full potential of the sub-basin's land. For the small-scale water storage scenario with additional water storage of 40% of total runoff in each sub-basin available, it can help transfer water from the wet season to supply the dry season crop to certain extent within the sub-basins. However, it is still insufficient to fulfill all additional water demands required for expanding the irrigation from all existing rainfed areas (rice, sugarcane and integrated farm) especially in upper sub-basins that are already under water stress. This leads to significant reduction in the outflow. However, a less extreme change in the land-use will have a smaller effect.

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Topic: 05. Mekong Basin hydrology and hydrography

Adaptive Neuro-Fuzzy Inference System for multistep ahead flood forecasting for the Mekong River

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The Mekong River provides essential water resources for millions of people and opportunities for the development in Mekong basin. The annual river floods with regular magnitudes can be beneficial to this area since they provide water and nutrient rich sediments that are useful for agricultural; however, very large floods occur less frequently (e.g., 20 to 100-year floods) but can cause significant loss of lives and property in this area. Accurate water level forecasts at key stations along the Mekong River are essential for an early warning system to issue reliable flood warnings in order that emergency actions can be taken efficiently to save human lives and mitigate flood damages in the Mekong's floodplains. The Adaptive Neuro-Fuzzy Inference System (ANFIS) combines the advantages of both the Artificial Neural Network and Fuzzy Inference System. It, thus, is a modern data-driven tool for hydrological forecasting nowadays. This study presents an application of ANFIS for 1-, 3- and 5-lead-days water level forecasting at Thakhek station in Laos. The upstream water level at NongKhai station and average rainfall at the sub-basin of Thakhek has been used as input information for ANFIS models. The forecasts given by ANFIS were evaluated base on the criteria and benchmark adopted by Mekong River Commission. They were also compared to the forecasts provided by the URBS model which had been used in the current operational flood forecasting system developed at Flood Management and Mitigation Centre – Mekong River Commission since 2009. The result shows that ANFIS can get more accuracy than URBS model for 1- and 3-lead-day water level forecasting. Although the error of 5-lead-day water level forecasts given by ANFIS at this station were still higher than the benchmark for particular high water levels at this station, however, their accuracy was comparable to that of URBS model. This suggests that water level forecasting at five and more lead days for the Mekong River is still challenge for both physically-based and data-driven flood forecasting techniques.

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Topic: 05. Mekong Basin hydrology and hydrography

Mekong downstream: Climate signatures in runoff

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Substantial upstream anthropogenic encroachment notwithstanding, Mekong runoff at Kratie (1924-2007) shows the signs of natural intraseasonal monsoon activity throughout the record. The 40-60 days active-break monsoon cycle bears the major short-term causation of drought and flood dynamics and their variability across South-to-East Asia and at planetary scale. As natural 'precipitation gauge' for a large meridionally extended area, the Mekong basin also convolves the streamflow signatures of monsoon advances and retreats, borne in the general circulation regimes of the planetary atmosphere. Indeed, mainstream discharge at Kratie displays interannual to multidecadal variations in intensity and phase of intraseasonal rainfall cycles during boreal summer, including seasonal onsets and withdrawals. At times unexpected clarity of these signatures encourages scrutiny into this complex data aggregate in order to understand its detailed, multiscale signal structures and their geneses. The complexity of Southeast Asian water cycle dynamics as reflected in Mekong runoff is also borne in the fact that the basin is located just in the interaction zone of the two major monsoon systems of the globe, the South Asian and the East Asian summer monsoons. The former splits into Indian and Bay-of-Bengal subsystems, the latter one comprises hemispheric and interhemispheric branches. Rain-bearing synoptic systems from the Western Pacific and their seasonal preference, notably that of the typhoon season, tend to be influenced by both actual phase and intraseasonal dynamic interplay of these regional monsoons. The Western Pacific High, which plays a steering role in their multiscale dynamics, takes part in interannual to centennial evolutions in the ENSO system and interacts with planetary waves that organize teleconnections and mediate thus further remote control at diverse spatiotemporal scales. The task calls for advanced analysis tools and a planetary perspective. A study is presented that focuses on Kratie runoff first and traces the basic signatures further northward then to finally comprise the data of six mainstream stations. Daily runoff is decomposed into few conceptual components each to which a modern method of sparse data approximation is individually applied in order to identify major modes of variability. The emerging picture of dominant modal structures in Mekong runoff from Vientiane downstream is blended with climatic signal structures that have been found in a large set of customary climate time series for the period 1870-1997, using the same approximation technique. The strategy has been evaluated before using data from the German part of the Elbe mainstream, one of the largest European rivers.

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Topic: 05. Mekong Basin hydrology and hydrography

Sediment dynamics in the Mekong basin - model development and multi-objective calibration.

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The Mekong delta is one of the most extensively used deltas world wide and provides natural resources to more than 17 million people. Environmental issues in the Mekong delta are closely linked to water usage and availability [3, 4, 9]. In addition, the sediment input to the floodplains during the annual flood plays a crucial role in terms of nutrient supply to agriculture [6]. Since flood seasonality, its magnitude and sediment delivery are driven by human activities and hydrological processes along the entire Mekong river [7, 8], it is highly important to assess the dynamics upstream of the Mekong delta. This study applies the hydrological model SWIM [5] to the watershed upstream of Kratie/Cambodia with a size of approximately 650.000 km2 and gives a quantitative depiction on the sediment and discharge dynamics. In order to reflect this large and heterogeneous catchment, different parameter regions are defined based on the availability of calibration stations. The model is driven by different data sources [1, 10], and, after the identification of the sensitive parameters, a multi objective calibration [2] is applied. The model depicts the discharge values well, e.g. by capturing the annual flood season and sediment dynamics. The next steps comprise an assessment of different sources of uncertainty that are incorporated in the model. This includes the climate input data and the sparely available and highly variable sediment data. Eventually, the study shall provide a basis to examine the future developments along the Mekong river, for example, quantifying the impacts of potential reser- voirs on the flow regimes and sediment dynamics. The presented study is part of the WISDOM project which aims to provide an integrated information system for the Mekong delta.

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Topic: 05. Mekong Basin hydrology and hydrography

Decoding the Hydrological Drivers of River Bank Erosion on the Mekong River

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We evaluate links between climate and river bank erosion on the Mekong. We employ a process-based model to reconstruct multi-decadal time series of bank erosion at study sites (Vientiane and Pakse) located within the Mekong's two main hydrological response zones, defining a new parameter, accumulated excess runoff (AER), pertinent to bank erosion. We employ a hydrological model to isolate how snow melt, tropical storms and monsoon precipitation each contribute to AER and thus bank erosion. Our results show that melt (23.9% at the upstream study site, declining to 11.1% downstream) and tropical cyclones (17.5% and 26.4% at the upstream and downstream sites, respectively) both force significant fractions of bank erosion on the Mekong. We also show (i) small, but significant, declines in AER and hence bank erosion during the 20th century, and; (ii) that significant correlations exist between AER and the Indian Ocean Dipole (IOD) and El Niño Southern Oscillation (ENSO). Of these modes of climate variability, we find that IOD events exert a greater control on bank erosion than ENSO events; but the influences of both ENSO and IOD when averaged over several decades are found to be relatively weak. However, importantly, relationships between ENSO, IOD and AER and hence river bank erosion are not time-invariant. Specifically, we show that there is an intense and prolonged epoch of strong coherence between ENSO and AER from the early 1980s to present, such that in recent decades Mekong River flows, and hence bank erosion, has been more strongly affected by ENSO. Importantly, this period of coherence coincides with the construction of dams in the upper part of the Mekong Basin. Declines of flows and associated impacts in the lower part of the Basin that have been linked to these dams may, therefore, simply reflect a decline induced by natural climate variability.

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Topic: 05. Mekong Basin hydrology and hydrography

Prediction and counter measures regarding sedimentation and erosion processes in the Mekong Delta

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Numerical modeling of coastal, estuarine, and inland waters is one of HYDROMOD's key activities. Within the WISDOM project the simulation and prediction of sedimentation and erosion processes within the target area of Can Tho and especially in the shipping ways of the Hau River and their vicinity was one of the main objectives of this model studies. The model system HYDROMOD-3D which has been applied for these studies already includes a river bed sedimentation and erosion module based on an algorithm which considers the bottom currents and its impact on the river bed. One of the major objectives of these studies was a further improvement of the modelling of sedimentation and erosion processes in the Mekong Delta and especially in the target area around Can Tho. In addition to the problem of river bed sedimentation within shipping routes the bank erosion is a very common problem all over the Mekong Delta and this counts also for our Can Tho target area. On a first attempt bank erosion can be described as a morphodynamic process which is caused by a continuous impact of currents and/or waves but also by singular events like strong rain fall runoffs or strong flood currents heavily scouring the river bank within a few days or even hours. Within this presentation we will report about our activities to develop and improve the model system to make it appropriate for the study area, the efforts to gain up to date basic data sets and about the first model results. Finally we will talk about first attempts to develop counter measures where sedimentation and erosion causes problems shipping lanes and the nearby river banks.

Session: 124 - 7

Topic: 05. Mekong Basin hydrology and hydrography

Sedimentation in the floodplains of the Mekong Delta: Its values and management strategies

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The Mekong Delta is one of the largest and most intensively used estuaries in the world. It experiences annual widespread flooding, which provide the basis of livelihood for about 17 million people in the Mekong Delta, but they also pose a considerable hazard when extreme events exceed protection levels. Especially since the Delta in Vietnam is intensively used for agriculture, the pristine natural floodplains have been altered to channel networks, dike rings, paddy fields and aquaculture ponds. Sedimentation in floodplain plays a key role for the economic and ecological sustainabilty of low lying deltas. Its values can be acknowledged for nutrient input for agriculture, but also in terms of compensation for delta subsidence and sea level rise. However, little attention is paid to floodplain sedimentation in the Mekong Delta, both in research and in planning. This study presents results from a dedicated sediment monitoring campaign, where the main processes and overall floodplain sedimentation were quantified for a test case in the plain of Reeds. Based on these finding, the value of sedimentation is estimated, their role for a sustainable development of the Delta is discussed, and management strategies for the optimization of floodplain sedimentation are outlined.

Phu Quoc Room

06.03.2013

08:00 - 09:45

Session 131 - 03. Mekong Basin forest dynamics and REDD+

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&

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Topic: 03. Mekong Basin forest dynamics and REDD+

A phenological land cover map for the Mekong Basin on the basis of multitemporal and multispectral satellite data from the MODIS sensor

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The Mekong Basin, covering large parts of Cambodia, China, Lao, Myanmar, Thailand and Viet Nam is endowed with a very diverse natural resource base. Rapid socioeconomic developments though, have led to extensive changes in the region's environment, some of which have significant implications on the ecosystem health and the people's livelihoods in the region. It is crucial therefore, that updated information on the state of the environment becomes available on a basin-wide scale to allow for comprehensive and comparable analyses within the entire river system. Against this background, a regional specific land cover map is derived for the year 2010 utilising multispectral and multitemporal information from the MODIS sensor aboard the platforms Aqua and Terra. Almost persistent cloud cover in the rainy season, though, makes optical remote sensing analyses in this region challenging and requires therefore special attention on data preparation and classification methods. We therefore apply a multistep unsupervised classification approach optimized for regions with frequent cloud cover and scarce reference data. Thereby multiyear EVI time series and different composite approaches are utilised to reduce noise related to clouds, cloud shadows, haze and surface anisotropy while preserving the phenological information inherent in the reference data. Furthermore, the very heterogenic climatic and physiographic conditions in the regions are addressed by a nested clustering approach based on physiographic subregions. Results demonstrate that the method performs satisfactory in terms of accuracy under given conditions

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Topic: 03. Mekong Basin forest dynamics and REDD+

Institutional arrangement and transaction cost in implementing of the National Five Million Hectares Reforestation Program in Vietnam

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Forest tenure has been changed in Vietnam with more stakeholders involved in forest management such as individual households, communities (including household groups and communal People's Committees), management boards of protection forest, management boards of special-use forest, state forest enterprises, joint-venture companies, and armed forces. (Nguyen et al, 2007). Being aware of the importance of sustainability in natural resource management to prevent the depletion of forest resource and to develop upland regions, the government of Vietnam has paid special attention to forest management. Program 327 for upland reforestation and afforestation has been started extensively in the early 1990s and farmers have been provided incentives and rewards to implement on bare hills and mountains. In 1998 the Vietnamese government launched the National Five Million Hectares Reforestation Program (5MHRP), as a continuation of Program 327, in order to increase the forest cover of 28% to 43% by the year 2010. The majority of upland farming households undertakes reforestation work, and they are now the primary owners of planted forests (The, 2008). The main concerns are how the institutional arrangement can be made and how the costs and benefits can be shared between stakeholders in implementing the 5MHRP. Our paper is first focusing on reviewing the 5MHRP to understand the policy vision of the program, and functions and responsibilities of involved stakeholders. Next, the costs and benefits sharing between stakeholders is analyzed to identify how the burden can be shared. The transaction cost in program implementation is also examined to understand how much time is counted besides other costs required. These analyses are based on empirical data from the interview of management authorities at various levels such as provincial, district, commune agencies, and community in Da Bac district of Hoa Binh province. Finally, institutional constraints and incentives in implementation the 5MHRP are identified and recommendations for policy adjustments are provided. Reference: Nguyen, Quang Tan, Nguyen, Ba Ngai and Tran, Ngoc Thanh. 2007. "Forest Tenure Reform in Vietnam: Experiences from Northern Upland and Central Highlands Regions" Proceeding: International Conference on Poverty Reduction and Forests, September 2007. Bangkok, Thailand. The, Bui Dung. Payment for Environmental Services in Vietnam: An Empirical Experimental in Sustainable Forest Management. Asean Economic bulletin, Vol.25. Nbr.1, April 2008 or http://sg.vlex.com/vid/payments-experiment-sustainable-forest-65019450,

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Topic: 03. Mekong Basin forest dynamics and REDD+

Integrating community-based measurement and remote sensing for Forest Carbon Stock Measurement: Three pilot projects for REDD+ in Laos, Thailand, and Vietnam (SUMERNET AN-12)

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REDD+ projects require monitoring, reporting and validation (MRV) or under some programs such the Climate Investment Fund's Forest Investment Program monitoring and evaluation (M&E). Important indicators for REDD+ are forest cover changes and the subsequent carbon stock changes over time. These two indicators can be measured through the combination of remote sensing satellite data and data analyses and field-level biomass data. A level of expertise, usually beyond what local people generally possess, is required for remote sensing analyses. However, local people can become important participants and project stakeholders in field data collection, particularly in forest parcels which are under community tenure. Data collection and management must adhere to quality control and standards. On-line data management tools focused on forest carbon offer a solution in support of such standards. Designed well, such systems also support knowledge management and capacity-building efforts. This research tests the on-line Forest MRV/M&E system developed by the Global Observatory for Ecosystem Services at Michigan State University as a project management and reporting system for community-based biomass field data for measuring forest carbon stocks. Three pilot project areas, one each in Laos, Thailand and Vietnam, were identified in order to test the Forest Carbon MRV/M&E system. The sites included three villages in Sangthong District, Vientiane Municipality, Laos; thirty-one villages in Borabue, Na Chueak, and Wapi Pathum Districts, Mahsarakham Province, Thailand; and two villages in Na Ri District, Bac Kan Province, Vietnam. The project utilized university, NGO, and government agency linkages to the communities in each country to hold workshop and training sessions. Local communities then collected field data and project researchers uploaded the data to the Forest Carbon MRV/M&E system. Field data were also combined with remote sensing data to map carbon stock estimates at the landscape level. The Forest Carbon MRV/M&E system successfully managed both the field inventory data and the geographic information for each project pilot area. Linkages to local agency staff, NGO and University personnel proved to be a key component to realizing successful training and coordination with local communities. The potential use of the Forest Carbon MRV/M&E system as a training tool for local communities was not part of the current research, but show promise as the system matures. The use of web-based tools and management systems shows a way forward in aggregating small-holder and community involvement in forest carbon mitigation projects and also in scaling up projects from local to national and regional levels, especially with the use of web-GIS tools.

Session: 131 - 4

Topic: 03. Mekong Basin forest dynamics and REDD+

Evaluation of the impact of pilot payments for forest environmental services: case study in Lam Dong Province, Viet Nam (SUMERNET AN-03)

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Forests provide products and environmental services that support life and livelihood activities. Deforestation and forest degradation continue in many parts of the country as a result of illegal logging practices, land conversion and fire. In response the Vietnamese Government has made great efforts to protect and restore forests. Decision 380/QD-TTg to pilot a Payment for Forest Environmental Service (PFES) in Lam Dong province is one of the most promising government policies as it has potential to improve forest management and reduce poverty. The study evaluated the impact of PFES on local communities and forest management practices. A combination of methods was used including key informant interviews, focus group discussions, site observations and household surveys. The results revealed that the scheme has made significant contribution to forest protection and management. The incentives under the scheme lead households who are forest owners to protect forest. On average, each household was paid about VND 10.20 million per year in from PFES, accounting for 32% of a household's total income. Since the scheme was introduced illegal logging practices and forest burning has declined considerably. The study revealed several factors influence the level of benefit households derived from involvement in the PFES program. Such as ethnicity of households, distance to PFES allocated forest area, ration of dependent in households, total land areas and household labor force. Although the scheme has only just started indicators are that PFES will have a positive effective on environmental services and forest quality. In the first two years PFES scheme has improved awareness of environmental issues, the role of forest resources and services, and the needs for forest protection among all major stakeholders.

Session: 131 - 5

Topic: 03. Mekong Basin forest dynamics and REDD+

Mangrove Ecosystem Services in the Mekong Delta: Combining socio-economic household surveying with remote sensing based analysis

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Mangrove ecosystems along (sub-) tropical coasts are threatened due to conversion of land use. In the Mekong Delta – Vietnam, where especially mangrove forests have been clearing for shrimp farming because high economic value of shrimp production. The value of ecosystem services can be quantified in many ways either by statistical method or modeling approaches. In order to make ecosystem services valuation a useful framework and applicable tool for environmental management and policy making, the values of these services first need to be quantified and visualized appropriately. Remote sensing has been widely proven as a useful tool for mapping ecosystem services, inventory of forest quality and quantity especially with the high resolution data. The objective of the current study was conducting the framework for an economic evaluation of mangrove ecosystem services based on in-situ and remote sensing observations. Based on about 300 household investigations, the direct benefits of different mangrove ecosystems were calculated based on different ratios of mangrove and aquaculture combination. The result showed that the quantitative value map of different mangrove coverage ranging from 100 USD to 3000 USD a year for one hectare. This study presented the capabilities in studying mangrove ecosystem services from space in combining with socio-economic household survey.

Session: 131 - 6

Topic: 03. Mekong Basin forest dynamics and REDD+

Payments for Environmental Services in Thailand: A Review of Discourses and Practices

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This paper scrutinizes the current discourses surrounding Payments for Environmental Services (PES) in Thailand and juxtaposes these with the practical attempts of implementing viable PES and REDD+ schemes in northern Thai watersheds. Methodically, we draw on focus group discussions, participant observation and semi-structured interviews conducted from 2009-2012 with a variety of stakeholders from academia, development projects and international organizations. We find that PES discourses revolve predominantly around institutional, political and social issues, rather than economic aspects of PES arrangements. We further identified a lack of coordination among major state actors involved in PES pilot projects. Reaching a common understanding of the basic concept and principles of PES among all stakeholder groups has proved challenging as well. There is also a fear among officials formerly involved in a command-and-control style of governing natural resources to devolve power to local actors in such incentive-based governance systems. Finally, securing long-term commitment among both "buyers" and "sellers" of environmental services has proven difficult, making such schemes overly reliant on donor and/or national government funds and on intermediary roles played by academics and external experts.

Session: 131 - 7

Topic: 03. Mekong Basin forest dynamics and REDD+

SURUMER: Sustainable rubber cultivation in the Mekong region

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Under the Framework Programme Research for Sustainable Development (FONA) contributing to the solution of global problems, the German Federal Ministry of Education and Research (BMBF) has established the research activity “Sustainable Land Management”. The joint project SURUMER is involved the specific focal research point A on “Interaction between land management, climate change and ecosystem services” Project goals The current practice of rubber cultivation has a large impact on ecosystem functions and services. For the sustainability of the system ensuring the integrity of ecosystem services and ecosystem functions an improved rubber management is needed. One of the challenges is the transfer of scientific results into practical land use options. The project follows a holistic approach, including different scientific disciplines (natural, technical, economic and socio-economic). Studies are conducted in different localities of contrasting land use, representing a close-to-nature forest, and a catchment area dominated by rubber plantations.The study region of the project is located in the Autonomous Prefecture of Xishuangbanna in the southern Yunnan province, Southwest China.

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Topic: 03. Mekong Basin forest dynamics and REDD+

National Satellite Forest Monitoring systems for REDD+

Author: **Dr. Inge Jonckheere - inge.jonckheere@fao.org**
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Reducing Emissions from Deforestation and Forest Degradation (REDD) is an effort to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands. “REDD+” goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks.

In the framework of getting countries ready for REDD+, the UN-REDD Programme assists developing countries to prepare and implement national REDD+ strategies. For the monitoring, reporting and verification (MRV), FAO supports the countries to develop national satellite forest monitoring systems that allow for credible MRV of REDD+ activities. These are among the most critical elements for the successful implementation of any REDD+ mechanism. The UN-REDD Programme through a joint effort of FAO and Brazil's National Space Agency, INPE, is supporting countries to develop cost-effective, robust and compatible national monitoring and MRV systems, providing tools, methodologies, training and knowledge sharing that help countries to strengthen their technical and institutional capacity for effective MRV systems. To develop strong nationally-owned forest monitoring systems, technical and institutional capacity building is key. The UN-REDD Programme, through FAO, has taken on intensive training together with INPE, and has provided technical help and assistance for in-country training and implementation for national satellite forest monitoring. The goal of the support to UN-REDD pilot countries in this capacity building effort is the training of technical forest people and IT persons from interested REDD+ countries, and to set- up the national satellite forest monitoring systems. The Brazilian forest monitoring system, TerraAmazon, which is used as a basis for this initiative, allows countries to adapt it to country needs and the training on the TerraAmazon system is a tool to enhance existing capacity on carbon monitoring systems.

The support will allow countries to follow all actions related to the implementation of its national REDD+ policies and measures. The monitoring system will work as a platform to obtain information on their REDD+ results and actions, related directly or indirectly to national REDD+ strategies and may also include actions unrelated to carbon assessment, such as forest law enforcement. With the technical assistance of FAO, INPE and other stakeholders, the countries will set up an autonomous operational forest monitoring system. An initial version and the methodologies of the system for DRC and PNG has been launched in Durban, South Africa during COP 17 and in 2012 Paraguay and Zambia will be launched in Doha, Qatar at COP 18. The access to high-quality satellite data for the countries is crucial for the set-up of the system. Much more countries will follow in the coming years, so also Viet Nam could use the developed technologies.

Phu Quoc Room

06.03.2013

10:15 - 12:00

Session 132 - 04. Mekong Basin landuse (non-forest) dynamics

Session Chairs:

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Topic: 04. Mekong Basin landuse (non-forest) dynamics

Transboundary flows of resources, people, goods and services in the Mekong Region

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Places are linked and transformed by flows. In the Mekong Region, for example, improved transport infrastructure is increasing trade in agricultural and manufactured products. Advances in communication and information technology are also changing the way people perceive themselves and others, their aspirations and how they organize. Many such flows are internal to a country, some go beyond. Transboundary flows are defined here as flows that cross shared international borders. This paper explores key patterns, drivers and consequences of transboundary flows on social development and the environment in the Mekong Region. Four main types of transboundary flows are distinguished. Resource flows refer to the movement of animals and natural resources. People flows refer to the movement of people. Goods flows are the movement of agricultural commodities and manufactured products. Non-material flows are symbolic transactions, in particular, of money, ideas and information. Our analysis suggests that transboundary flows of goods and investment within the Mekong region are often not as large as those suggested in political discourses promoting or criticizing regional economic integration. Domestic and external flows are often large relative to inter-regional flows and depending on scales and units of analysis may overwhelm the latter. This is especially true for the most open and industrialized economy of Thailand, whereas for Lao PDR or Myanmar/Burma within region transboundary flows are much more significant. Transboundary flows of people vary widely over time, by boundary, source and destination conditions with movements being into Thailand. People move across borders with varying degrees of freedom from involuntary movements across borders to flee war and suppression to tourism. For transboundary flows of resources like water or clean air, it is alterations in flows and changes in quality rather than just increases which are of concern to destinations. Non-material transboundary flows such as those related to ideas, technical skills or culture have received less attention. These latter flows are more indirect but profound, influencing the evolution of other flow as they shape perceptions, beliefs and expectations. Transboundary flows, in short, are not independent of each other. Transboundary flows create opportunities, risks and burdens for social development, economic growth and environmental sustainability. Separating out impacts of transboundary flow from other internal and external flows has not always been done. Our analysis concludes that transboundary flows in the Mekong Region are not always that important, especially when their magnitude and impacts are compared with internal and global flows.

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Topic: 04. Mekong Basin landuse (non-forest) dynamics

Science Driven Conservation Questions in Lancang-Upper Mekong Region

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The ecological health of the Lancang-Upper Mekong region as part of the "roof" of Southeast Asia is deteriorating, which has potential great consequences on biodiversity and ecosystem services, as well as human well-being. There is much uncertainty associated with the complex interplay of the major change drivers along the upper Mekong. There are also implications for the lower Mekong, including demographic shifts, human development needs, land-use and land cover change, increasing investment and trade, and climate change. Effectively linking scientific knowledge and conservation actions to meet human development needs while protecting fundamental ecosystem services is proving difficult. What are the right questions to link legitimate science outcomes to conservation and sustainable development decision making? We propose nine questions: 1) What are the patterns/drivers of regional environmental change; 2) What are the ecological and social tipping elements? 3) Do we have the right species protected in the right places for climate-smart restoration and adaptation? 4) Can a landscape conservation approach make a difference? (Land sharing or land sparing?) 5) What about above-below ground interactions? 6) What are mountain- specific adaptation barriers and bridges? 7) Can carbon-markets protect biodiversity and ecosystem services? 8) Do conservation payments work? 9) What is the potential for transboundary governance to help link the upper and lower Mekong? We will pursue answers to these questions in our presentation. conservation and sustainable development.

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Topic: 04. Mekong Basin landuse (non-forest) dynamics

Detecting land use changes and its linkage to flood responses in the Chi river basin, Thailand

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The role and importance of agriculture in the Chi River Basin which is one of the Mekong main tributaries in northeastern Thailand, is known as an economic driving force of the region. Consequently, pressure from population growth and increasing land demand turn the land development into uncontrolled way. Land use patterns have been changed considerably that may result in unusual hydrological behaviour. To quantitatively reveal this effect, an evaluation of land use change was then analysed. In this study, the SWAT hydrological and 1D/2D SOBEK hydraulic models were used. The SWAT results indicated that little or no significant potential impact of future land use change on river basin flood regime, but rather at sub-basin scale. The impacts were apparently greater in some upstream sub-basins where additional forest land helps to buffer the effects of intensifying runoff, i.e. the reduction of the 1% annual probability of exceedance peak discharge can be approximately 10% (varied strongly from one sub-basin to another), whereby there was no significant downstream hydrological impact. To better understand how changes in land use may affect future flood risk, the 1D/2D SOBEK model was used to test the expected land use of 2057 against the present land use conditions. The results showed that the flooded area decreases only insignificantly across the river basin, i.e. from 143,000 ha to 142,000 ha, during the 1% annual probability of exceedance flood. The decrease in flood extent is therefore marginal under the future land use scenario. In turn, flood damage costs will continue to increase significantly due to the most remarkable change in the number of commercial properties at risk of flooding. Under the future land use scenario, the cost of flood damage is expected to rise from US$ 86 million to US$ 140 million. If such an exceptionally 0.1% annual probability of exceedance flood occurs, under current land use conditions, 165,000 ha of land could be inundated and could cause up to US$ 10 million in damage. The future land use change only results in a small flooded area reduction from the case of existing land use conditions, but its damage may increase by US$ 18 million. The following actions are suggested in relation to specific ranges of flood depth: - between 0.00 - 0.50 m, flood proofing option can be applied, i.e. the provision of temporary walls around individual buildings and raising the habitable floor levels above the flood level, and the modification of land management practices (flood adaptation); - between 0.50 - 2.00 m, the inhabitants would have to move to the first floor; - more than 2.00 m, the evacuation of people off the floodplain through an effective flood warning system. Based on the results, a good understanding of the relative scale and direction of future changes will be obtained, which can help to minimize future flood risk and damage costs, and this can be used as the best available information to improve flood management.

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Topic: 04. Mekong Basin landuse (non-forest) dynamics

Forecast Mekong: Mapping the Mekong Basin with time-series and historical data to support informed decisions

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Forecast Mekong is part of the U.S. Department of State's Lower Mekong Initiative, which was launched in 2008 by Secretary Hillary R. Clinton and the Foreign Ministers of Cambodia, Laos, Thailand, and Vietnam to enhance U.S. engagement with the Lower Mekong countries in the areas of environment, health, education, and infrastructure. Toward these goals, the Forecast Mekong team is working to increase environmental science capacity within the Mekong Basin in Southeast Asia and to provide assistance to local scientists for improving digital geospatial products to aid in making resource decisions (i.e., water resources and food security). USGS has conducted remote sensing workshops and conferences in the region and worked with local universities on remote sensing and wetland monitoring projects. This presentation will focus in particular on geospatial datasets developed for the Mekong Basin that are available to the scientific community. With its broad viewing swath, the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument is ideal for monitoring temporally variable phenomena such as flooding regimes, vegetation communities, and crop growth and vigor at broad regional scales. However, frequent cloud cover over the Mekong Basin presents tremendous challenges in terms of using remote sensing to study and monitor the region. Though MODIS captures imagery of virtually the entire planet twice per day, there are parts of the Mekong Basin which are almost always cloud-contaminated for any given month. In order to create predominantly cloud-free, true-color imagery for the entire region on a monthly basis, exclusion algorithms were developed at multiple stages that detect and reduce the effects of clouds and poor quality data. Additional MODIS-based products were developed for the Mekong Basin, including the Normalized Difference Vegetation Index (NDVI), NDVI change from historical baseline conditions, and a Normalized Difference Water Index (NDWI). The true-color, NDVI, NDVI-change, and NDWI products were produced monthly for the time period of 2003-2011. These data are publicly available for download in GeoTIFF format or can be viewed via a web mapping application on the Forecast Mekong website (http://deltas.usgs.gov/fm/default.aspx). Another dataset available on the Forecast Mekong website that may be of interest to the remote sensing community is the Joint Operations Graphics (JOGs) produced by the U.S. military for parts of Vietnam, Cambodia, and Laos during the mid-1960s to the early 1970s. The maps were produced at 1:50,000 scale and contain detailed information on topography, vegetation, hydrography, and cultural features. These paper maps were scanned and georeferenced, and provide unique historical spatial data on wetlands in the lower Mekong Basin.

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Topic: 04. Mekong Basin landuse (non-forest) dynamics

Water Resources Management for Sustainable Agriculture in the Mekong Delta, Vietnam: The Role of On-Farm Practices

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Given the combined pressures of national food security and uncertainty of impacts of the upstream development and climate change on agriculture, revisions are necessary to the current approach of water resources management at both regional and local level in the Mekong Delta of Vietnam. An assessment study aims to evaluate impacts of water resources management projects and to identify rooms for further improvement of water resources management for sustainable agricultural development in the Mekong delta. Focus group discussions with local staff and farmers followed by household interviews were conducted at eleven sites in six provinces (An Giang, Can Tho, Tra Vinh, Soc Trang, Bac Lieu and Ca Mau) in 2011; in total, 181 farm households representing wealth groups were interviewed. The study sites were clustered into four major groups (hereafter called “zones): (1) flood zone (upper and mid-delta), (2) freshwater-brackish interface zone (irrigated coastal zone), (3) brackish water zone (rainfed coastal zone), and (4) saline water zone (coastal zone). Water resources management projects have facilitated rice intensification in the flood and interface zones while allowing agricultural diversification in the coastal zones. Further rice intensification helped farmers earn higher farm income and create more off-farm jobs for the poor. However, rice yields and income have been maintained with increased agro-chemical costs. Farmers in the interface zone earned less income per hectare farm and labour than the others, indicating low water use efficiency of intensive rice culture in this zone. In the coastal zones, rotating shrimp with rice allowed farmers earning higher income but reducing employment opportunities for the poor. Income from natural resources exploitation, which most of the poor live on, has declined in most of the zones. Farmers have encountered competitions over water uses at different level, from farm to community. Improvement of both structural and non-structural measures at community and farm level is essential for higher water productivity. Future water resources interventions should focus on not only agricultural production but also a broader context of ecosystem and rural development, which would create livelihood opportunities for the poor.

Session: 132 - 6

Topic: 04. Mekong Basin landuse (non-forest) dynamics

Spatial and temporal change patterns analysis of rubber plantations in the border region of China, Laos, and Myanmar

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Co-Authors: **Prof. Zhiming Feng, Prof. Luguang Jiang, Ms. Jinghua Zhang**

The border region of China, Laos, and Myanmar is located in southwest of China including Xishuangbanna Dai Autonomous Prefecture, northern of Laos which has Luang Namtha, Oudomxay, and Phongsaly province, and northeast Shan State of Myanmar which has Kengtung and Mongphyat county. The border region has become the hot spots of land use and cover changed or changing drawing close attention from national and international communities. Based on MODIS-NDVI data we analyzed phonological characteristics of vegetation cover type and determined the temporal window for rubber plantations detection. Spatial and temporal change patterns of rubber plantations were quantified by interpreting Landsat images from 1980, 1990, 2000 and 2010 using object-oriented classification method according to spectral differences between rubber forests at different growth stages. Topographic features, such as elevation, slope, and aspect, were analyzed to explore rubber plantations distribution pattern. The results showed that: (1) The optimum temporal window for rubber detection was from January to February or from early June to late October and mature rubber forest has obvious differences compared with other land cover types and that young rubber forest was often confused with fallow farmland and tea garden. (2) In 2010, there were 598377 ha rubber plantations in the border region of China, Laos, and Myanmar, which mainly distributed in China accounting for 83.80%, while Myanmar with 9.56%, and Laos with 6.64%. From 1980 to 2010, area of rubber plantations was 51818 ha, 121867 ha, 258895 ha, and 598377 ha respectively with annual growth rate 35%, which illustrated rubber plantations expansion significantly. Laos and Myanmar increased the rubber cultivated area from nothing in 1980, while Laos spread out in the northwest of Luang Namtha province and southwest of Phongsaly province around basin and Myanmar expanded in northeast of Kengtung and Mongphyat county around basin similarly. (3) Rubber plantations showed significant expansion changes from intensive to disperse. The distribution elevation of rubber plantations gradually rose with the maximum from 1036 m in 1980 to 1410 m in 2010, meanwhile the altitude ranges expanded from 544 m in 1980 to 987 m in 2010. Rubber plantations were mainly on gentle slopes, while the extended occupied the majority of steep slopes. Aspect had large influence on rubber plantations distribution pattern. There were more rubber plantations on south aspects than north while more on west aspects than east, and rubber plantations on south and east aspects expanded rapidly in comparison to a trend of general decrease on north and west aspects. For local sustainable development, the expansion of rubber plantations into forest and higher elevations and slopes should be controlled, and cultivate plantations in sustainably and scientifically to safeguard relatively intact of tropical ecosystems and manage land over the long term.

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Topic: 04. Mekong Basin landuse (non-forest) dynamics

Understanding the impacts from the dynamics of the urbanized villagers through mobility: a case study from Isan villages, Thailand

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The recognition of global phenomenon as mobility issues has resulted in many assessments of the potential effects of changing both people and places in different parts of the world. Currently, socio-economic dimension and mobility issue are the crucial factors of changes of Isan villagers, Thailand. Ironically, with many policies and some urban-based scholars continued to view the rural village as a peasant society (Prapart 2010, pp.1-10). In practice, it is difficult to find local labour since many villagers prefer nonfarm jobs in towns to farming in rural areas. Such aspirations for better living standards are seen in most Isan communities reflecting the rise of 'urbanised villagers'. Interestingly, many Thai scholars hardly discuss the identity of the villagers through the dynamic view with significances between the current urban-rural linkage. This study found that the term 'urbanised villagers', created by McCargo and Naruemon (2010, pp. 1016-7), is useful for understanding the flexibility and identity of contemporary Isan villagers since since villagers' living patterns have been split which are divided between urban and rural areas and the deterritorialisation and mobility that have accompanied this. In some Isan villages, these were established by suburbanised groups through the creation of small factories to supply urban merchants. For examplae, Ban Hora in Roi Et province provides the most striking case for showing the paradox in the power relations between the state and the villagers. While the state employs 'power over' to attempt to retain villages' agro-based communities, many villagers do not rely on the natural environment as indigenous societies did. Therefore, it is interesting phonomenon to investigate the case studies which have shown some success in increasing household revenues from both agricultural activities and non farm jobs from the groups of reverse migration. This study found that there were change their status from the farmers to the rural entrepreneurs and there are loose social organisations from these groups to run their local businesses. However, formal actors such as the government and local self government is not providing the ideas and processes for dealing with this phenomenon and for the rural environment, especially with regard to mobility in local development. The community organisations seen in the case studies have been created by informal actors –rural entrepreneurs and women's groups – based on the individual needs in each household.

Phu Quoc Room

06.03.2013

13:30 - 15:15

Session 133 - 12. Capacity building, education and outreach

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&

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Session: 133 - 1

Topic: 12. Capacity building, education and outreach

The Approach and Main Outcomes of PRoACC - An Integrated Post-doctoral Research Programme on Adaptation to Climate Change in the Mekong River Basin

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The development of well-informed, scientifically sound and societal acceptable adaptation policies and measures is essential for the sustainable development of the region. Water is the key issue in that perspective. The Post-doctoral Research programme on Adaptation to Climate Change (PRoACC) contributes to better scientific understanding of climate change adaptation from hydrology, ecology, social, economic, institutional and integrative perspectives. Furthermore, PRoACC contributes to the development of climate change adaptation policies and strategies, and strengthens the cooperation of national/regional academic institutes related to climate change adaptation through targeted capacity building. During the first phase (2010-2012) eight post-doctoral researchers addressed various issues related to climate change adaptation in the Mekong basin in a multidisciplinary manner, i.e. all post-docs had different academic backgrounds/projects and carried out their research in cooperation with various stakeholders. All post-doctoral fellows came from the region and have been hosted by local/regional knowledge institutes. In the second phase (2013-2014) of the programme, a stronger interdisciplinary approach around four major themes and even more intense stakeholder participation will be sought. This paper describes the PRoACC approach and summaries the main outcomes and conclusions achieved by the many collaborating partners; furthermore, it will sketch the ongoing research in the second phase of the programme. Special attention will be given to policy relevant research findings. Partner Institutions collaborating in PRoACC in the Mekong River Basin during phase one (2010-2012); even more partners from all Mekong countries are expected to cooperate in phase two (2013-2014): Asian Institute of Technology, ATI, Bangkok, Thailand Khon Kaen University, Mekong Institute, Thailand Water Resources University, WRU, Ha Noi, Viet Nam Vietnam Institute of Meteorology, Hydrology, and Environment, Hanoi, Vietnam Southern Institute of Water Resources Research (SIWRR), Vietnam Chinese Academy of Sciences, CAS, Beijing, China Changjiang River Commission, China National University of Lao, Lao PDR Mekong River Commission Secretariat, Lao PDR

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Topic: 12. Capacity building, education and outreach

Addressing Sustainable Development Challenges in the Mekong Region: Sustainable Mekong Research Network in Action (SUMERNET AN-01)

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Decision makers and policy developers in the Mekong Region are facing great challenges in finding ways to maximize benefits from development, while maintaining ecosystem integrity and minimizing the impact on the livelihoods of marginalized people, who are heavily dependent on ecosystem services and thus more vulnerable to abrupt changes in the management and allocation of available resources for development. This presentation demonstrates the efforts made by the partners of the Sustainable Mekong Research Network (SUMERNET), a long-term research network dedicated to addressing these challenges. The SUMERNET was established by 14 founding members in 2005, with the ambitious vision to achieve sustainable development in the Mekong region through stronger knowledge-based policy processes. With support from Sida and CDKN, SUMERNET continues to expand its partnerships with over 40 organisations, and supports more than 100 Mekong riparian researchers in nearly 20 cross-border collaborative projects, while strengthening the relevant capacities of these riparian partners. From the wide vista of sustainable development challenges, SUMERNET currently focuses on 5 areas: ecosystem services; trans-boundary issues; poverty and livelihoods; urbanisation; and energy and climate change. Ten collaborative projects are at the stage of delivering their final results to address policy needs, which were identified jointly by their boundary partners (as defined by Sarah Earl et al., 2001) and policy makers. These projects are listed hereafter. 1. Vulnerability assessment of people's livelihoods in flood-prone areas of Cambodia and Vietnam 2. Making economic integration work for the rural poor through contract farming practices in Thailand, Lao PDR, Cambodia and Vietnam 3. Transboundary Fish Trade in the LMB with a focus in Cambodia, Thailand and Lao PDR 4. Communicating water-related climate change risks in the Mekong Delta in Vietnam, Thailand and Cambodia. 5. Climate change implications to food security and livelihood of small scale farmers in Lao PDR and Philippines 6. Impact of urbanization on the hinterland and local responses in Thailand and Lao PDR. 7. Sustainable urban tourism through low carbon initiatives in Thailand and Vietnam. 8. Forest Payment for Ecosystem Services in Vietnam and policy implication for Laos and Cambodia 9. REDD Plus –Community-based participatory carbon measurement in Vietnam, Lao PDR and Thailand. 10. Climate change adaptation – mitigation prioritization in Vietnam and Lao PDR using the Social Return on Investment Framework (CCAMP-SROI). The final results of these projects will be presented in different sessions of this Symposium, and will be peer reviewed before they are published in the SUMERNET flagship book tentatively titled, "Livelihoods, Ecosystem Services and the Challenges of Regional Integration in the Mekong Region" in 2013.

Session: 133 - 3

Topic: 12. Capacity building, education and outreach

China And The Mekong River Commission ： The Role Of China In Mekong River Management---From Legal Perspective

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Although China has been a member of several River Basin Organizations (RBOs), and has signed some water agreements, unfortunately, China still is seen as a country unwilling to enroll institutionalizing cooperation such as establishing an international water body with legal framework. Moreover, there is a widely spread view that China just set some institutions in name only. This research will study the reason why China belittles MRC and analyze the existing domestic and international pressure that China has to face in this context. As a result, the reasons why upstream states are unwilling to participate in institutionalizing cooperation will be discussed as well.

Session: 133 - 4

Topic: 12. Capacity building, education and outreach

Water pollution management in the vicinity of the Lower Mekong Basin: German-Vietnamese research projects “TAPIOCA” and “EWATEC-Coast”

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An overview is given about two joint German-Vietnamese research projects financed by the German Ministry of Education and Research BMBF and the Vietnamese Ministry of Science and Technology MOST. The first project “TAPIOCA” was completed in autumn, 2012. The main objective of the project was to develop modeling procedures and process techniques to sustainably improve the water quality of the highly polluted surface water of the Saigon river basin upstream of Ho Chi Minh City. The project consists of experimental, numerical and capacity building components. The experimental part was assigned to the treatment of agrochemical waste water caused by tapioca starch production. Various small-to large size firms in Vietnam and other South East Asian countries are producing tapioca starch without facilities for the waste water treatment. Presently, most of the untreated waste water is discharged into rivers. By combining high-tech and low-tech components, innovative techniques had been developed and optimized with the help of a multi-stage pilot scheme. Results were integrated in an expert system for the modeling of the water pollution for the surrounding of the pilot plant, and later for the entire Saigon river basin upstream of Ho Chi Minh City. The expert system comprises modules for the combined simulation of the water balance, contaminent transport, hydrodynamics and water quality of a reservoir-river system. It allows simulation and optimization of combined measures in the planning stage to optimally reduce the surface water pollution. The second project “EWATEC-COAST” (Environmental and water technologies of coastal zones in Vietnam under climate change conditions) started in autumn, 2012. It goes clearly beyond the scope of work performed in the TAPIOCA project. Study areas are the highly polluted inland water and estuary system of the Thi Vai river and the adjacent Can Gio mangrove forest. Both areas are located south-east of Ho Chi Minh City. Various companies, mostly situated in industrial areas along the river, are discharging waste water without treatment into the river system. The river has been considered as ecologically dead since about 1995. EWATEC COAST will significantly contribute to rehabilitate the affected water bodies and environment. First task is the development and application of a model-based "management system" for sustainable water and environmental protection of coastal zones. Components of the integrative system for decision making are the meteorology and climate change, the quantity and quality of surface water and ground water systems, the mangrove ecosystem, aquatic organisms and coastal protection. The second task is the implementation of innovative water technology for the treatment of tannery wastewater by means of an innovative multi-stage pilot plant in an industrial zone located at in the project region.

Session: 133 - 5

Topic: 12. Capacity building, education and outreach

Participatory Community Based Prioritization and Costing of Adaptation Interventions in Lao PDR and Viet Nam (SUMERNET AN-17)

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Adaptation to climate change has necessarily become an integral component of planning and policy decision making, particularly in major agricultural regions such as the Mekong Basin where productivity is highly susceptible to changes in rainfall and temperature. Determining what adaptation actions to prioritize and identifying the related costs and benefits is a complex challenge, heightened by the multitude of options and the differing value frameworks of stakeholders. Top-down policies and cost estimates related to climate change adaptation frequently lack sufficient resolution for identifying realities and values at the community and household levels. Without local input, adaptation costing estimates may lead to misallocation of funds to interventions not identified as priorities to vulnerable communities. This study piloted the Participatory Social Return on Investment (PSROI) framework, developed to identify stakeholder priorities for adaptation and analyze the value of interventions from stakeholder perspectives. PSROI is a pluralistic theoretical and methodological framework that focuses on local capacities and community strengths, instead of solely needs, when planning for resilience. Local environmental, economic, and social contexts are conceptualized in a community planning workshop and integrated into a Social Return on Investment costing analysis based upon the inputs of a diversity of community stakeholders. The PSROI framework was used in two sites in Yen Bai province, Vietnam and two sites in Savannakhet province, Lao PDR, to assess local level agriculture system adaptation interventions. Forecast costing analyses were conducted from both the community-based bottom-up and nationally centered top-down perspectives to assess differences in costing outcomes from varying analytic focal points. The PSROI pilot case studies demonstrate that even between communities with similar general adaptation priorities, subtle differences in local contexts can result in the selection of adaptation interventions with divergent inputs, outcomes, associated costs. Costing analyses showed that integrating localized identification of stakeholders, inputs, and outcomes of prioritized adaptation interventions is useful in clarifying design and cost assumptions, and incorporating associated localized values are especially important when assessing interventions that are not national prevalent. As locally prioritized interventions can have broader landscape wide implications, such as irrigation planning, local level PSROI analyses should be coordinated with decision making across sectors and level of governance to plan for successful adaptation. This study demonstrates that community involvement in prioritizing and costing local adaptation interventions can be important for policy decisions and funding allocation, and can guide implementation and long term monitoring of impact.

Session: 133 - 6

Topic: 12. Capacity building, education and outreach

Capacity building on low carbon society for low income cities in the Mekong Basin of the Northeastern Region of Thailand

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The Mekong Basin in the Northeastern Region of Thailand is a part of the Mekong Basin in Thailand like the Northern Region of Thailand. In a part of the Mekong Basin in the Northeastern Region of Thailand is compound with low, moderate and high-income cities. This study selected to study only low-income cities, because it is one of very interesting area in the Mekong Basin of the Northeastern Region of Thailand in the case of natural resources, wetland types, land use and ways of life of people. This study aimed to study the suitable methodologies to low carbon for low income cities in Mekong Basin in the Northeastern Region of Thailand in the nearly future by studied the relation between their characteristics of social, economy, population, political administration, geography and environment which can encourage or support their carbon reduction, include the barriers to increase their carbon emission by used SWOT technique together with Human Ecology Theory. The results of this study demonstrate that the dominant of geographical characteristics of these areas which had influence and impact on their biodiversities in each ecology and had related to land use, occupation, daily activities and ways of life of people include the economic base of each city. All above factors can reduce and increase their carbon emission under various conditions which came from the inner and outer factors. Furthermore, the level and type of political administration had the role to reduce and increase the carbon emission by the annual government statement of expenditure because they had linked to education and cognition promotion on low carbon society. In addition, the education base of people and their attention on environment are the common base to build low carbon society in each city. So, the integrated methodology is the suitable way to push each society in low income cities in Mekong Basin in the Northeastern Region of Thailand to be low carbon society in nearly future, because each low income city had specific characteristic. Moreover, the best capacity building for one low-income city is not necessary to fit for other low-income city.

Session: 133 - 7

Topic: 12. Capacity building, education and outreach

PBL Education for Designing Sustainable Infrastructure System at Tonle Sap Lake

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From 2010 to 2016, The Development Technology Course, Graduate School for International Development and Cooperation (IDEC), Hiroshima University, will accept over 40 students, are chosen from among public officials, from the Greater Mekong Sub-region (GMS), such as Laos, Myanmar, Vietnam and Cambodia. This course has provided the coursework, the name is “Development Technology”, and this coursework is divided by three phases. Phase I is lectured based learning, to promote systematic understanding of sustainable infrastructure from the perspective of Ocean Development Technologies, Technologies for Environment Conservation and Disaster Prevention of Ground Space, Regional/Urban Policy-Making and Planning Technologies, Public Transportation Planning in Urban/ Regional Area, Technologies of Sustainable Regional Ecosystem Development, Sustainable Architecture, Renewable Energy Policies and Technologies, Technologies of remote sensing and geographic information systems for ecosystem management, Earth System Science , Genetic Analysis for Ecosystem Management, and Environmental Monitoring Technologies. Phase II is PBL (problem based learning) to strengthen students communication and practical skills. In this phase, based on the above systematic knowledge, learned in phase I, students promote their own group works. The main group work topic, which is provided by lecturers to students, is “Development of Sustainable Infrastructure System at Tonle Sap Lake”. In this topic, almost all contents in phase I, are included. In 2012, there were four group works and each topic is (a) Very Large Floating Structure? – Development Project at Tonle Sap Lake -, (b) Waste Management at Tonle Sap Lake, (c) Transportation and Eco-Tourism Improvement at Kompong Luong, and (d) Improving the Tonle Sap Ecosystem - A Case Study of Anlung Raing Floating Village -. Then, in phase III, lecturers and students try to discuss about the question “how can we design and develop a sustainable infrastructure system at Tonle Sap Lake?” by reviewing all groups final reports. This feedback can contribute to enhance students’ systematic understanding of sustainable infrastructure development in developing countries. In this research, we explain about the current status of the coursework “Development Technology”, based on PBL education, provided by the Development Technology course, IDEC, Hiroshima University, and discuss about the problems and future direction or improvements of the coursework.

Phu Quoc Room

06.03.2013

15:45 - 17:15

Session 134 - 12. Capacity building, education and outreach

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Topic: 12. Capacity building, education and outreach

Spatio-temporal evolution of habitat settlement in the Lancang river basin based on Human-Earth relationship

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Since the international economic cooperation launched in Great Mekong Sub-region in 1990s, the Lancang River, the upper reach of Mekong river basin, has received wide attention from the international community. This study focused on habitat settlement of the Lancang River Basin based on clarifying the concept of habitation settlement, establishing an analytical framework. An evaluation index system for habitat settlement of the Lancang River Basin was built, which was applied to estimate trends in spatio-and temporal evolution of habitat settlement of 56 counties (autonomous regions or municipalities) in the Lancang River Basin from 2000 to 2009. Conclusions are drawn as follows: firstly, from the point of view of spatial patterns, suitability ranking of human settlement in the Lancang River Basin decreasing from south to north; from temporal evolution points of view, from 2000 to 2009, the suitability of habitat settlement in the Lancang River Basin was overall getting worse. Secondly, over the past decade, GDP Per Capita (GDPPC) and the Proportion of the Tertiary Industry (PTI) beyond infrastructure factors, such as Road Density (RD), Telephone Penetration Rate (TPR) and Healthcare Index (HI) to become the key constraints to the suitability of habitat settlement in the Lancang River Basin. Thirdly, several policy recommendations, for example, vigorously developing the economy, enhancing the proportion of tertiary industry and further improving the infrastructure in the Lancang River Basin, are put forward at the end of the article.

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Topic: 12. Capacity building, education and outreach

Promoting environmental awareness in education at university level

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PROMOTING ENVIRONMENTAL AWARENESS IN EDUCATION AT UNIVERSITY LEVEL Being the heart of the largest rice-producing region of Vietnam, the Mekong Delta has developed rapidly in recent years. However, at the same time the environmental situation seems to get worse every year. With a very low coast and a substantial proportion of the population dependant on the weather-sensitive agriculture, the Mekong Delta is, according to the United Nations organization, one of the most vulnerable coastal regions in the world facing the negative impacts of climate change. Climate change is however not the only concern. Also, loss of bio-diversity and natural habitats, ever-higher levels of pollution and insufficient waste management are equally distressing. Several problems such as environmentally-unfriendly farming practices, lack of proper treatment of waste water from fishery farms or factories and littering from a dense population are now serious environmental issues in the Mekong Delta. These problems have been taken care by the governmental agencies. A number of measures have been carried out to address them. However, most measures seem ineffective. This raises the question about the level of public awareness. The government of Vietnam is committed to the objective of sustainable development and has pointed out that education is a top priority area for raising awareness and changing behavioural patterns. In the National Action Plan on Education for Sustainable Development in Vietnam 2010-2014, the objectives were set to integrate awareness into practical actions through changes in educational strategies, policies and programs. In fact, responsibilities are now not only placed on the governmental agencies, NGOs or environmentalists but on the teachers who as agents of change must contribute significantly to raising students' awareness on environmental issues. Teachers are expected to adopt a socially responsible teaching (SRT) approach by making changes in their teaching. This can be done by integrating environmental issues into teaching programs on a step-by-step basis. The individual and small actions are believed to be able to make a difference. The students whose awareness have been raised will become live ambassadors of environment to deliver the message of environmental protection to their families and friends, and more broadly to their community. This mechanism will definitely create a comprehensive change in terms of public awareness among the delta communities. Educational programs, seminars, workshops and conferences on environmental issues must more often make a kind of 'mission statement' to save the environment through environmental education to all ages in society. Thus, a fresh new window of opportunity to get a nationwide awareness process from the ground will be opened.

Session: 134 - 3

Topic: 12. Capacity building, education and outreach

From teaching to co-learning: Managing knowledge diffusion for environmental sustainability in the Mekong Delta, Vietnam

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Agricultural and rural development in the Mekong Delta in Vietnam has over the past few decades undergone the second wave of transformation: environmental sustainability. If the first transformation emphasised on productivity through yield-increase oriented modernisation of the sector, which turned the delta into one of the most active and productive agricultural regions of the country, the new epoch is alternatively constructed with integrated crop management, clean/organic farming models, good agricultural practices, and community-based learning organisation. While new knowledge evidently determines such transformational processes, in this second transformation, crucially knowledge diffusion has to change from a teaching to learning paradigm. Knowledge diffusion for sustainable agricultural and rural development in the Mekong Delta is still prominently characterised by teaching thinking and practices. As such, despite its complexity and multi-actor engagement, knowledge diffusion is rightly represented as a pipeline knowledge flow from agricultural extensionists, academics, development practitioners and agribusiness professionals as a knowledge source to farmers as passive knowledge receivers. Knowledge is narrowed as problem-solving explicit technological solutions. Artifact-oriented knowledge diffusion thus aims merely at knowledge transfer success based on adoption velocity and coverage. Grounded on knowledge as knowing in practice, this paper argues that knowledge generation, diffusion and use are integral and that new knowledge is generated and should be managed throughout knowledge diffusion and use. Sustainable agricultural development cannot be achieved unless a co-learning culture between rural development professionals and farming communities is cultivated. Adoption of participatory or bottom-up methods without continuous learning and dialogical reflections easily becomes a fad instead of fundamental change. This paper uses multiple cases to demonstrate the failure and success of environmentally sustainable interventions from both teaching and learning approaches. The cases are presented under three main themes: integrated pest management, ecosystem-based farming and water management. The data selectively used in this paper were collected during a one-year field research project in the Mekong Delta within the period April 2010-2011. It is highlighted from our findings that managing knowledge diffusion for environmental sustainability is not only managing transferred knowledge within single projects or interventions. It instead involves new knowledge generation processes and creation of sustained co-learning practices among actors engaged in sustainable development.

Session: 134 - 4

Topic: 12. Capacity building, education and outreach

Integrating Environmental and Climate Change Education in syllabi through Teacher Working Groups

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Integrating Environmental and Climate Change Education in syllabi through Teacher Working Groups Based on the experiences in Bac Lieu Province, Mekong Delta, Viet Nam Abstract: The Vietnamese Mekong Delta is an area of high agricultural production and economic growth. Inevitably, the intensive agriculture, aquaculture and large-scale water-control structures affect the environmental sustainability. In addition the effects of Climate Change are posing challenges that need to be addressed by local authorities and the society in general. The first step towards a self-determined and sustainable future is the education of students and educators respectively. A sound foundation through Environmental and Climate Change Education will pave the way from understanding towards a change in attitudes and behavior. Teacher Working Groups can be used as an appropriate tool for the integration of Environmental and Climate Change Education in class. The tool is able to stand alone as well as be an integrated part of any project. The working groups can be established in a well-functioning natural environment as well as in a severely affected surrounding. The participatory bottom up approach ensures the required high flexibility, tackling the needs on site and therefore guaranties tailor-made output for the region. During regular meetings, the teachers work on lesson plans, methods and additional teaching materials. All developed products are used by the ones developing it and moreover been promoted to other teachers in the region. In Bac Lieu, over a time span of 3 years, 42 Teacher Working Groups were set up in order to integrate Environmental Education in secondary and high schools all over the Province, covering the subjects of biology, geography and civic education. The Teacher Working Groups in the project were used to develop new materials and integrate them in lesson plans on one side and facilitating the schools in the province to integrate the new content on the other. The experiences and lessons learnt in Bac Lieu are showing great promise for green, sustainable education. An education that is able to support students, teachers and a sound future development in the region.

Session: 134 - 5

Topic: 12. Capacity building, education and outreach

Development and implementation of climate change adaptation measures in coastal areas

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Co-Authors: **Ms. Kristiina Nuottimaeki, Mr. Philipp Schmidt-Thomé**

Climate change is a common challenge that societies are facing. Coastal areas and river estuaries are typically the most vulnerable areas to climate change and its impacts. In many countries, climate change adaptation strategies at national, regional and local levels as well as action plans concerning climate change adaptation have already been developed. However, new tools and methodologies are still needed for risk assessment processes. Several hydro-meteorological extreme events already now pose substantial and growing threats to the health and safety of the population, and are expected to become exacerbated under changing climate. It is essential to promote the transfer of experiences and know-how in the field of climate change-induced environmental risks and adaptation measures. Good experience of science-stakeholder co-operation in risk assessment and climate change adaptation have been achieved in case studies in the Baltic Sea Region (Seareg, ASTRA, BaltCICA) and this experience is currently applied in Vietnam under the project VIETADAPT (Development and implementation of climate change adaptation in coastal areas in Vietnam). The main aim of the project is to contribute to the Vietnamese Climate Change Adaptation Strategy by developing adaptation measures on local planning procedures in co-operation with local stakeholders. This is achieved by promoting science-stakeholder communication. The project organises workshops with local stakeholders where local concerns, interests and perceptions on climate change impacts are discussed and analysed. Based on the workshop discussions as well as on local impact studies, climate change adaptation measures for the case study areas will be developed and finally evaluated together with stakeholders. Beside with successful science-stakeholder co-operation, it is also essential to involve young Vietnamese experts into climate change impact studies. In the VIETADAPT-project, young experts are deeply involved in the project activities. They contribute to the local climate change impact studies and take responsibility of reporting and presenting of results within workshops. The project also gives possibility to be trained within special training courses, such as GIS, language courses and groundwater modelling.

Session: 134 - 6

Topic: 12. Capacity building, education and outreach

Water Management and Climate Adaptation in the Vietnamese Mekong Delta

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Water Management and Climate Adaptation in the Vietnamese Mekong Delta A need for increased Science – Policy interaction Dr. Rien A. C. Dam Deltares The Netherlands The last decade the Vietnamese part of the Mekong Delta has seen a wide range of scientific research projects dealing with issues pertinent for water management and climate change adaptation. In addition to numerous internal projects, an abundance of external or imported expertise and technologies has been made available. Important progress has been made in the understanding of dynamics of the river floods, managing water resources for agriculture irrigation, aquaculture, rural and urban water supply and other important water management challenges. Increasingly, studies are conducted on the impacts of sea level rise, changing hydrological and meteorological patterns, environmental deterioration and other aspects of climate change. Ideally, the growing scientific understanding of the complex Mekong Delta environmental systems should lead to improved governmental, operational and technological management capabilities. First, an overview of the scientific landscape is presented. On the basis of a number of projects and (English language) publication records a review and analysis will be discussed on the progress of scientific research on several important topics. Next, the governmental and managerial institutions are considered, and their track record in dealing with water management and climate change adaptation challenges. It is assessed whether increased activity in and results from the scientific domain have lead to a similar increase in policy, government interventions or regulation, or responses by other stakeholders. The question is raised whether the existing governance structures in the delta provinces are sufficiently able to absorb and work with the growing levels of insight in the environmental system. On the basis of a several recently completed and ongoing projects a case is build for stronger and more comprehensive interaction between the scientific community and policy makers, government agencies and stakeholders in the region. Some characteristics for this increased and improved science - policy – practice are proposed.

Session: 134 - 7

Topic: 12. Capacity building, education and outreach

"(Wastewater) tariff models for industrial zones – conflicts of interests between ecological principles and economical feasibilities"

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Co-Authors: **Prof. Karl-Ulrich Rudolph, Prof.-Ing. Dieter Lompe**

Macroeconomic growth of regions and nations is based on the development of industrial zones due to the fact that only efficient and balanced economic structure is needed for sustainable changes (trade, employment a.s.o.). For this reason it does not astonish that "ecological principles" are subordinated "economic demands/requirements". Nevertheless it is valid to "allocate" ecological contaminations and their corresponding expenditure just and reasonable (polluter-pays-principle). In spite of such simple fact the reality line out that administration, (water-) companies, customers (industrial companies etc.) and the "environment" (e.g. represented by ministries or NGOs) stand partly diametric vis-à-vis to each other. (East) German industrial zones had faced similar challengers after the reunification in 1990. Nowadays, instead that various tariff-models based on the standards of cost and performance accounting were developed, implemented and continuously adapted, these models are confronted with "new requirements" respective trends, i.e. the request for more transparency and flexibility. Furthermore a third level of calculation is fixed by regulation-, antitrust- and competition-authorities (like OFWAT or the German Federal Cartel Office). Tariffs and their calculation are obliged to be transparent and watertight. Therefore these authorities verify these demands on international accounting standards (IFRS etc.) in combination with comparable-market-models. The current court decisions underline that pure rentability-focused-calculations are no longer sufficient. Companies are in charge to extend their external calculation more and more on liquidity-parameters like cashflow, effective interest-charge. At present more and more German water-companies implement and develop such calculation-models, which face these "three steps of verification". This experience offers emerging nations the chance to setup at an early stage transparent and flexible tariff-structures to prevent cost-intensive disputes. Thereby it counts to design tariff-models in emerging markets compatible to projected requirements and – more than ever! – practicable/feasible. For the first time an evaluation of such a tariff-model in emerging countries is part of a research project. Within the AKIZ-project – "Integrated Wastewater Concept for Industrial Zones" which is executed in Tra Noc IZ, Vietnam – a subproject deals with the challenge of setting up and implementing wastewater tariffs in industrial zones in Vietnam and elaborates some recommendations for the revision of Decree 88.

Grand Ballroom I

07.03.2013

08:00 - 09:45

Session 211 - 07. Mekong Basin aquatic ecology, biodiversity and water quality protection

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Session: 211 - 1

Topic: 07. Mekong Basin aquatic ecology, biodiversity and water quality protection

Conserving Biodiversity and Sustaining Livelihoods along the Mekong River in Luang Prabang, Xayabouri and Vientiane Provinces, Lao PDR

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The recent IUCN Indo-Burma freshwater biodiversity assessment surveyed 2,515 freshwater species in Indo-Burma and found that overall 13% of the species were threatened. The study identifies hydropower development as the main threat to freshwater biodiversity in Southeast Asia. Lack of knowledge has also been identified with 37% of freshwater species found to be data deficient and many under-surveyed locations. The section of the Mekong River between Luang Prabang and Vientiane is one of the least-studied sections of the entire Mekong mainstream. Despite ongoing hydropower development here, no detailed fauna or flora surveys have been conducted in most of this stretch of the river. Part of the area is globally recognized as an 'Important Bird Area' (IBA) and is part of a critical migration and breeding corridor for a large assemblage of migratory fish. The area also supports around 30,000 local residents, who depend directly on natural resources. In 2011 and 2012, International Union for Conservation of Nature and Natural Resources (IUCN) Lao PDR Office, along with partners (the National University of Laos (NuoL) Faculty of Science, the Lao Living Aquatic Resources Research Center (LARReC), the University of North Carolina, the University of Chiang Mai) and international consultants, organized the first ecological survey of the Mekong River between Luang Prabang and Vientiane. This was the first step of a five-year Mekong conservation project, financed by the Critical Ecosystem Partnership Fund (CEPF). The objectives of the survey were to document the diversity and richness of flora and fauna along the Mekong River and to assess the status of endemic, restricted-range and/or threatened taxa. Ecological surveys were made by boats that stopped frequently in different natural habitats along the Mekong River. The survey also included interviews with villagers and surveys in markets. The results identified 23 new records for the Lao flora, 2 new records of bird species and 7 reptile and amphibian species of national conservation significance. Spawning sites for Probarbus julliani, an endangered fish species, have been also identified. Some sites have a high level of biodiversity remaining; however, the results showed that natural habitats and wildlife populations have been heavily impacted by human activity and are threatened. The primary threats identified include overharvesting, overfishing, wildlife trafficking, and direct habitat degradation by the development of hydropower projects on the river, road development, and bench enforcement. The next phase of this five-year project will focus on conservation through a participatory approach with local communities. Main activities will endeavor to protect sites with the highest biodiversity value, along with developing and expanding community co-management of key natural resources, and raising the capacity of district and provincial government staff to manage natural resources.

Session: 211 - 2

Topic: 07. Mekong Basin aquatic ecology, biodiversity and water quality protection

Water quality in the Mekong basin – Making the case for water related ecosystem services

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Water-related ecosystem services are benefits provided by ecosystems within a basin to maintain ecosystems and human wellbeing (Smith et al., 2006). In river basins, livelihoods are often inseparably linked to the various water-related ecosystem services such as the provision of fresh water, agricultural production, hydro-electric power generation, soil formation, flow regulation, maintenance of base flows, groundwater recharge, etc. Many of these services rely on water in good quality which is mainly determined by the geology, soil type, land cover and increasingly by human activities such as excess agrichemical use, human and industrial waste water discharge, and hydropower generation. Thus, water pollution has the potential to negatively affect related ecosystem services as well as different water users at multiple spatial scales. While the water quality in the Mekong basin is generally good (Campbell, 2007; ICEM, 2010), pollution of water sources is increasing with the Lower Mekong Basin (LMB) being the most impacted area. Acidification, high organic load, low dissolved oxygen content and pollution with pesticides and microbial contaminants are – with regional differences - of increasing concern. Especially smaller canal systems are impacted, which tend to be more polluted than the mainstream while having direct relevance for the people's livelihoods and domestic water use (Sebesvari et al., 2012). Future threats are linked to dam construction, to severe and more frequently occurring droughts in the dry season which might cause low water flows in the LMB. Low water flows would exacerbate the water quality concerns while in the coastal areas sea-level rise will likely lead to salinization of soil and water resources. Given the transboundary and basin-scale nature of water quality issues, we discuss the need to focus on basin scale assessments of relevant ecosystem services and livelihood-dependencies from water-related ecosystem services. The increasing importance of impact assessments e.g. in the context of hydropower development (ICEM, 2010; Keskinen et al., 2012) opens up a window of opportunity for the increased integration of water-related ecosystem services and linked livelihood and food security aspects into future assessments.

Session: 211 - 3

Topic: 07. Mekong Basin aquatic ecology, biodiversity and water quality protection

Drinking water quality in the Mekong Delta: Pesticide and antibiotic application and resulting pollution

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In the context of the rapid development of agriculture, aquaculture and industry in the lower Mekong delta since the mid 1980s, agricultural chemicals and antibiotics have been used in increasingly large quantities, causing in many instances water pollution. As many communities and individuals still rely on untreated surface and groundwater for their daily livelihoods, this poses a potential risk for local populations. To assess this potential risk a survey was conducted on the use of different drinking water sources as well as on the application of pesticides and antibiotics in rural areas in Can Tho and An Giang provinces in 148 households between September 2011 and June 2012. In the study sites, surface water and groundwater were the main sources of water for domestic use, accounting for 68% and 51% of all water resources, respectively. Besides, some households (up to 36% in Thoi Lai- Can Tho) extracted canal water for drinking purpose. In parallel, the amount and spraying frequency of pesticides applied were different among the study sites. More than 60% of interviewed farmers applied higher amount of pesticides than the recommendation of the manufacturer. Improper pesticide storage and disposal as well as inadequate labor protection was found in almost all interviewed households. Fish pond owners used antibiotics following either instructions on labels or aquaculture extentionists. However almost none of them applied water treatment before discharge. According to a literature review and the results of the first interviews conducted between September and November 2011, 16 popularly used active ingredients of pesticides and 3 commonly used antibiotics were selected for a one-year monitoring campaign on their residue in different drinking water sources. A solid phase extraction (SPE) based multi-residue analysis method from Laabs et al (2007) [1] was modified and applied for pesticides while the analysis of the antibiotics was conducted after Golet et al (2001) [2] and Goebel et al (2005) [3] with modifications. To measure the target compounds of pesticides and antibiotics, gas chromatography/mass spectrometry (GC/MS) and liquid chromatography/tandem mass spectrometry (LC/MS/MS) were employed, respectively. Isoprothiolane, Fenobucarb, Fipronil were detected in almost all the analyzed water samples. Some of studied pesticides were detected in piped-, bottled-, rain-, and groundwater as well. As a first assessment of the potential risk of pesticide residues on human health, the benchmark from the drinking water guideline of European Communities for total pesticide occurrence (0,5 µg/L) [4] was used for comparison purposes. More than 90% of the collected samples exceeded this threshold. There are no established guidelines for the thresholds of antibiotic concentration in drinking water so far.

Session: 211 - 4

Topic: 07. Mekong Basin aquatic ecology, biodiversity and water quality protection

Water Quality issuse related to special industrial zones along the Hlaing River

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Myanmar has abundant water resources both surface water and groundwater. Conservation of water resources is one of the substitutable manner for our country. In this paper, water quality of Hlaing River is monitored and assessed for spatial variation. This river is located western part of Yangon city which is a commercial city and former capital of Myanmar. The river is largely used for constant disposal of effluents from industrial zones. This study involved collection of water quality data from seven locations along the river and all the contributing drains as well. These samples were analyzed for a variety of physical,chemical and biological quality parameters.

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Topic: 07. Mekong Basin aquatic ecology, biodiversity and water quality protection

Managing acidic pollution in a coastal area in Mekong River Delta, Vietnam: Case study of Bac Lieu province

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A roving monitoring of pH and salinity in canal network in Bac Lieu province, Camau peninsula in the Mekong River Delta from 2001-2006 indicates dredging canal caused a severe acidic pollution in canals at the beginning of rainy season. To minimize the acidic pollution impacts in the coastal area, a mathematical model of acidic water propagation had been constructed to simulate water flow, salinity and acidity in canal network based on VRSAP (Vietnam River Systems And Plains) model. Lateral acidic flows along canal at different spoil types (years after dredging and amount of total acidity in spoil) was monitored on field in 2004. The reduction of acidity in saline water was investigated in laboratory in 2005 and repeatedly studied in 2010-2011. The acidic water model was calibrated and validated with measured data in 2003 and 2005, respectively. As a decision support tool, the model has been applied for identifying options of managing water quality in the study area such as: (i) recommending location and quantity of canals for annual dredging to minimize the acidic pollution; (ii) finding suitable daily sluice operation for intake of sea water to reduce acidity in canal system at the beginning of rainy season and (iii) combining canal widening with sluice operation for harmonic management of acidity and salinity propagation in canal system.

Session: 211 - 6

Topic: 07. Mekong Basin aquatic ecology, biodiversity and water quality protection

Faecal contamination in the Nam Khan River (Lao P.D.R.): observations and modeling

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Measurements of Escherichia coli (E. coli) concentration were carried out in the Nam Khan river system (North Laos), from headwaters to the main branch of the river, under contrasted hydrological conditions over the wet and dry seasons of year 2011. The results show the control of E. coli contamination by both land use (dependent on the size of a soil surface E. coli stock produced by human and livestock excretion) and hydrology (dependent on the proportion of overland flow in the river discharge). Direct point source contamination is of minor importance in this rural watershed, but the levels reached by high discharge are worrying. The E. coli module of the SENEQUE/Riverstrahler model has been adapted to the context of the Nam Khan river, and validated with the available observations. Future scenarios of fecal contamination of the Nam Khan river are explored by the model taking into account demographical trends and possible technical options for wastewater management.

Session: 211 - 7

Topic: 07. Mekong Basin aquatic ecology, biodiversity and water quality protection

Rivers and Myanmar peoples: effective water governance in the making

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Ayeyarwaddy is more than a river in Myanmar. Myanmar peoples regard and adore Ayeyarwaddy in countless ways such as mother Ayeyarwaddy who provides food, energy, and life supports; inseparable part of Myanmar culture, tradition and music; a national symbol and pride; inspiration for creation of art and literature, etc. Hence the motto is “Ayeyarwaddy is Myanmar: Myanmar is Ayeyarwaddy”. Ayeyarwaddy river is about 2170 km long. It is the most important commercial waterway. Although the Ayeyarwaddy enjoys the top status, the other major rivers such as Chindwin, Kaladan, Leimyo, Mu, Thanlwin, Zawgyi, Panglaung, Myitnge, Dotehtawaddy, Mayu, Attaran, Gyaing, Sittoung, Yangon, Myitthar, Bago, Ngawun, Hlaing, Shweli, and numerous small rivers together contribute to the fresh water wealth of Myanmar. In an average year, 860,000 million cubic meters of water is discharged by all the rivers of Myanmar into the sea. At present Myanmar is undergoing an unprecedented political, social and economic reforms. Green Economy and Green Growth became new national development policy. The new investment law being enacted. H.E. Current President of the Republic of the Union of Myanmar promoted the “Clean Government and Good Governance” approach. Water sector is part and parcel of it. Hence the serious promotion of effective water governance in Myanmar occurs. As a matter of fact, water resources of Myanmar are the vital natural capital for water-energy-food security in Myanmar. Water sharing can be a source of conflicts (or) collaboration. Law and institutions create legally enforceable expectations (water rights) to ensure the fair collaboration. Equitable sharing of water resources would lead to trust building and peace building among all ethnic nationalities of Myanmar. “Water” is a medium for “Peace”. Climate change impact should also be eased by best practices of mitigation and adaptation methods through IWRM. Water governance is defined by UNDP in 2005 as “the broad range of political, social, environmental, economic and administrative systems that are in place to regulate the development and management of water resources and provision of water services at different levels of society”. The Ayeyarwaddy River Basin Research Organization (ARBRO) was established in mid 2012, with the recommendation from the Ministry of Transport, to share knowledge and build capacity for IWRM. Currently Myanmar is drafting a water law. Myanmar Water Partnership is made up of all water-related departments and line agencies under government Ministries, Technological Universities, water related NGOs and research organizations in Myanmar. Since all walks of life are involved in shaping of the Good/Effective Water Governance in Myanmar, it is fair to say that “Rivers and Myanmar peoples are inseparable and good/effective water governance is in the making”. This presentation shares the ups and downs of our journey towards effective water governance in Myanmar and the way forward.

Grand Ballroom I

07.03.2013

10:15 - 12:00

Session 212 - 07. Mekong Basin aquatic ecology, biodiversity and water quality protection

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Topic: 07. Mekong Basin aquatic ecology, biodiversity and water quality protection

Arsenic groundwater contamination in the upper delta plain, Mekong River Delta, Vietnam

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Arsenic contaminated groundwater in the upper delta plain of Mekong River Delta and its effect to community health has been studied. Results recorded by Arsenic Test (Hironaka- 1998) method in fieldwork and High Resolution Coupled Plasma Mass Spectometry with a detection limit for As of ~0.1 µg/l in Analysis service center in Ho Chi Minh City, Vietnam (AOAC in laboratory- TCVN 6626-2000 Vilas). Concentration of arsenic from 460 private tubewells of 15- 90 m deep ranged from 15 to 1,650 µg/l. High content of arsenic are usually found in 15-70 m depth wells, almost located in the areas of the upper delta plain around the Mekong and Bassac rivers. Some areas with a high density of 70-80 % tubewells have arsenic levels of >500 µg/l located in Dong Thap and An Giang provinces (Nguyen et al., 2006). Almost groundwater from 200 and 300 m depth is save or very low As level. In generally, high As contaminated area usually concentrate in Mekong and Bassac riparian area and channel bars. Low levels have been documented in the remainder. This regional pattern would be related partly to age of sediments and the Holocene sea-level rise. Holocene alluvial and deltaic deposits generally contain groundwater elevated in arsenic; while concentrations are very rarely elevated in Pleistocene deposits (>50 ky.BP). This is indicated by the very high fraction of wells deeper than 120m containing

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Topic: 07. Mekong Basin aquatic ecology, biodiversity and water quality protection

Comparison of toxicity tests in terms of detoxification success control

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Today in Vietnam several industrial companies dispose their wastewater after insufficient treatment or even without treatment. Wastewater from certain industrial branches can contain toxic environmental chemicals (pesticides, heavy metals, pharmaceuticals, etc.) and thus be harmful to the environment. Some substances can be responsible for severe diseases. With high toxicities even little dilutions of this wastewater can interfere with biological treatment steps of central wastewater treatment plants (WWTPs). On behalf of the German-Vietnamese AKIZ subproject 2 in Can Tho, Vietnam, under tropical conditions decentralized detoxification methods for toxic industrial wastewater are being implemented. This study compares three of standardized toxicity tests to help decision makers choosing a good method in order to assess the success control of detoxification methods. Following three tests were investigated:

• Nitrification inhibition test (NIT) (ISO 9509): Activated sludge with nitrifying organisms from local WWTPs is exposed to the tested water in different dilutions for 4 hours at 22 °C in the dark. Subsequently, nitrate and nitrite are determined as indicator for nitrifying activation.

• Oxygen consumption inhibition test (OIT) (ISO 8192): After 30 minutes of activated sludge from local WWTPs exposed to the tested water in different dilutions, the oxygen consumption rate is determined. With double effort the distinction between heterotrophic and nitrifying organisms is possible.

• Luminescent bacteria test (LBT) (ISO 11348): Enriched luminescent bacteria Vibrio fischeri is exposed to the tested water in different dilutions for 30 minutes at 15 °C in a thermostat. Subsequently, the decrease of light emission of the bacteria is determined. The bacteria can be stored at -18 °C. Complete test systems can be purchased from international distributors. All three tests were applied to original wastewater from a Vietnamese pesticide company. Furthermore, the sensitivity of these test systems was examined based on pesticides enriched pure water. For more than two months the LBT has been implemented in Can Tho to analyze the success of performed detoxification methods. When pretreated wastewater is given to a centralized bio-mechanical WWTP, it is reasonable to examine the toxicity using the OIT and NIT. Here, original bacteria from biological reactors are used. On the other hand, today there is still a lack of well functioning WWTPs in Vietnam providing usable sludge. The LBT does not use activated sludge, but very sensitive bacteria. In addition, its results were highly reproducible. On-site from a well-trained technician 6–10 determinations per day were possible. Heterotrophic bacteria are way less sensitive compared to autotrophic nitrifying bacteria. Luminescent bacteria turned out to be at least as sensitive as nitrifying bacteria. Furthermore, different treatment methods could lead to different inhibition reactions.

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Topic: 07. Mekong Basin aquatic ecology, biodiversity and water quality protection

Motivating self-contained shrimp farming to redue risk, evironmental protection and sustainable development of the shrimp farming in the costal zone in the Mekong Delta, Vietnam. Case study in Dam Doi – Ca Mau Province

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Brackish water shrimp farming concentrated mostly in the southern coastal provinces, accounting for 87% of brackish water shrimp farming area of the country. Forms of popular culture is scale farms, with an average of 3-5 ha / farm. So far, the shrimp farms have contributed greatly to facilitate the reorganization of agricultural labor of 30 million, bringing the number of workers in aquaculture sector to 2 million in 2010, bringing many farmers out of povery, some become rich, earning millions, or billions Dong / year ... However, with the rapid development, the brackish water shrimp farms are facing many difficulties, restrictions and increasing challenges, especially environmental issues - one of four important factors determined the success of shrimp farming, those are food, seed, technique and environment. This paper presents the results of research carried out on the closed shrimp farming in Dam Doi - Ca Mau, the advantages of self-contained shrimp farming model in order to reduce risks, ensure environmental protection and sustainable development of brackish water shrimp farming in the Mekong Delta.

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Topic: 07. Mekong Basin aquatic ecology, biodiversity and water quality protection

Water quality issues of aquaculture development in the Mekong Delta: an analysis

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Water quality in the Mekong delta is facing with numerous pollutant sources such as urban/industrial, agriculture, and aquaculture wastewater. According to the aquaculture development plan in the Mekong delta, Striped Catfish (Pangasianodon hypophthalmus) areas will increase from 8,000 hectares in 2010 to 13,000 in 2020, this will significantly impacts on water quality of the Mekong delta since about 2% of the Mekong river water passes through the pangasius ponds. Surface water resources in the Mekong delta is not only directly used but also played as receiving water bodies for aquaculture activities. To develop a sustainable Catfish plan, two aspects must be considered: (1) Is water quality in the future good enough for Catfish framing? (2) Is the river capacity able to receive wastewater from Catfish activities (together with other sources)? The paper will present these issues based on an analysis of pollutant sources in the Mekong delta as well as results of water quality modeling using the MIKE 21/3 software (with Ecolab module). The Mekong Rivers crossing An Giang province are chosen for this analysis. Wastewater from catfish framing as well as other sources (urban/industrial, agriculture) are considered as input data in other to assess water quality capacity of the system. The results showed that given the high purification capacity of the Mekong river, the system may be able to receive wastewater from catfish activities however improving wastewater treatment of point sources (urban/industrial), as well as proper waste (sludge) management of pangasius farming is required.

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Topic: 07. Mekong Basin aquatic ecology, biodiversity and water quality protection

Survey on the presence of Mercuric compounds in the Tien River

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Tien river is one of two main streams in Lower Mekong river basin in Vietnam. Tuan el al. (2005) reported that rivers in Mekong delta was contaminated with untreated wastes which come from urban, industry, fishery and agriculture activities. This paper aimed to survey the presence of mercuric compounds contamination of mercury compounds in the sediment, suspended particulate matters (SPM), water and some fish species of of Tien river. In the first survey, 16 water samples and sediments were taken along the Tien River from Hong Ngu (near Campodia boundary) to Cua Tieu estury in 2010. Seven sampling sites in the brackish water zone within 50 km far from the estuary Cua Tieu in the second and the third surveys in April 2011 and May 2012. Water and sediment quality at the sampling sites were determined. The sediments were taken at the top layer of the river bed. Mercury content of sediments and benthic fishes living at the studied area were estimated. The concentrations of mercury species including dissolved and particulate Hg, monomethyl Hg were analyzed using ICP-MS at the laboratory of Gwangu Institute for Science and Technology (GIST). The result shown that total Hg in unfiltered water ranged from 0.43 to 44 ng/L. These values are less than the allowable limit of Vietnamese surface water quality standards (1 µg/L). There was a strong correlation between total Hg (r^2 =0.9, n=24) to particulate Hg in the body water. The surveys shown that dissolve and particulate Hg concentrations in the brackish water was higher than those in the freshwater. Similarly, MMHg concentration of sediments in the brackish water were little higher than those in the fresh water. This may be due to contribution of particulate Hg into the brackish water. In fact, the total suspended solids (TSS) in the brackish water was higher than those in the freshwater zone. TSS in the brackish water zone ranged from 82 to 522 mg/L, whereas TSS in the fresh water zone fluctuated from 8-40 mg/L. The average total Hg of the sediments was 0.38±0.19 nmol/g. A positive correlation between organic carbon (TOC) of sediment and total Hg of the sediment was found (r^2=0.62, n=24). TOC and nitrogen of sediments in the fresh water were higher than those in the brackish water. This may due to attribution of discharge of wastewater containing big amount of organic sediments from big cities located in the freshwater zone. The total Hg content of 20 fish muscle samples catched in the brackish zone ranged from 29 to 1172 ng/gram of the muscle. The average total Hg content of the fish samples was 230 ng/g, whereas MMHg content was 79% total Hg. The highest mercury contents (330-1172 ng/g) were found in the muscle of two benthic fishes (Cephalocassis borneensis and Glossogobius sparsipapillus).

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Topic: 07. Mekong Basin aquatic ecology, biodiversity and water quality protection

The two faces of ecological sustainability

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Why and how does ecological sustainability matter? It is meanwhile well known that not-sustainable water management and utilization practices lead to an erosion of water-related eco-system-services and thus constitutes a threat future natural and societal development capacities. Consequently, ecological sustainability matters, but needed policies and investments are often replaced by short-term profit making goals (in the sense of a 'moral hazard'). Long-term negative economic impacts of a not-sustainable resource management are tentatively ignored as they don´t take place immediately and therefore remain somewhat abstract. Now, the question of how ecological sustainability matters was studied in the case of the Vietnamese tra catfish sector, which has the potential to become a long-term driver of rural development and economic growth in the Mekong Delta. However, at least since 2010 its sustainability is scientifically discussed and politically interpreted. Accordingly, LITTLE ET AL. speak about a "whitefish war" (2012), where meaningful interpretations are primarily made to protect markets and maintain economic hegemony. During the last decade, international requirements regarding tra catfish product as well as production quality gradually increased. These put the export production ar high risk. Therefore, an initiated transformation of the tra catfish sector aims to comply with the new requirements and thus improve its image. To date it is not clear whether this transformation will be sufficient for maintaining the Vietnamese catfish´s market share. The example of the Vietnamese tra catfish case indicates that in a globalized world, characterized by market interdependencies, water quality protection in the sense of ecological sustainability gets a new significance. It is not only the ecology that might negatively impact on eco- or production services, but it is the globally created image of sustainability which is meaningfully interpreted to govern markets and thus impacts on local economies that heavily rely on exports. The example of the Vietnamese tra catfish case represents an interesting and useful 'lesson learnt', which is of high relevance for the Greater Mekong Sub-region, where countries are looking forward to play out their growth potential.

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Topic: 07. Mekong Basin aquatic ecology, biodiversity and water quality protection

Database Supports the Mekong Fish Network

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The Mekong River is the most productive inland fishery in the world, a natural system that provides food and livelihoods for over 60 million people. Rapid infrastructure development and the impacts of climate change are expected to alter the river's productivity. Substantial data regarding the capture and use of fish from the Lower Mekong Basin exist, yet limited data have been synthesized for trend analysis at a basin-wide scale. Programs aimed at establishing standard sampling methods, synthesizing data from across the Lower Mekong Basin, and enabling knowledge transfer among researchers in different nations have previously shown limited success. The U. S. Geological Survey (USGS) and FISHBIO are collaborating to develop a network to support sound scientific and technical cooperation, with an emphasis on data collection pertaining to Mekong fish diversity, fisheries sustainability, and food security. Expected near-term benefits of the Mekong Fish Network are based on the outcomes from a consultation workshop held with Mekong-based researchers and resource managers in February of 2012. These benefits include the establishment of standardized sampling protocols and the capture of standard data in a common database. The database has been established and is currently being refined to provide a tool for data management, allowing users to upload their data to a web-based platform, or to enter it directly online with full control over sharing preferences. Encouraged by discussions among stakeholders about the Network's potential utility, USGS and FISHBIO expect to develop additional tools in 2013 to facilitate communication and to foster research that enables long-term trend analysis for this transnational river.

Grand Ballroom I

07.03.2013

13:30 - 15:15

Session 213 - 08. Tonle Sap Lake: ecology, biodiversity and rural livelihoods

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Topic: 08. Tonle Sap Lake: ecology, biodiversity and rural livelihoods

Results of a Hydrographic Survey of the Confluence of the Mekong, Tonle Sap, and Bassac Rivers, Phnom Penh, Cambodia

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Co-Authors: **Mr. Richard C. Wilson, Mr. Benjamin J. Dietsch**

The confluence of the Mekong, Tonle Sap, and Bassac Rivers is a critical junction, and it has a profound effect on the hydrology, economics, transportation, and food production in Southeast Asia. The confluence of the rivers is known as Chaktomuk, or “four faces,” and is located in Phnom Penh, Cambodia. The U.S. Geological Survey conducted a hydrographic survey of the Chaktomuk junction in cooperation with the U.S. State Department, the Mekong River Commission, the Autonomous Port of Phnom Penh, and the government of Cambodia. The hydrographic survey was conducted with a high-resolution Reson Seabat 7125 multibeam echosounder, which mapped the entire riverbed of the study area. Exact positioning and elevation was provided through the use of a real-time kinematic global positioning system, while an Applanix Position and Orientation System for Marine Vessels (POS-MV) unit provided motion correction. The Port Authority UNICEF boat was modified and equipped with the echosounder system. Initial results of the survey show the effects of sand dredging and land reclamation activities. This data set will serve as a baseline to evaluate the geomorphic evolution of the Chaktomuk junction.

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Topic: 08. Tonle Sap Lake: ecology, biodiversity and rural livelihoods

The flood pulse as the underlying driver of vegetation in the Tonle Sap

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The Tonle Sap in Cambodia is the largest lake and most important fishery in the Mekong Basin. The flood pulse from the Mekong River inundates the floodplain every year, shaping a mosaic of natural and agricultural habitats that sustain the primary production of this ecosystem. Considering the imminent changes that will occur in the basin as a response to water infrastructure development and the changing climate, it is crucial to quantify and understand the interaction between the hydrology and the vegetation of this floodplain. Therefore, the main objective of this study was to identify the drivers of observed vegetation patterns in the Tonle Sap floodplain. Variables (33) describing multiple aspects of the hydrology, soils, human use, vegetation structure, and plant species composition were investigated at 77 locations along eight 5-15 km transects around the lake. As expected, strong correlations among hydrological indicators were found, the strongest being between maximum water level and average annual flood duration ($r^2 = 0.88$). Flood duration was highly correlated ($r^2 = 0.73$) with the largest principal component of 16 floodplain soil attributes. A multivariate linear analysis of the measured data suggested that flood duration and soil properties play a significant role in determining canopy height, canopy cover and vegetation aboveground biomass. However, most of the responses of vegetation follow unimodal trends along the flooding gradient. Vegetation structure characteristics were also influenced by fire and human use. Two Eigenvalue-based ordination techniques were applied to a presence/absence dataset with 89 plant species and it was found that the variation in plant species composition follow gradients of flooding and biological characteristics. The strong link found between hydrology and vegetation characteristics implies that changes to the current flood regime could significantly modify this unique floodplain ecosystem.

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Topic: 08. Tonle Sap Lake: ecology, biodiversity and rural livelihoods

Connecting livelihoods with water resources: natural resource use zones in the floodplains of Tonle Sap Lake

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Water-related impact assessments require integration of various data, information and methods. Spatial and statistical methods can facilitate data integration and improve the use of analysis results. We present a 'spatio-statistical analysis' of livelihoods in 1555 villages of the Tonle Sap Lake and its floodplains. We used two key governmental socio-economic databases (Population Census 1998 and 2008) allowing exploration of the present situation as well as rudimentary trend analysis between 1998 and 2008: first ever done in the Tonle Sap. The study contributed to an 'Exploring Tonle Sap Futures' study that forms part of a regional research project (http://www.csiro.au/science/MekongFutures) that looks at the water-food-energy nexus at different levels. We found statistically significant linkages between physical location and socio-economical profiles of the villages, enabling examination of the spatial connections between hydrology, natural resources and livelihoods. Building on our previous research in the Tonle Sap [1,2], we divided the area into three zones based on topography and urbanization. Villages located 0-6 meters above sea level formed 'Fishing Zone', while villages located between 6 meter and national roads (with 3 km buffer) formed 'Agricultural Zone'. Finally, Urban Zone consisted of villages classified as urban in the 2008 Census. The three 'resource use zones' were further divided into 18 sub-zones, based on the administrative borders of the six Tonle Sap provinces. Our results indicate the three zones being considerably different. The Urban Zone had more diverse and less natural resources dependent livelihood base, while the people in the Fishing Zone were in opposite situation: they have generally less assets, have fewer livelihood options, and depend strongly on common property resources such as fish and wetlands. Notably, the livelihood structure in the whole area also remained relatively stable between 1998 and 2008, with agriculture being undoubtedly the most important livelihood. Remarkable is also the dominance of youth: the age groups between 15-19 years and 20-24 years are by far the biggest in the area. This 'youth surge' is thus just entering the work force, providing both opportunity and challenge for the development of the area. Our analysis provides several interesting methodological indications. The inclusion of provincial borders to complement 'spatial zones' enabled more detailed analysis, created connection with administration, and facilitated the communication of analysis results to governmental decision makers. Further, the inclusion of a separate Urban Zone enabled us to study the differences between rural and urban areas. Spatial analysis and especially the resulted 'datamaps' enabled us to present a detailed picture on the current state and changes, while keeping the message comprehensible and visually inspiring – thus providing a good base for scenario building and impact assessment [3].

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Topic: 08. Tonle Sap Lake: ecology, biodiversity and rural livelihoods

Tonle Sap Great Lake and Observed Fishery Issues: Reviewing and Comparing Relevant Literature

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This article examines the present degradation of fishery resources in the Tonle Sap Great Lake in Cambodia. The paper is structured into two main parts. First is the review on the related literature to understand the status of fishery resources and efforts made by the government of Cambodia in solving conflicts over the use of resources. Second is a comparative analysis on similarity and dissimilarity of scientific assessments of fishery resources with the government's five year fishery progress report and the 2002 independent study by group of local and international researchers initiated by Environmental Justice Foundation (EJF). Reviewing existing literature reveals that the resource status is critical and at a cross-roads for both conversation and development. Besides acknowledging the rich diversity, Tonle Sap Great Lake has faced several issues including conflicts between communities and fishing licenses, overfishing, pollution and destruction of flooded forests, population growth, weak enforcement of regulations, erosion and sedimentation, and infrastructure development. Responses from the government range from the formulation of policies and programs to implementation such as establishing community fisheries. However, problems persist and solutions require collective effort by the government as well as civil society and donors to help improve the management of resources and living standards of fishermen. In conclusion, the comparison discovers more similarities than dissimilarities among the papers reviewed. Fishery issues and responses are evident in the reviewed papers. Suggestions for improved fishery management around the Lake are summarized at the end of this article.

Session: 213 - 5

Topic: 08. Tonle Sap Lake: ecology, biodiversity and rural livelihoods

Assessment the ecosystems in the Tonle Sap Lake, Cambodia, using RadarSat-2 Wide Fine data

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The Tonle Sap Lake located in Cambodia is the largest freshwater lake in Southeast Asia, which has a large ecological, economical, and socio-cultural value. In recent years the ecosystems of the Tonle Sap Lake and its surrounding area have been affected not only by climate-change, but also by an increase in human activity on the lake. Synthetic aperture radar (SAR) have a large potential to access the ecosystems of this great lake. As SAR data enables weather- and cloud independent observations, it is especially suitable in this area of common cloud cover especially in the rainy season. However, the large area of the Tonle Sap leads to the difficult of collecting the high resolution SAR data covering the whole region at the same time. Recently, the RadarSat-2 new mode SAR data (Wide Fine mode) with a scene size of 170×150km and a resolution of 8m could overcome the above problems and could be better used in the study of Tonle Sap's ecosystems. In this paper, RadarSat-2 Wide Fine mode data with dual-polarization (HH, HV) were acquired to study the ecosystems of Tonle Sap Lake. The multiple parameters derived from the dual-polarization SAR data were used to the land cover classification after compensating the backscattering shift caused by the variation of the incidence angle. The distribution characteristics of the typical classes in Tonle Sap were discussed, such as the flooded and not flooded forests, shrubs and grasses, agricultures, artificial objects, and so on. The results provide valuable information, which is needed for the long-term conservation of natural resources of the Tonle Sap Lake.

Session: 213 - 6

Topic: 08. Tonle Sap Lake: ecology, biodiversity and rural livelihoods

Very small floating structure in Prek Toal core area of Tonle Sap biosphere reserve

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Prek Toal is one of the core areas of Tonle Sap Biosphere Reserve. Environmental problems in PreakToal is caused by local people activities such as unmanaged solid waste disposal, untreated wastewater discharge from latrine and household consumption, flooded forest degradation due to high demand of fuel wood which then results in water bird's habitat lose and lose of biodiversity in the lake. Human, in another view, also bear reversed negative impacts such as health problem, income generation reduction owing to reduction of natural resources, especially fishery resources, in addition to high expenditure on house repairing or rebuild, low life quality, etc. Besides lots of measures initiated by various stakeholders, the Very Small Floating Structure (VSFS) should be the additional promising option. This proposed project aims to introduce new concept or enhance the existing environmental and social improvement projects to rehabilitate both socio-economic and environmental condition in the Tonle Sap Lake. VSFS is a floating structure in which houses could be built on. This structure will be made of long-term floating foundation, equipped with those available energy systems: biogas and solar energy, with hygienic latrine, and with water purification system. In addition, some basic service such as waste collection will be also introduced. Every unit of VSFS includes a basic floating structure, on which 1, 2, or 4 houses (maximum) can be built, connected to mooring system, and equips with several important systems: a water purification system, hygienic larine, a biogas system, and a solar energy system, which could be used for lighting and running TV or radio. All these system are already used in most of the communities in Cambodia, while there are very few are introduced to the floating communities. Hence, we expect that it will not a big problem to introduce these into the VSFS. Through this project the environmental problems and some socio-economic problem, which has and will be happened, including water pollution; unmanaged disposed solid waste, human and animal waste; high cost of rebuilt the house; and flooded degradation and wildlife habitat destruction will be improved and rehabilitated.

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Topic: 08. Tonle Sap Lake: ecology, biodiversity and rural livelihoods

Trans-boundary Fish Trade in the Lower Mekong Basin: Impacts on Fisheries and Rural Employment in Cambodia, Lao PDR and Thailand

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A sizeable fish trade occurs between Cambodia, Lao PDR, and Thailand, supporting many rural livelihoods. The majority of fish in this area are caught in Cambodia or on the Southern Lao border, and then shipped via three major trade routes to Pakse and Vientiane in Lao PDR. The fish stock is severely threatened by irresponsible fishing methods; pollution from unregulated chemical use; rising demand; and development in the region. Dams on the Mekong and its tributaries could devastate migratory fish populations (Mekong River Comission (MRC) Technical Report #10, 14). Threats to the fishery are well-documented, but, prior to this study, no data had been collected on the contribution of the fish trade to employment and income in the study area. Researchers from Cambodia, Lao PDR, and Thailand investigated the fish trade along one of three major trans-boundary routes of in the region—between Stung Treng, Cambodia; Champassak, Lao PDR; and, Ubon Ratchathani, Thailand—and attempted to quantify its multiplied effect on livelihood and employment by determining how much income the fish trade contributes to actors at each point of the fish trade commodity chain: fishers, traders, and exporters. Researchers gathered data through informant interviews with key stakeholders and households involved in the trade; focus group discussions with local authorities and officers; and in-depth observation made possible by long-term familiarity with the community and its members (in Thailand). Study results reveal that the size of the fish trade in this area has been previously underestimated, or has grown in recent years, compared to a baseline established by Phonvisay and Bush (2001) that concluded that 86,800 kg/year of fish were exported from northern Cambodia to Lao PDR—the present study estimates that trade to be 530,710 kg/year. The results also show that the fish trade represents a significant source of employment for the rural poor, providing 23% of household income for 2,750 Cambodian fisher households, and 70% of household income for 3,273 Lao fisher households, and further income to dozens of fish farmers and traders in both countries. Major changes to the path of the trade route were identified, with increased trade to Vientiane due to road improvements, and the end of official trade from Lao PDR to Thailand. The fish trade is not well-regulated or standardized among the three countries, leading to trade inefficiencies, unfair practices, and a lack of a coordinated response to difficulties or environmental threats. Key policy recommendations formulated as a result of this study include: the establishment, clear communication, and enforcement of regulations regarding fish catch and conservation zones; cross-boundary policy coordination; and inclusion of income from the fish trade in cost-benefit analysis of potential development projects, especially dams.

Grand Ballroom II

07.03.2013

08:00 - 09:45

Session 221 - 09. Mekong Delta: Climate change related challenges

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Topic: 09. Mekong Delta: Climate change related challenges

The Mekong Delta: a giant with feet of clay?

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The Mekong (Cuu Long) Delta is one of the most fertile regions of Vietnam which has seen tremendous development in the recent past (Renaud and Kuenzer, 2012). Agricultural production has increased rapidly thanks in part to the development of infrastructure making it a critical region for rice, vegetable, fruit and aquaculture production. In addition urbanisation is proceeding rapidly, in particular but not only in Can Tho City (Garschagen et al., 2011). However, the delta remains extremely vulnerable to changes brought about by human activity and by global environmental change, including climate change. These threats come from (i) upstream where activities from Mekong riparian countries could alter the flow of the river affecting the hydrology, sedimentation processes, nutrient transport as well as the status of the aquatic ecosystems (ICEM, 2010); and (ii) coastal areas where sea-level rise is predicted to inundate large portions of the delta and impact ecosystems and agricultural production via salinization of water resources much further inland. The delta is therefore "sandwiched" between two (potentially) major threats but processes within the delta itself contribute to its vulnerability to a large extent: examples include the development of infrastructure which alter the natural flow of surface water; overexploitation of natural resources; intensification of agriculture and industrialisation with little control over pollution resulting in contaminated freshwater resources; and the rapid development of aquaculture including shrimp farming which also pollutes the environment. These changes could mean that the function of ecosystems and the services they provide could collapse in the future, endangering the livelihoods of the ca. 18 million inhabitants in the delta. These threats above could be overcome through adaptive resource management by learning from what has already happened in the delta and in other deltaic regions of the world. We discuss whether or not the "all engineering" solutions to control floods or sea-level rise are truly the best option or if encouraging different, more resilient land use systems, or ecosystem-based solutions to disaster risk reduction (see Renaud et al., in press) are not viable alternatives for the Mekong Delta. It is likely that the intensification of rice production, which has shown its limits in some areas in terms of (i) production potential, (ii) pollution engendered while attempting to keep high productivity (Sebesvari et al., 2011 & 2012), (iii) secondary impacts of infrastructure designed to increase productivity (Hoang et al., 2009; Birkmann et al., 2012), and (iv) poverty alleviation (Stewart and Coclanis, 2011) needs to be revisited and other, more diverse production systems envisaged through a participatory approach as an alternative to pursuing the same development processes as has been done in the last decades, at the risk of seeing a collapse of the social-ecological system in the future.

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Topic: 09. Mekong Delta: Climate change related challenges

Widespread erosion of the Mekong delta shoreline: from progradation to destruction phase?

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The world's river deltas are threatened by hydroelectric dam constructions, embankments, channelling of flow, and aggregate extraction. These anthropogenic activities outweigh the effects of climate change and sea-level rise in causing delta vulnerability(1), and will exacerbate the impacts to be expected from these effects(2). We show here from satellite image analysis and field work that the Mekong delta is now in a phase of vulnerability. Orthorectified high-resolution (2.5 m) SPOT 5 images of the delta concerning the years 2003, 2007, and 2011/12, were analysed using DSAS 4.3 coupled with ArcGis software(3). The images show that the delta shoreline has retreated at an overall rate of over 8 m a year. 75% of the delta shoreline is now actively retreating at rates that exceed 50 m a year in its western part. The river-mouth sector, dominated by sandy beach ridges, maintains a semblance of stability, albeit with marked local sediment redistributions that indicate sediment budget stress. Field verifications highlight beach-ridge shoreline retreat rates of up to 3 m a year between the various distributary mouths. A similar comparison of earlier Landsat images of 1985 and 2005 confirms this rampant erosion. We attribute this erosion to significant perturbation of the deltaic sediment budget generated by aggregate extraction from the beds of the channels of the Lower Mekong and by dams in the upper reaches. Aggregate extraction is presently practised on a very large scale. The pressures on the sediment budget of the Mekong delta are also set to increase as all the six countries sharing the basin move forward towards achievement of their hydropower and water management needs through the planned cascade of several large dams. Large-scale hydropower dam development on the Lower Mekong mainstream in the coming years will therefore have cumulative negative effects with those of aggregate extraction on the Mekong delta. These effects are similar to those affecting other Asian mega-deltas, which have been eroding, deprived of much needed sediment that not only has to balance the effects of sinking due to compaction, but also sediment redistribution by waves and currents in a context of sea-level rise(4). The Mekong delta is now on the world list of mega-deltas at risk. References 1Ericson, J.P. et al., 2006. Effective sea-level rise and deltas: Causes of change and human dimension implications. Global and Planetary Change 50, 63-82. 2Syvitski, J.P.M. et al., 2009. Nature Geoscience 2, 681–686. 3Thieler, E.R. et al., 2009. Digital Shoreline Analysis System (DSAS) version 4.0 - An ArcGIS extension for calculating shoreline change. U.S. Geological Survey Open-File Report 2008-1278. 4Wang, H. et al., 2011. Recent changes of sediment flux to the western Pacific Ocean from major rivers in East and Southeast Asia. Earth-Science Reviews 108, 80-100.

Session: 221 - 3

Topic: 09. Mekong Delta: Climate change related challenges

How to protect 30 million people in the Mekong Delta against increasing flood risk?

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The results of MRC's basin wide scenario assessments and the SEA of mainstream dams have provoked major discussions on the impact of proposed mainstream dams and the associated knowledge gaps. Other results of the scenario assessments have received less attention, such as the forecast increase in flooding problems on the floodplains in the Mekong Delta during the next 50 years, due to the combined impact of climate change and floodplain development in the Mekong Basin. The Mekong Delta comprises two very distinct parts: the densely populated and highly developed Viet Nam Delta and the largely undeveloped Cambodian floodplain. The development of floodplains in the Mekong Basin for urbanization, agriculture and other land uses will reduce the area available for natural flood storage and attenuation. This could result in large environmental and economic losses in the densely populated Mekong Delta. The feasible options to protect an increasingly affluent population of over 30 million against large floods are limited as well as controversial. Options to store or divert sufficient flood volumes in the Mekong Delta are not available. Dams, either under construction or planned in China, Lao PDR and Cambodia have limited flood storage capacity and will have limited flood management capability. The scenario assessments show that a much wider evaluation of flood plain options is needed to take into account the threat of climate change and the potential social and economic consequences that arise. Whilst these threats are clearly evident for Viet Nam, the assessments emphasise the inter-dependence of potential solutions between Viet Nam and Cambodia. In addition, the scenario assessments show that Cambodia has a number of additional major issues to address, particularly with regard to impacts on the Tonle Sap from upstream flow modifications and the barrier effects of new dam construction. To address these issues in an integrated manner, further studies are required to investigate long term flood management options in the context of both climate change and emerging strategies for upstream development as well as to explore the potential for synergies between the two. A major multi-sector study of long-term flood management options has been prioritized as part of the IWRM-based Basin Development Strategy. This study, which has just commenced, has the support of several programmes within the Mekong River Commission. It will take a holistic approach and consider all plausible structural and non-structural options throughout the Mekong Basin for flood management and mitigation. The key questions to be addressed are: 1) What is the long term strategy (50-100 years) for managing the flood plain, and how should this guide actions over the next 20 years, and 2) How much of the natural flood plain needs to be preserved and where best would that be?

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Topic: 09. Mekong Delta: Climate change related challenges

Water to Change - A vision from the physical to socio-economic aspects

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The paper is to present the new research strategies to support sustainable development of the Vietnamese Mekong Delta (VMD), especially in the context of the real-world dynamics. The research was first triggered by focusing firmly on the flood dynamics in the VMD to study the hydrological changes in the area with relatively little attention given to evaluate the potential and actual vulnerability of local residents and other water governance aspects. In other words, the socio-economic aspects of the flood issues were not studied in details. However, the obtained results briefly presented the vulnerability of the VMD according to flood (changes), which provided the decision makers at the provincial level a warning related to water (changes) issues. Such the deltaic scale research still had limitations (i.e. too coarse) and did not present sufficient information to understand the impacts of climate change and other socio-economic development in situ. Regional hydrodynamic models were developed (e.g. for the Long Xuyen Quadrangle, Soc Trang and Tra Vinh province), based on the deltaic model, to take into account the relevant hydraulic and hydrologic components in the area. In addition, socio-economic perspectives were also taken into account to improve the water governance in each selected region. This is a relatively new approach to integrate local and scientific knowledge.

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Topic: 09. Mekong Delta: Climate change related challenges

Future flood hazard under climate change in the Mekong Delta – a variability based approach avoiding model chains

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The main characteristic of flood hazard estimations is the association of a probability of occurrence to a flood event of a defined magnitude. This is usually performed via frequency analysis assuming stationarity and independence of the analyzed time series. This assumption, however, often does not hold true even for historical records and periods and it will be even more challenged under the expected impact of climate change on the water cycle in general, and flood probabilities and magnitudes in particular. Thus strategies and methods have to be developed and evaluated for accounting for climate change impacts on flood hazard. In the proposed work the flood hazard in the Mekong Delta, one of the most endangered areas by climate change on earth, is estimated for the present and future horizons. The methodology for estimating the flood probabilities in future builds on the detected correlation of the variability of the North-Western Pacific monsoon index and the variability of the annual maximum discharge of the Mekong at Kratie, the upstream boundary of the Mekong Delta (Delgado et al., 2011). We use the sub-decadal variability of the monsoon index to directly quantify the scale parameter of a non-stationary extreme value distribution function, which is a measure of the variability of flood discharges. By this linear relationship of variances the future flood hazard can be estimated directly from Global Circulation Models, using more reliably simulated wind speeds instead of precipitation. The proposed approach also avoids the usual model chain GCM – RCM – bias correction of RCM rainfall simulation – hydrological model – fit of extreme value distribution. Besides the obvious reduction in modeling efforts the method also reduces the uncertainty sources in the prediction of future flood frequencies considerably. In order to derive estimates of future flood hazard in the Lower Mekong Basin, 15 Global Circulation Models and several scenarios from the ENSEMBLES project were used. In a first step the models were tested for their ability to simulate the observed monsoon variability in the 20th century, which lead to an exclusion of some less skillful GCMs in this respect. From the remaining models future monsoon intensities can be calculated, from which ensembles of flood probabilities of different magnitudes in the Mekong Delta can be estimated for any future horizon. The results of this method were further transformed into flood hydrographs, from which probabilistic flood hazard maps for the Mekong Delta were derived by a hydrodynamic model (Dung et al., 2011) exemplarily for the year 2050.

Session: 221 - 6

Topic: 09. Mekong Delta: Climate change related challenges

Mekong delta of Vietnam is one of the three most damage delta of the world by climate change

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The increasing of air temperature; the change of local hydrology regime; the salinity intrusion; the extreme weather happen more frequently and the river bank erosion are the main phenomenon of climate change in Mekong delta of Vietnam. To make the local climate change resilience activities plan to be feasibility and suitable to local condition and have no regrets, the local knowledge and determination are the most important element. This report to introduce how does the Cantho government to combine local knowledge and the choices of scientist to the climate change resilience plan to mainstream the climate change resilience plan to the socio-economic development plan of Cantho city. We hope to show the lesson learned from the climate change adaptation in Cantho city's practice as an experience for another local of Mekong delta and the rest of south East Asia.

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Topic: 09. Mekong Delta: Climate change related challenges

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Climate scenarios are useful in characterizing future climate risks. However, most projected climate scenarios are at the national, regional and global levels which are too coarse and have to be downscaled for more precise planning and impact assessment purposes. Livelihood opportunities ideally should shield the farmers from climate risks but this depends on their ability to adjust to the changing climate conditions.

This paper presents the downscaled climate scenarios for two major rice producing provinces in Lao PDR and the Philippines for the years 2020, 2050 and 2080 and the potential impacts of changing climate on food security and the livelihood of small-scale farmers in three ecozones. The food security and sustainable livelihood frameworks (FAO 2008 and DFID 2002) were used to derive recommendations that can guide local policy actions towards climate compatible development.

The study focused on rice. Data on rice production practices and farmers' livelihood sources were collected through FGD, and interview with rice farmers. Daily weather data (rainfall and temperature) from 1971 to 2000 were collected from the national weather bureau. Statistical downscaling technique using Coupled Global Climate Model (CGCM3) and the IPCC's A1B scenario were used in generating the climate scenarios. Potential impacts of climate scenarios on rice yields were determined using Decision Support System for Agrotechnology Transfer (DSSAT) on crop simulation. In this model, the generated daily weather data, physiochemical properties of soil, rice crop management practices and genetic coefficients of standard rice crop variety were integrated to simulate the growth and development of the rice crop.

Results show that the changes in rainfall and temperature have significant effects on rice yield but the effects differ depending on location, ecozone and cropping season. In the Philippines, projected temperature will slightly increase in both provinces but projected increases in rainfall is higher in Tarlac (80%) in 2050 and 2080, but slightly lower 27% in Pangasinan during the same period. The combined effects of rainfall and temperature increase will result in lower rice yield in Tarlac but higher yield in Pangasinan. The decline in yield is higher in the rainfed upland of Tarlac but the same ecozone will get the highest yield increase in Pangasinan.

In Lao PDR, there is no significant increase in temperature between 2012 and 2080 but there will be significant increase in rainfall in the two provinces during the same period. There will be a potential increase in rice yield in the irrigated lowlands of Luang Prabang while in Savannakhet, yield in irrigated lowland will decrease in 2020 but increase in 2050 and 2080. Livelihood sources should shift from farm to non-farm to mitigate climate change impacts.

This study shows the importance of downscaled climate scenario in assessing climate change impact and in identifying appropriate response actions.

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Topic: 09. Mekong Delta: Climate change related challenges

Shrimp Farming Vulnerabilities and Adaptation to Climate Change in Ca Mau Province, Vietnam

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Shrimp farming production comprises more than one-third of GDP in Ca Mau Province and sustains livelihoods for hundreds of thousands of inhabitants. Recently, Ca Mau was ranked as one of the most vulnerable provinces in Vietnam to climate change in the aquaculture sector and shrimp farming. This research aims to discover potential impacts on shrimp farming, and the vulnerabilities, and adaptation of shrimp farmers to climate change. It will mainly focus on shrimp farmer households involved in extensive, improved extensive, semi-intensive, and intensive shrimp farming systems in the coastal area. The findings from the study will provide a detailed understanding of climate change risks, vulnerability, and adaptation in shrimp farming and contribute to a sustainable livelihood framework for local shrimp farmers in the region in the context of climate change impacts.

Grand Ballroom II

07.03.2013

10:15 - 12:00

Session 222 - 09. Mekong Delta: Climate change related challenges

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Session: 222 - 1

Topic: 09. Mekong Delta: Climate change related challenges

Land use, land cover changes in the Mekong Delta, Vietnam

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In the aspect of climate change, the Mekong Delta, Vietnam is one of the most influenced regions in the world under the effects of global warming. Such effects include ocean warming, a rise in sea level, heat waves and periods of unusually warm weather, intense precipitations, typhoons, high tides and storm surges. These are expressed in intensive flooding at coastal zones and inland, salinity intrusion, coastal erosion, and degradation of biodiversity. In addition, the impacts of climate change are enhanced drastically by human activities in a feed-back process. In this overall context, this report focuses on quantifying the changes in land use, land cover, in coastline, river bank, dyke and canal network, in water level, in flood extent and duration, and in cultural practices; investigating the causes and effects of the observed changes by analyzing the relationships among the changes by using remote sensing and in-situ data such as biodiversity, salt intrusion, water quality, crop rotations, climate, and together with socio-economic data. The report will focus on the two selected sites. One is at coastal area (from Soc Trang to Ca Mau province) and the other is the inland wetland area (Tam Nong- Dong Thap province). The former is characterized by mangroves, aqua cultural activities, and coastal erosion; dominantly affected by sea tides and occasional tropical typhoons. The latter is featured as part of the Plain of Reeds, which is a vast wetland extending from Cambodia, subjected to seasonal flooding; originally this wetland had high biodiversity, covered by Melaleuca forests and seasonally inundated grassland and was converted into agricultural land. The remote sensing data is significant to provide both large view on the Mekong Delta and high resolution observations in the regions where significant impacts of global change are being observed. Sources of remote sensing data dating back from 1973s were used to quantify the changes. Possible factors related to climate changes and vice versa are analyzed along with changes of land cover and cultivation patterns via human activities. The analyses in this report were based on analyses of the studies on agricultural activities, land cover changes, coastal erosion, climate, and floods. In addition, various information sources and secondary data from other studies were also taken as extra evidences.

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Topic: 09. Mekong Delta: Climate change related challenges

GNSS-R based water level monitoring - Preliminary results

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Due to climate changing conditions and an increase in population, severe changes in the Mekong delta in Vietnam have been recorded in the last years: extreme flood events occur more frequently, drinking water availability is decreasing, soils show signs of salinization or acidification. Therefore, an optimized and integrated resource management is needed. For this purpose hydrologic, hydraulic, ecologic and sociologic data must be available. The goal of the German-Vietnamese Water Related Information System for the Sustainable Development of the Mekong delta (WISDOM) project is to build up an information system to support the system's end-user in planning and decision making. Conventional radar and laser altimeters provide high altimetric accuracy but with insufficient spatial and temporal resolution. Ground based instrumentation, like e.g., pressure or laser gauges, offers a high temporal resolution only for a local point. Since earth-reflected L-band signals from the Global Navigation Satellite System (GNSS) satellites show a high reflectivity on water and ice surfaces or wet soil, GNSS-Refelctometry (GNSS-R) could contribute to monitor the water level on the Mekong delta and be used as a possible complement, supporting already existing monitoring networks. Two different GNSS-R altimetry methods exist: the code based and the carrier phase based altimetry. Theoretically, the latter one is more accurate. With the aim to give a well-founded response to this question, a new generation of GORS (GNSS Occultation, Reflectometry and Scatterometry) JAVAD GNSS receiver has been developed. This receiver permits the parallel recording of the in- and quadrature-phase component of the reflected and direct signal respectively. Therefor it enables the analysis of phase observable. Within the WISDOM project, we conducted a two week lasting campaign in Can Tho City, Vietnam in 2012. Several reflection events on the 150m large Mekong Delta river have been recorded using two antennae. During the first week, the antennae were placed 10m above the reflecting surface while during the second week they were installed 20m above the reflecting surface. This contribution will present the first evaluation of the adapted and extended functionality of the dual front-end GORS JAVAD GNSS receiver. First results in cycle slip detection and in the reconstruction of disturbed phase observations will be discussed. Finally, the possibility of using GNSS-R for water level monitoring within the WISDOM project is illustrated.

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Topic: 09. Mekong Delta: Climate change related challenges

Geomorphology, coastal evolution and shoreline changes in the Mekong River Delta, Vietnam

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The study emphasizes on geomorphology, coastal evolution of the Mekong River Delta (MRD) for the last 3 ka, particularly, shoreline changes for the last 100 years. Based on the changes of morpho-sedimentary map and detailed investigations of deltaic facies in the boring cores, depositional facies and delta evolution patterns are recognized for the last 3 ky, a tide- and wave-dominated delta at the active delta plain and a tide- dominated delta at Ca Mau deltaic margin. (1) The tide- and wave-dominated delta has occurred at the active delta plain of which shoreline is over 300 km long. The tide- and wave-dominated delta is characterized by well-known developed beach-ridge system on the subaerial delta plain (Ta et al. 2005). In the last 50 years, deposited coasts are usually located around the active river mouths with its rate of 15-20 m/y, meanwhile coastal erosion has been occurred severely at the south side of distributaries with its rate of 10-15 m/y, particularly, up to 30-40m/y in Ben Tre and Tra Vinh provinces. (2) The tide- dominated delta has been occurred at the Ca Mau deltaic margin, southwest part of the MRD. It is characterized by well-developed mangrove marsh on the subaerial delta plain. Sediment supply is almost fine materials such as silt and clay are mainly transported south-westward from the Mekong River mouth due to northeast monsoon activities and deposited in the distal delta of Ca Mau deltaic margin (Ta et al. 2005). But since the last 100 years, source of supply sediments to the western coast has been supplemented from eroded materials at the eastern coast. On the basic of topographic maps, satellite images and field measurements, shoreline changes are estimated in the last 100 years. At Ganh Hao area of the eastern coast, erosion rate is more severe with average of 30-50 m/y. In the western coast, the Ca Mau cap is well-known as a rapid deposition shoreline. Its rate is approximately of 50-80 m/y, some places are up to 100 m/y. This phenomenon is evidently driven by deposition of material discharged by the Mekong river system as well as by material derived from coastal erosion in eastern areas. Moreover, there is a great subtidal mud flat well developed around the Ca Mau cap, about 18 km long with 530 km2 in area. Above-mentioned data indicate that the change in shoreline of the MRD seems to be effected more strongly by monsoonal activity in the recent years as a consequence of global warming, climate change and human activities.

Session: 222 - 4

Topic: 09. Mekong Delta: Climate change related challenges

Developing a vulnerability-based approach to the evaluation of climate change adaptation options in the Mekong Delta and beyond

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Adaptation to climate change has been recognized as major challenge to the Mekong Delta both by science and practice. Recent literature and the public discourse in the field of development and sustainability have demonstrated the growing debate on possible adaptation strategies, but strategic, multi-dimensional approaches to the evaluation of different adaptation options are still rare. The presented study builds on the understanding that going beyond mere cost-benefit analysis and including aspects of, e.g., culture and social equity is crucial in order to assure successful adaptation in the long term. It builds - empirically and conceptually - on research in the field of vulnerability in rural, urban and peri-urban contexts and presents a comprehensive approach to the evaluation of adaptation to water-related hazards in the Mekong Delta. Through a structured review of the literature on adaptation evaluation the need for integrated frameworks became evident as most studies still focus on single aspects of adaptation and often neglect the assessment of existing vulnerabilities and second-order impacts of adaptation. This approach thus integrates different stakeholder views and is considerate of multiple dimensions. The perception of adaptation processes and impacts as well as their value to different actors are looked at by displaying the underlying preferences and priorities. It consequently allows an appreciation of decision-making processes and a better comprehension of choices for or against specific strategies. This concept demands more than a single methodological paradigm which is why qualitative, participatory and quantitative methods were applied complementarily. Analysis of the field research data underlines the broad variety of coping and adaptation measures in varied vulnerability contexts. To date, the implementation of a measure is rarely consulted with the affected population which lowers the overall acceptance of planned adaptation that can lead up to intentional mistreatment of installed structures for individual benefit. Power asymmetries play, in this context, a considerable role and often determine the prospects of success of the respective strategies. Based on the importance assigned to various quality criteria for evaluation, different measures are prioritized by different groups which affects adaptation decision-making. While the empirical work has focused on the Mekong Delta, the conceptual framework is transferable to other areas within the larger context. It contributes to a better comprehension of adaptation patterns across different stakeholder and vulnerability groups. Portraying the divergent evaluation can foster more justice in climate change adaptation and strengthen the acceptance and successfulness of planned adaptation measures and potential development pathways. This is why this novel approach with its remaining limits and further research needs can be of great value to climate change adaptation.

Session: 222 - 5

Topic: 09. Mekong Delta: Climate change related challenges

Erosion protection through bamboo breakwaters: climate change adaptation in the Mekong Delta

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The coastline of the Vietnamese Mekong Delta is influenced by the discharge regime of the Mekong River, the tidal regime and wave climate of the East Sea and long shore currents resulting from the prevailing Monsoon winds. This leads to a dynamic process of accretion and erosion. Mangrove forests, which mainly grow in a narrow belt along the coast line, reduce the wave energy and protect the dyke and hence residential and economic areas in the hinterland from erosion and flooding. However, this protection belt is endangered by unsustainable resource use, expansion of aquaculture and climate change impacts such as the increasing frequency and intensity of storms, floods and sea level rise. In places, over 30 meters of land are eroded per year, making the regeneration of protecting mangroves impossible without measures which reduce the wave energy. Attenuation of wave energy, which is a prerequisite for mangrove regeneration, can be achieved through the installation of breakwaters which reduce the wave heights and thus erosion while at the same time stimulating sedimentation. The most effective breakwater design was identified by testing different shapes, placements and materials through numerical and physical modelling. Field measurements were carried out to understand the morphodynamic processes and verify the numerical model. T-shaped bamboo breakwaters were found to be the most effective measure due to the bamboo's flexibility and strength as well as the wide and local availability and low costs. In order to avoid downdrift erosion, breakwaters have to be placed in such a way that they do not alter the prevailing currents. This was achieved by connecting eroded gaps between head-lands through T-shaped bamboo fences and thus recreating the original coast line. Once sufficient sedimentation has occurred between the breakwaters and the dyke, mangrove forests can be regenerated to ensure long term coastal protection. 4,500 meters of T-shaped bamboo breakwaters were installed in severe erosion sites along the east coast of the Mekong Delta in Bac Lieu and Soc Trang provinces. All measures are closely and continuously monitored. This will also provide knowledge on coastal protection through erosion barriers and mangrove regeneration for future optimisation. Monitoring results show that the Bamboo breakwaters have a significant effect on the reduction of wave heights and increased sediment accumulation.

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Topic: 09. Mekong Delta: Climate change related challenges

Communicating water-related climate change risks to improve local adaptation in the Deltas of the Mekong Region ((SUMERNET AN-13)

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The densely settled, low-lying coastal and delta areas of the Mekong region are among the most vulnerable areas to climate change in the world. Extreme floods pose the greatest threat as human settlements and infrastructure continues tot into high risk locations. To contribute to sustainable development of delta communities in the Mekong region, it is important that those working to support vulnerable communities have the tools to effectively communicate. The "Communicating Water-Related Climate Change Risks to Improve Local Adaptation in the Deltas of the Mekong Region" project, funded by Sumernet, is working to identify effective ways to improve and share understanding of water-related climate change risks and uncertainties among local stakeholders. The goals of this research are 1) To understand how different stakeholders (including, officials, researchers and students, farmers and fishermen) perceive types, levels and sources of water-related climate change risks and uncertainties; 2) To develop effective communication models on water-related climate change risks with participation of local stakeholders in order to promote shared learning and strengthen local adaptation capacity; and 3) To facilitate sharing good practices and experience in climate change risk communication and advocate for replication of the communication models to delta communities in the Mekong region. To understand perceptions of farmers to water-related climate risks, a survey of over 600 people has been conducted in six communities along the Mekong in Viet Nam, Cambodia and Thailand. The survey was complemented by semi-structured interviews with government officials, media representatives, researchers, and farmers. These interviews explored in more depth perceptions of water-related risks and investigated how different communication tools are currently being used and their relative effectiveness. Several communication models were developed – short video clip, SMS message set and 'talking Farmer' – and piloted in three communities. The development and testing of models was guided by multi-stakeholder Risk Communication Working Groups formed in each location. A post-intervention survey will be conducted in November 2012 to assess the effectiveness of the different risk communication models. The project aims to use the knowledge gained to develop better models for communicating water-related climate change risks among national and local stakeholders in the Mekong region.

Session: 222 - 7

Topic: 09. Mekong Delta: Climate change related challenges

Community-based for water salinity measurement at the Mekong delta, Vietnam

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The Mekong Delta of Vietnam contains more than 18 million inhabitants within approximately 4 million hectares of extremely low-lying land, mainly at elevations less than 2 meters above mean sea level. The Mekong Delta is one of the megadeltas worldwide that have been identified as highly vulnerable to the impacts of climate changes and sea level rise. With the changes in precipitation, increasing water demand for development of upper parts in the Mekong river basin, as well as increasing rates of sea-level rise that are predicted to occur in climate change models, salinity levels in the Mekong Delta are likely to increase, with salinity intrusion moving further inland.
Frequently updated or near real-time salinity data are of great interest to the communities in the Mekong Delta of Vietnam. Salinity data are important for managing rice farming, aquacultures, horticultures, cash crops, freshwater fisheries and also drinking water of the communities in rural areas of the Mekong Delta.
Since 2011, a salinity monitoring project was initiated by a group of scientists of Cantho University, Vietnam (CTU) and Geological Survey of United States (USGS), using a participant network of university students, women, farmer, teachers and students of local schools, extension workers throughout the provinces of the Mekong delta to measure salinity by simple and inexpensive equipment.
The salinity were measured on a regular basis at specific location by participants in rural communities. Then the measurement values were sent to CTU though a cell phone by text message and incorporated into a database through an automated process. Up to date, the monitoring network has about 200 participants and the network addressing up to 1,000 individuals in the salt water intrusion areas of nine provinces of the Mekong delta.
Different landcovers in a recent satelite image were identified as sampling locations. Each sampling location was associated with one or several participants in geographic coordinates. Commercial application programming interface was used to develop an application to receive and relay text messages into an SQL server database. The sampling locations and associated salinity data was displayed on an interactive, user-friendly web mapping application developed using ArcGIS server software and Google Maps, with new data continually added on a daily or weekly basis.
The up-to-date raw salinity data, time series charts, and salinity contour (isohaline) maps will be available to anyone else with an internet connection. With time, the collected data will be integrated and an early warning text message will be sent to the participant network through an automated process.

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Topic: 09. Mekong Delta: Climate change related challenges

Mekong Delta Transport Infrastructure Development Project (MDTIDP)

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The MDTIDP has been kicked off in January 2010 and is meant to support the economic development and to reduce poverty in the Mekong Delta (surface area comparable to the Netherlands). To achieve this goal, the MDTIDP will improve the supply chain efficiency for production and domestic/international trade in the region. It will relieve bottlenecks on the main supply chains/shipping corridors and better link the poor communities to that supply chain. In the Mekong Delta, these supply chains consist mainly of roads, waterways and their related infrastructures, exposing the benefits of efficient multi-modal transport and logistics services. MDTIDP is the first multi-modal transport project in the Vietnam Mekong Delta. The safety and traffic carrying capacity of two main inland waterways routes, namely the Northern Trans Mekong corridor and the Southern Coastal corridor connecting the Mekong Delta to Ho Chi Minh City are being enhanced. These trunks will be upgraded to so-called Class III standard waterways catering for vessels/barges convoys up to 1,000 DWT. The first northern corridor covers water transport from Ha Tien/Rach Gia area through Triton Canal via the Bassac/Mekong river towards Can Tho, through Nguyen Van Tiep canal, My Tho, Vam Co river system to reach HCMC. The second corridor runs from Ca Mau through Bac Lieu to the Bassac/Mekong rivers to My Tho or Can Tho, through Vam Co river to reach HCMC. The waterways in the Mekong region have great potential for water transport with 700 km of coastal line and 28,000 km of canals of which 13,000 km is navigable, accounting for 70% of inland waterways nationwide. The project is executed under the PMU-SIW in HCMC, under the aegis of the VIWA of the Ministry of Transport and co-funded by the World Bank. Royal HaskoningDHV is in charge of execution of Phase 1 designs (done before 2010 by other consultants) and the Phase 2 works (designs, BoQ, cost estimates, tender documents in 2011 by Royal HaskoningDHV). The works included dredging of 250 km waterways, bridges, ship lock, bank revetment and installation of navigational aids for 24 hrs navigation along the 250 km project stretch. The special geomorphology and water/sediment/environmental features of the Mekong Delta canals system are such that the multiple use of more inland waterways may be the only promising and most cost-effective way to satisfy the long-term needs for increased transport of export-oriented bulk goods and commodities in southern Vietnam. The project will serve as a demonstration of how multi-modal transport projects can be developed. Bibliography: Loan Agreement World Bank & Government of Vietnam (2007); Contract DHV with PMU-SIW (2009); Feasibility Study Mekong Transport Infrastructure Development Project (MTIDP, 2006).

Grand Ballroom II

07.03.2013

13:30 - 15:15

Session 223 - 09. Mekong Delta: Climate change related challenges

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Topic: 09. Mekong Delta: Climate change related challenges

Sustainable management of water resources to adapt to climate change and rising sea water in the Cuu Long River Delta

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Cuu Long River Delta (CLRD), situated on the lower Mekong River Basin (MRB), is a particularly important area for the socio-economic development of Vietnam and the region. However, the CLRD is easily being affected by the development in the upstream region. Current strong economic growth in countries in the region leads to an increased need in food and energy, which ramps up competition and threats to the security of water resources in the region. In addition, climate change (CC) is predicted to threaten the security of water resources and be a possible cause of increased drought, flooding and landslide. In this context, orientation for the development and sustainable management of the water resources in the CLRD is a vital need for Vietnam.. With the effort to safeguard the security of water resources and to ensure a harmonious benefit between the nations sharing the water resource, the International Mekong River Committee has recently issued a number of orientation documents on the development of the basin based on an integrated water resources management (IWRM) principle1). In these documents, IWRM is considered as one of the development principles in the basin and a key for sustainable and fair development goals within the MRB in general and in the lower Mekong River in particular. In this shared effort, Vietnam is gradually developing and improving institution and legal regulations to meet the urgent need on CC and SLR adaptation in Vietnam in general and in the CLMD in particular2,3,4,5). Being aware of the importance and challenges that CC and SLR might bring about for the water resources in the CLRD, Vietnam puts forward a number of focus tasks to effectively implement the sustainable water resources management in the CLRD, with an aim to “strengthen IWRM in the CLRD to adapt with CC and SLR while ensuring the sustainable development of the socio-economy and environment protection, harmonizing the benefits among water users in the area, and strengthening the international collaboration in the management of the natural resources between countries in the MRB”.

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Topic: 09. Mekong Delta: Climate change related challenges

Re-building resilience of coastal aquaculture: enabling drivers to promote landscape integrated aquaculture systems.

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Coastal zones are complex ecosystems, where local livelihoods are dependent on natural resources and exposed to natural hazards. In recent decades, rapid expansion of shrimp farming in the Mekong Delta has changed the landscape, and modified natural resources use and local livelihoods and altered resilience of the coastal zone .Future climate change in the coastal zone of the Mekong Delta will add another type of challenge to the shrimp producers in the coastal zone. Sea level rise, increased temperature in the dry season and reduced rainfall will modify the pond environment and therefore influence farm productivity. Increasing numbers of extreme weather patterns and storms may create other hazards. Each production system, from intensive to integrated mangrove –shrimp farming has different degrees of tolerance of such environmental changes. Our hypothesis is that integrated landscape systems are more resilient than intensive and specialized production systems and can help to rebuild resilience of the coastal zone by maintaining or restoring the ecosystem's capacity to resist shocks and stress. Our study summarizes recent findings from the RESCOPAR project regarding the role of integrated systems in disease management, the access to certification and markets, and the importance of the regulatory framework to support such production systems. Those findings on constraining and enabling factors for integrated mangrove shrimp system development where then discussed and weighted during expert consultations to understand farmers decision making and ultimately identify drivers that influence shrimp producers to opt for more resilient aquaculture systems. Recent research in pond management and disease outbreaks show that disease outbreaks are related to climate variations and that integrated mangrove shrimp systems can reduce the vulnerability of the shrimp to those changes. The transmission of White Spot Syndrome Virus (WSSV) infection on extensive shrimp farms appeared mainly due to the recycling of WSSV over time in the same pond, whereas in semi-intensive shrimp farms transmission of WSSV was mainly from neighbouring ponds resulting in different risk management strategies for the farmers. Access to higher market prices through certified organic shrimp is an enabling factor for mangrove shrimp farming development. However, non-transparent transaction cost along the value chain reduces the benefits that producers capture.The regulatory framework for mangrove exploitation limits the incentive to develop landscape integrated production system, due to non-transparent payments or regulations constraining forest management. Our research shows that development of more resilient coastal aquaculture is possible but will require adaptation of the regulatory framework, and contractual relationships along the value chain to drive farmer's choices towards more sustainable production systems contributing to the restoration of the coastal ecosystem's resilience.

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Topic: 09. Mekong Delta: Climate change related challenges

Impact of Sea Level Rise on submergence, salinity and agricultural production in a coastal province of the Mekong River Delta, Vietnam

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Bac Lieu province is a low lying coastal province in Camau peninsular (CMP), the southern tip of the Mekong River Delta (MRD) of Vietnam. Submergence and salinity have strong influence on agri- and aquaculture production in the province. These stresses can aggravate under the expected sea level rise (SLR). This study aimed at quantifying the impact of different SLR scenarios (SLR = 12, 17, 30, 50 or 75 cm) on the two said stresses and to propose adaptive options to mitigate their impacts. The "Vietnam River Systems and Plains" (VRSAP) model was used for simulation of water and salinity in canal networks in CMP for 03 hydrological years of low, average and high water. The model was validated in the baseline year 2008 of which topographical data, water use and sluice operation were inputted and were used for all scenarios. The effect of SLR was taken into account in the model by increasing water levels in the coastal boundary stations along the CMP by the same amount as the SLR. Under present sea level, the risk of submergence is highest in October and in the western parts of the province, with the canal water level used to higher the soil surface and there was no possibility of gravity drainage. In dry season, salinity was high in the western part where farmers grow brackish water shrimp. Salinity was kept low (< 2 g L-1) in rice production area in the eastern part of study area, thanks to the salinity control structures installed in the study area. For scenarios of SLRs < 30 cm, the risk of submergence increased, water in the canal raised an amount equal to the SLR. On the other hands, salinity level in the study area decreased slightly. In general, the hydrology of the study area can still be managed by the existing water management structures, with some increase in the height of dykes surrounding fields to reduce submergence risk in western parts of the study area. New rice varieties, with enhanced submergence tolerance, are needed for the rainy season, especially in the western parts of the province. For scenarios SLR > 30 cm, the submergence risk aggravate with water level in the canal rise almost at the same level as the SLR. Maximum salinity in the rice growing area (eastern parts) also increased by ~ 4 g L-1. Rice varieties with enhanced submergence tolerance (for rainy season) and enhance salinity tolerance (dry season) are needed. Changes in water management structures and their management are needed to cope with the aggravated submergence and salinity.

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Topic: 09. Mekong Delta: Climate change related challenges

Effect of sea dyke (barrage) project at Rach Gia Bay – Kien Giang province on water supply and flood control of the Long Xuyen quadrangle Mekong Delta, Vietnam

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According to a recent World Bank study, Vietnam ranks among the top five developing countries most impacted by climate change, especially due to sea level rise. Within Vietnam, the Mekong Delta in the south of the country has been identified as being particularly susceptible to the impacts of extreme climate events and climate variability, two extreme weather conditions – draught and flood – have occurred much more often. Faced with these challenges, the government of Vietnam has an idea of constructing a sea dyke (barrage) at Rach Gia Bay – Kien Giang province to create fresh water supply reservoirs. It is now at the research stage. MIKE Flood (MIKE 11- 1D & MIKE 21 – 2D) has been used to simulate different scenarios. The paper presents the different options of the sea dyke, their effects on water supply in the dry season and on flood control in the rainy season for the Long Xuyen quadrangle in the Mekong Delta. The results show that the created reservoir can supply up to 4.8 billion m3 fresh water, which has great significance in the dry season. But the dyke and the structures do not help much in food control, only reduces the flood peak at the sea, near the dyke, but not in the flood plain itself.

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Topic: 09. Mekong Delta: Climate change related challenges

Study on coastal protection and production functions of mangrove vegetation in Thanh Phu Natural Reserve, Mekong Delta, Vietnam

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Mangroves are widely distributed along the coastline of Viet Nam, where they provide several functions such as protection against sea waves caused by storms and tsunamis, giving a huge production etc. However, population growth and economic development in these coastal zones is threatening this important natural service. Impacts of climate change, through sea level rise and changes in precipitation patterns and monsoon cycles are expected to exert further pressure on these vulnerable systems. In this study the numerical wave propagation model SWAN was used to simulate the possible impacts of climate change on the wave dissipation capacity of different types of mangrove vegetation. Through assessment of forest structure (tree density, diameter, height, root structure), biomass of mangrove plantations in the Thanh Phu Natural Reserve was analyzed in correlation with diameter at breast height (DBH). Vegetation characteristics were assessed in planted plots and in natural regenerated areas (A. alba and S. caseolaris) in the study area and used as model input. Different sea levels (4.1-5.06 m) and coastal erosion (width of the mangrove vegetation from 1.5-0.5 km) were used to simulate the impacts of climate change. Planted plots with a cover of 70% reduced the height of incoming waves by 55% (0.9 to 0.4 m), compared with 44% (0.9 to 0.5 m) for natural forest. This is attributed to the difference in root structure between Rhizophora (stilt roots) and Avicennia and Sonneratia (pneumatophores). Using the planted plots a sea level rise with up to 0.96 m did not change the wave dissipation potential of Rhizophora. However, an assumed reduction in the width of the Rhizophora vegetation from 1.5 to 0.5 km, as a consequence of coastal erosion, reduced the height of incoming waves with 17% (0.9 to 0.75 m), irrespective of sea level. There is regression between tree density and DBH, of the vegetation in the study area. To derive an allometric relation to estimate aboveground biomass, we harvested 32 trees covering all ages to examine allometric relations. In each stand, 3 to 4 trees were chosen randomly and harvested at ground level. We measured the fresh and dried weight of stems (WS), branches (W¬B), leaves (WL), and above ground still root (WR) in situ. The allometric relationship was satisfied best when only DBH was used as an independent variable with the correlation is very high r2=0.72 to 0.97 of leaf, branch, stilt root, stem and total above ground biomass and the 95% confidence band . The total aboveground biomass was estimated in the respective plantations to be more than 76 to over 319 t/ha. Of this, more than 50% of total aboveground biomass was represented by stems. The estimated biomass value of this study is consisted with that value of other mangroves in the world. Total biomass of R. apiculata plantation in Thanh Phu Natural Reserve accounted for about 170,000 ton dried weight or 78,056 ton C.

Session: 223 - 6

Topic: 09. Mekong Delta: Climate change related challenges

Development of the Mekong Delta under Uncertainties and a Robust Decision Making Approach

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Sustainable development of the Mekong delta is suffering short-term and long-term threats, which are of high level of complexity and uncertainty, and driven by internal- and external factors. The uncertainties of climate changes/sea level rise and also of anthropogenic activities, responds and conflicts within- and ouside of the Mekong delta will be unpredictable. Conventional decision making process has been mostly scenario-based, which are built on historical data/knowledgebase plus futuric predictions for a limited time frame. Besides, current technical interventions have to follow existing national norms and legal frameworks that are so complicated to be replaced in a foreseen period. However, we have to decide as soon as possible for a strategy for an unpredicted future. The paper wil discuss about decision making process in context of such complexities and uncertainties so that the interventions could be optimized.

Session: 223 - 7

Topic: 09. Mekong Delta: Climate change related challenges

High-resolution climate information for Southeast Asia for climate impact modelers

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Climate change and climate variability are main drivers for land–use, especially for regions dominated by agriculture. Within the framework of the project Land–Use and Climate Change Interactions in Central Vietnam (LUCCi) regional climate simulations are performed for Southeast Asia in order to estimate future agricultural productivity and to derive adaptive land–use strategies for the future. To achieve the goals of this project reliable high resolution climate information for the region is required. Therefore, the regional non-hydrostatic Weather Research and Forecasting (WRF) model is used to dynamically downscale large-scale coupled atmosphere–ocean general circulation model (AOGCM) information. WRF has been driven by the ECHAM5-GCM data and the scenario A1B for the period 1960-2050. The focus of this paper is on the setup of WRF for East Asia. Prior to running the long-term climate simulation in operational mode, experimental simulations using different physical parameterizations have been conducted and analyzed. Different datasets have been used to drive the WRF model and to validate the model results. For the evaluation of the parameterization combination special emphasis is given to the representation of the spatial patterns of rainfall and temperature. The expected climate change signal is derived and the spatially-explicit information from the high resolution climate simulations will be presented and discussed. Special emphasis wwill be given to expected frequency changes of meteorological extremes.

Phu Quoc Room

07.03.2013

08:00 - 09:45

Session 231 - 11. Collaboration platforms in basin management: Information Systems and Spatial Infrastructures

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Session: 231 - 1

Topic: 11. Collaboration platforms in basin management: Information Systems and Spatial Infrastructures

Research of LANCANG River Basin Data Information Sharing System

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Focus on the development of database and data sharing system in Lancang River Basin (Upper reaches of Mekong River), a synthetic database system was developed for the river basin management. The main datasets including water resources and development, landcover change, ecological system change, disaster distribution, human activity influence on forest change, etc. Metadata system, simply called 'data about data', and the key technology of information sharing, was used for database development. Based upon the contrast of the national and international metadata standards, it points out that sharing data is the prerequisite and there are drawbacks in traditional data sharing mode. It is necessary to set up sharing mechanism of data management on the basis of metadata and dataset. We adopt three levels of metadata management Metadata Section, Metadata Entity and Metadata Element. We established the metadata standard template, including Identification Information, Data Quality Information, Spatial Reference Information, Content Information, Distribution Information and Metadata Information sharing system of Digital LANCANG River Basin. The core is metadata management system of the metadata information sharing system and the base is to establish the metadata standard of the metadata management. We set up different metadata warehouse of different metadata management system. Then we defined the metadata views to carry out the interface between other information sharing system and users. The metadata information sharing system has characteristics of distributed data organizing and management, distributed data sharing, distributed fast data index and data accessing between multi-operating systems. Through the construction of the integrated management information system of LANCANG River Basin, the data resources among different departments was shared effectively, and the historical data scattered in various sectors were integrated.

Session: 231 - 2

Topic: 11. Collaboration platforms in basin management: Information Systems and Spatial Infrastructures

The Semantic Description for Water Related Information System for Mekong Delta, Vietnam

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The German-Vietnamese Water-Related Information System for Mekong Delta (WISDOM) project (www.wisdom.eoc.dlr.de) is a multidisciplinary project associated with the principle of IWRM (Integrated Water Resources Management) which is defined as “a process, which promotes the coordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems” (http://www.gwp.org/). The project focuses on development and implementation of an innovative water-related information system (IS) containing all the outcomes and results of the different research disciplines involved in the project. The WISDOM IS is a web based data infrastructure applying internet infrastructure and related technologies on information from a variety of sources like sensor networks, field based surveys, census data and earth observation. It consists of a huge amount of data from several research fields, from geographic data and satellite imageries, sensor data that show water quality, water level to statistical data, reports and literatures in the field of water knowledge, livelihoods and knowledge management. The collected data use several models and terminology to describe the same real-world object or phenomenon. Furthermore, the data have different formats, different scales and areas of interest and different disciplines which cause semantic heterogeneity. As a result, finding and accessing the appropriate data or information is not straightforward. The users have to have knowledge about the thematic schemas of the system and normally have to search many times to collect all the relevant data for their works. A forward looking solution of providing all relevant data precisely for a specific query in the WISDOM information system is to resolve the semantic heterogeneity of data. This presentation introduces a new approach applying ontology for describing the semantics of collected data. The semantic description facilitates data discovery and retrieval for the WISDOM information system. Within this new approach, all datasets are described by linkages to superior subjects so that relevant data sets of multidisciplinary fields are provided by only one search. All in all, the ontology approach facilitates user search for data being more precise and suitable for their demands. As a characteristic of ontology, this approach ensures for transferability and scalability to other domains.

Session: 231 - 3

Topic: 11. Collaboration platforms in basin management: Information Systems and Spatial Infrastructures

Modeling frameworks- A basis for building decision support systems on river basin scale, the OMS and JAMS cases

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The Object Modeling System (OMS) is a framework and development kit for designing, building, validating, and deploying water resources and agro-environmental models. OMS was built under the auspices of the US Department of Agriculture (USDA). It has been designed as a pure Java, object-oriented modeling framework. OMS is designed as lightweight, non-invasive framework as one of its main objectives is to easily enable water resources and agro-environmental modelers to develop new models for system or to adopt existing models to run under the new system. Development of OMS started in 2001, currently version 3.1 of OMS is available. OMS (http://www.javaforge.com/project/oms) is comprised of four platforms: (1) Model Development, (2) Model Deployment (Cloud Services), (3) Data Provisioning and (4) Knowledge Base (Component Repository). Components are based on a common “life cycle” which include the initialization of parameters, e.g. data base connections and other settings, a stepwise execution of the model algorithms based on time series input and output and a finalization of settings e.g. closing of data base connections. Models are defined by linking component’s variable inputs and outputs, this also includes feedbacks between succeeding time steps. Annotations (meta data) are used to specify resources within a component or model. Meta data on the component or model, field and method levels are distinguished. By integrating modeling services into information systems powerful decision support systems (DSS) can be built to provide timely information that support decision makers. Taking emerging technologies into account, these services might be accessed on desktops in offices as well as on mobile devices in the field. The Vietnamese Ministry of Agriculture and Rural Development (MARD) is currently implementing a DSS for hydraulic works of irrigation and drainage systems servicing areas greater than 200 hectares. This system will be used by MARD as well as by the corresponding district agencies and other stakeholders throughout the country. It will be Web-based and contain a GIS based graphical user interface (GUI). The operation of the hydraulic works will be based on hydro-meteorological data augmented by data from water balance models. A similar approach is under development in the frame of the LUCCI (Land Use and Climate Change Interactions) project. The basis of the DSS is the IMLS (Integrated Land Management System) platform which comprises tools for Web-based geo data management, modeling and image analyses. The modeling tool is JAMS (Jena Adaptable Modeling System) which includes components for describing spatial and temporal domains (context components), components representing natural processes, components for model assembling, GUI components, model optimization and sensitivity components. The model framework is a core part of the DSS development in LUCCI. The test case for this development is the Vu Gia Thu Bon river system in central Vietnam.

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Topic: 11. Collaboration platforms in basin management: Information Systems and Spatial Infrastructures

Archival apps and formats for interactive e-books in Mekong development planning

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Take a hypothetical 1,300 MW, $1.5B inter-basin transfer tributary hydro scheme, releasing 100 m3 turbinated effluent at full power, >90% wheeled to Thailand. Say that a fulminating critic wrote "Fluvicide", a broadside claiming that so hydrologically altering two major Mekong tributaries, would manifest in damaged migratory fisheries as far upstream as Yunnan, and far down as Tonle Sab. But maybe that was alarmist, and anyway, it would likely take years to make valid empirical determinations; given the signal-to-noise ratio in fish landings data —especially with scores of other hydel projects coming online throughout the basin.

Suppose there was a relatively trivial fishery for a specific small run of tiny (i.e., <50g wet weight per individual), migratory catfish spawning right below the proposed outfall. A fishery known for critical and notable ecological, nutritional, and cultural attributes. A certainty —corroborated by longterm local knowledge— that the schools would be arriving there within hours or days after the monsoonal high discharge had reached its seasonal peak, and stream stage would thereafter decline consistently until the following rainy season.

Mechanisms cueing these migratory/reproductive behaviors unknown but likely include day length, in-stream chemistry and hydrology, and thermal factors. Migration always peaks in the following week, when mass spawning occurs within a discrete patch of flooded forest exactly where the outfall — c. 70 km length by 100 m width of trapezoidal concrete channel, with another 100 m. in graded earthworks along each side— would have its confluence with the second order Mekong tributary receiving stream.

Noteworthy access to this specific fishery at this specific time allocated to outsiders: wide range of ethnic groups, many coming from quite afar; harvested biomass almost exclusively used to produce pa daek:a fermented condiment providing baseline protein for rural populations in Southeast Asia. And not least, specific ceremonies and performances always mounted during the brief spawning/harvesting window.

Whether this hypothetical hydel scheme would measurably impact yields down in Tonle Sab, and what exactly were the effecting mechanisms, would be challenging to determine empirically and methodologically.

But on the other hand, unimaginable that introducing 100 m3 of turbinated discharge —likely cold, oxygen-deficient and possibly anoxic, for a fair part of each 24 hour period, the release regime optimized with energy demand pricing— within 200 m. of the flooded forest spawning zone could be consistent with that little fishery's continuation.

Production/distribution costs US c. $10-20K for an online e-book in English and in Lao archiving pre- and post-project conditions, and work underway; interviews with key players; the dances, songs and prayers; a map/airphoto package and a matrix of relevant hydrological data. Proposed to, and rejected by, the proponents. They could have done it themselves.

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Topic: 11. Collaboration platforms in basin management: Information Systems and Spatial Infrastructures

Field Calculator as an ex-ante impact assessment tool for closing the rice yield gap in Mekong Delta

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Rice yields and yield gaps are the result of a complex combination of biophysical (climate, water, soil, plant variety etc.) and socio-economic (labor, equipment, capital resources, knowledge, advisory support etc.) factors at a specific time and place. For the biophysical factors, many technologies have been developed that can help close rice yield gaps. However, many of these are 'component practices' aimed at alleviating particular constraints, or optimizing a particular resource input such as water or nutrients. Added benefits are obtained when different component technologies are brought together, as demonstrated by 10-20% increases in yields obtained over the past couple of years through the '1-Must Do-5 Reductions' program in the Mekong delta (An Giang province). Such experiences should scale out through the systematic process of integration. Toward the establishment of systematic integration of biophysical and socio-economic factors to close the rice yield gap, an ex-ante impact assessment tool called 'Field calculator' is being developed under the collaboration between IRRI and the Ministry of Agriculture, Vietnam. This field calculator will be composed of several databases, including site-specific information on target rice-based cropping systems, integrated by calculation rules developed by Microsoft Excel VBA (Visual Basic for Application). It makes use of existing technical coefficient generator, which has previously been used in several rice growing areas (Pathak and Wassmann, 2007; Ponsioen et al., 2006; Reidsma et al., 2012). In this presentation, we offer some ideas on the development of Field Calculator, to enhance the discussion on the requirement of such tools for the sustainable rice production.

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Topic: 11. Collaboration platforms in basin management: Information Systems and Spatial Infrastructures

Six Nations, One River: Testing a Model of Perceived Effects of Inter-governmental Collaboration on Sustainable Tourism in the Greater Mekong Sub-region

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Collaboration is one of the most frequently recommended strategies to address many global issues such as climate change, disease, and terrorism (Gray, 1989) – but, does it work for sustainable tourism? The study tested a model of inter-governmental collaboration as it relates to sustainable tourism. Three hundred and fifty nine government officers from the Greater Mekong Sub-region in Southeast Asia participated in an online survey regarding the relationship of sustainable tourism and collaboration. Structural equation modeling (SEM) analyzed survey data. Both inter-governmental collaboration and sustainable tourism were conceptualized based on various related bodies of literature. Inter-governmental collaboration was defined by eight factors (resources, governance, administration, issues, attachment, mutuality, trust and leadership). Similarly, sustainable tourism was identified as having four factors (economic, environment, culture and societal). Sufficient theoretical support exists that sustainable tourism largely depends on inter-governmental collaboration. Empirical results reveal a modified model with eight constructs and twenty three indicators that appears to be a better fit to the data set than the proposed model. Inter-governmental collaboration was redefined by four factors rather than eight and significantly influenced sustainable tourism. The overall fit of the modified structural equation model and the acceptable-to-high standardized loadings of the constructs suggest empirical support for a relationship between inter-governmental collaboration and sustainable tourism. The study is significant for at least four main reasons. First, the study contributes to the existing body of knowledge by providing a more complete and deeper understanding of collaboration theories and their specific application in tourism. Second, it adds to existing work by expanding use of the SEM approach in tourism. Third, it informs policy development by providing scientific information on how to improve inter-governmental collaboration to achieve ST. Finally, it provides practitioners with specific and concrete measurements and indicators of sustainable tourism collaboration.

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Topic: 11. Collaboration platforms in basin management: Information Systems and Spatial Infrastructures

Considering sustainable water management of the Mekong River Basin – in perspective of governance studies

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This study aims at considering how water governance of the Mekong River Basin should be for the sustainability in this basin. This report picks up two case studies from Japan and Cambodia. Indigenous people living in remote area of Ratanakiri Province, North-eastern part of Cambodia, has been suffering from severe floods since around the year of 2000. Its cause is dam constructions in the Vietnam side along the Se San River and the Sre Pok River, which are tributaries of the Mekong River. Tailwater from dams in Vietnam causes severe floods and affected their daily lives quite seriously. For example, floods flush away all the agricultural products and livestock, and fish mostly disappear because of water level fluctuation, and thus indigenous people living along the rivers cannot live their lives – no foods and no means to earn money. This incident occurred because of insufficient environmental impact assessment (EIA), no announcement and information on these dam constructions toward Cambodian side, and no disclosure and explanation on EIA toward residents along these rivers. In other words, this was just due to the lack of governance.
In Japan, we also had the incident indicating the lack of governance. In 1997, the River Law has been changed so that public opinion should be reflected in the master plan. In the case of Lake Biwa and Yodo River basin, Yodo River Basin Commission consisting of experts and citizens suggested that no more dams should be built along the river. However, national government decided to build them in opposition to the Commission's opinion. As a result, public opinion was not reflected in the master plan.
For the latter case of Japan, my previous studies mentioned that the role of national government should be to show the clear vision of basin management plans for the entire country because it should be an actor of national level. Along with that vision, local municipalities themselves can manage each river or lake basin. This idea completely makes sense in terms of the 'principle of subsidiarity', which means actors in an appropriate level should play an appropriate role. In that sense, from the viewpoint of governance studies, because functions and authorities national government has should be very strong and significant, this study concludes that the way of governance which the adjusted type of neo-institutionalism is insisting on is more suitable for sustainable water resources management.
Finally, this report indicates some discussion and recommendations on water resources management of the Mekong River Basin on the basis of the above argument. In short, power of national government is still strong in Mekong River basin, and thus, some function or platform to coordinate various interests among Mekong River Basin countries should be organized by river basin organization, namely, Mekong River Commission.

Phu Quoc Room

07.03.2013

10:15 - 12:00

Session 232 - 10. Impacts of urbanization and industrialisation on agriculture and water resources

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Topic: 10. Impacts of urbanization and industrialisation on agriculture and water resources

Sustainable Treatment of Waste Discharge from Phnom Penh, Cambodia, using Natural Wetlands: Successes and Future Challenges

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The city of Phnom Penh, Cambodia, uses a system of naturally-occurring wetlands to treat approximately 90% of its waste before discharge to the Mekong, Tonle Sap, and Bassac Rivers. From a sustainability or green infrastructure perspective, the advantages of a natural wetland system for treatment include much lower electric power consumption, no chemical treatment requirements, (eliminating concerns related to chlorine and chlorine by-products), reduced needs for highly-trained operators, minimal construction and maintenance costs, and a system that is more consistent with nature. However, the issue of treatment efficiency to protect public health also is important. As such, sampling was done in Boeng Cheung Ek, the largest of the wetlands (approximately 1,500 ha) and its tributary combined sewer system, in a two-phased project to assess treatment efficiency. In the first phase of the study (2007-08), levels of Cu, Cr, Zn, total phosphorus, nitrate, detergents, E. coli and total suspended solids entering the wetland from the three main tributary sewer channels and levels in the outflow from the wetland were compared for the dry season. The difference in mean concentration between inlet and outlet reflected reductions in the range of 44% (nitrate) to 99.97% (E. coli). The second phase of the study (2011-12) focused on E. coli, detergents, total phosphorus and total nitrogen and a treatment efficiency similar to that of the phase one study was found. Phase two also expanded the modeling efforts as Boeng Cheung Ek was divided into four zones and a personal computer version of the Stormwater Management Model (PCSWMM) was used to seamlessly model flow quantity and quality through the sewer system, pump stations and wetland. Modeling was done both for design storms and on a continuous basis for the months of May and June, 2011. The model accurately reflected flow in the sewer system, surface flooding conditions, and contaminant concentrations in all zones of the wetland. It can be concluded that the wetlands provide a good level of treatment for the city's waste. However, Phnom Penh is growing and some of the wetlands have been filled in for new construction, so the capacity to treat waste is being reduced while the city's population is increasing. This poses some interesting urban planning questions and it remains to be seen if Phnom Penh can follow a path of sustainable development in its water resources management. A number of cities in the lower Mekong Basin are facing similar sanitation and drainage challenges and these may be exacerbated by future changes in climate. Dynamic, deterministic models such as PCSWMM can be useful decision-making tools to explore system responses and possible improvements to the system under current and future climate conditions.

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Topic: 10. Impacts of urbanization and industrialisation on agriculture and water resources

An Analysis on Water Resources Utilization in Lancang River Basin

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The Lancang-Mekong River is the most significant international river across China and Southeast Asia, over 80 million people lives in this basin. As what ADB (Asia Development Bank) said in the "Great Mekong Sub regional Cooperation Plan", over 2.32 million km2 and 220 million people will be affected directly by the development of the Lancang-Mekong River, and the natural environment, and socio-economic conditions within a large area will be greatly changed. But with the conduct of the resources development, there are more and more conflict and coordination problems between China and other five Southeast Asian countries. So it is very important to figure out the current situation of water resources in Lancang River Basin, which is the upstream of the whole Lancang-Mekong River. Both water quality and quantity are investigated in this paper. The main research methods and data used are as follows: l) Divide the Lancang River into three reaches: the upper reach above Jiuzhou, the middle reach between Jiuzhou and Gajiu, the lower reach between Gajiu and Jinghong, then analyzing the precipitation data and runoff data from 1950s to find out the mean annual runoff of the river in China. 2) Using social-economic data from 1970s to find out the utilization trends of the water resources to predict the consumption in the future, 3) Using some hydro-chemical indexes and the organic pollution indexes to find out the water quality of the river. The results are as follows: 1) In most areas of the basin precipitation is concentrated from May to October, accounting for 65% to 90% of the annual precipitation. The water replenishment of the upper reach is melt water, the main water replenishment of the other two parts are rainfall 2) The mean annual runoff of the river is 741.5×108m3, the mean annual groundwater resources is about 303.7×108m3.3) The total water consumption of the agriculture, industry and domestic water will reach 80×108m3, and the water for hydropower will not beyond 150×108m3,4) As water quality is concerned, the water quality status of Lancang River is comparatively acceptable at present, but the deterioration trend is very severe, the upper and middle reaches is much better and stable than that of the lower reaches. 5) CODMn and TP have played the major roles in water pollution, rainy season is more serious than that in dry season.

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Topic: 10. Impacts of urbanization and industrialisation on agriculture and water resources

Assessing hinterland household perceptions of impacts of secondary urban centers: a comparative study between Thailand and Lao PDR

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Urbanization has created opportunities and challenges not only to the inhabitants and administrators in cities and towns, but also to those living in the hinterlands in the Mekong Region. This study investigates the perceived impacts (positive and negative) of urbanization on the hinterlands of two secondary urban centers in Thailand and Lao PDR. Household surveys were conducted in the hinterlands of Khon Kaen and Vang Vieng. Perceptions on impacts of urbanization on hinterland were categorized under five themes, namely economic, social, political and administrative, ideological and cultural, and environmental impacts. Factors influencing these perceptions included demographic and socio-economic factors and relationship with city/town factors. Data were analyzed by means of descriptive statistics and multiple regression analysis. The research found that households in the two hinterlands had a range of shared perceptions on urbanization impacts, despite large difference in the urban growth process and characteristics in the two countries. Increased education and employment opportunity, as well as increased people's participation, especially women's participation in local administration were among the most important positive perceived impacts in both places. As for the negative impacts, in the Vang Vieng hinterlands residents were most concerned about environmental impacts. In Khon Kaen the greatest concerns were with the impacts of urbanization on young people's behavior and social problems. Overall, the highest proportion of items with unfavorable impacts was under the environmental theme. Results of Multiple Regression Analysis show that in the case of Khon Kaen, household heads' age positively and monthly income negatively influenced their perceptions. For Vang Vieng, length of stay of the household in the village positively influenced the perceptions, while number of household members belonging to political parties or other town-based organizations and the proportion of type of agricultural production being changed to serve markets in the city negatively influenced the perceptions.This study cautions urban planners and administrators to not forget that urban impacts extend beyond urban areas into the hinterlands, and that people in the hinterlands are aware of and tolerate or adapt to these impacts and have developed both positive and negative attitudes towards these impacts. The study also provides urban planners and administrators priority themes and issues for urban development that care for the hinterlands.

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Topic: 10. Impacts of urbanization and industrialisation on agriculture and water resources

Capabilities of optical and radar data for Mekong hydropower dam observation

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As the Mekong River holds a rich potential for hydropower development, many dams were constructed or currently being constructed on the river's main stem river and its tributaries. Dam construction brings with it positive and negative impacts associated with infrastructure development, urban expansion, and access to environmental resources. Especially, the construction of a series of cascade hydropower has caused lots of environmental problems such as changes of biological diversity, unbalanced hydro-environmental system, and more and more serious geology calamity and damaged natural landscape. Therefore, it is very essential to monitor and evaluate the environmental problems around the hydropower dams.

Due to relative low cost and suitability for large area, remote sensing technology can play an important role to monitor and assess above mentioned environmental problems. In the southwest China area with frequent cloudy and rainy weather, especially in Mekong River watershed, there are lots of limitations for optical remote sensing imagery. As an advanced Earth observation technology, Synthetic Aperture Radar (SAR) has become an important tool and is widely used in the regions with cloud cover. However, the intrinsic characteristics of SAR imagery (such as layover, shadow and foreshortening effects) could become a severe problem, especially in the mountain areas.

In this paper, our research explores the capabilities of optical and radar data for Mekong hydropower dam observation. Especially for addressing four main research field: (1) Long time series land use/land cove (LULC) change and vegetation cover dynamic change near dam using the optical and SAR data; (2) Landslide areas monitoring close to dam sites from the optical and InSAR data; (3) Multi-sensor SAR data (e.g., TerraSAR-X and ENVISAT ASAR data) for extracting inundated areas and evaluating inundation loss; (4) SAR data vessel monitoring. At this paper, the infrastructure distribution close to the Xayaburi dam site in Laos and close to the Manwan dam site in China were extracted based on double scattering and characteristic backscattering coefficients derived from RADARSAT-2 datasets. However, the resolution and parameters selection of SAR are main factors and have an effect on the extraction of infrastructure distribution characteristics. Our analyses results indicate that integrating multi-source remote sensing data is considered to be an efficient and useful method for monitoring and assessing the environmental problems around the hydropower dam sites.

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Topic: 10. Impacts of urbanization and industrialisation on agriculture and water resources

Hydropower and irrigation development: implications for water resources in the Nam Ngum River of the Mekong Basin

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To meet rising demands for food and energy, the number of hydropower dams is growing rapidly and irrigation schemes will likely expand, in the Mekong Basin. The cumulative hydrological effect of planned water resources development has previously been assessed at the Mekong Basin scale. This paper analyzes how water control structures modify the balance between water demand and water supply along the Nam Ngum River, a Mekong tributary in Lao PDR. The Nam Ngum Basin, already containing both irrigation schemes and hydropower dams, has the potential for significantly enlarged river-fed irrigation, as well as additional upstream hydropower dams. We analyzed flow data recorded since 1962, in combination with a reservoir system optimization model, to assess changes in monthly river flows induced by existing and planned hydropower dams. Current and potential irrigation water demands were assessed from satellite images, cropping calendars and simple crop water balance. Our results indicate that, by the 2030s, if eight hydropower dams are completed in the Nam Ngum Basin, dry season river flow could increase by more than 200% and wet season flows could decrease by 20%. In the absence of dam storage, current irrigation water demand would compete with minimum environmental flow requirements during dry years. In contrast, full hydropower development allows current irrigation water demand to triple, to reach the potential levels of development, whilst maintaining environmental flows. The contribution of the Nam Ngum Basin to the Mekong River flow at Kratie, a few hundreds kilometers upstream of the Tonle Sap Lake, has changed from 5 to 15% in April, since hydropower dams started developing in the Mekong Basin, suggesting that the effect of water control development in the Nam Ngum Basin impacts water resources further downstream. Beyond the effects on water resources, there are a number of other impacts on fisheries, sediment, biodiversity, ecosystems, and population resettlement that should be considered in order to better understand the environmental and socioeconomic costs and benefits of these hydropower dams.

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Topic: 10. Impacts of urbanization and industrialisation on agriculture and water resources

AKIZ Project – “Integrated Water Management – Wastewater Treatment - Sustainable Water Use”

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Vietnam has about 200 registered industrial zones (IZ), without sustainable wastewater concepts. For the IZ Tra Noc, Can Tho City, in the Mekong - Delta a unique "Flagship Project" is under implementation. Accomplishing an investment for the central sewage treatment plant of the IZ, the research project, sponsored jointly by the German Federal Ministry of Education and Research (BMBF) and the Vietnamese Ministry of Science and Technology (MOST) shall develop an integrated wastewater concept for tropical IZ (AKIZ = Integriertes Abwasserkonzept fuer Industriezonen), to secure the efficiency and sustainable functioning of the whole system including all its components (life cycle optimization). Taking representative factories in Can Tho and especially within the IZ Tra Noc, near-to-source measures shall be demonstrated, like the pre-treatment of wastewaters (e.g. from a pesticides production to remove toxic substances), like the generation of energy from wastewaters (e.g. for a seafood processing company), and like the recuperation of valuable substances and water-reuse from wastewaters (e.g. for a brewery or biochemical factory). Pilot plants in technical scale, mounted in containers, shall be used to adapt and verify High-Tech solutions to the local conditions. Additionally, appropriate technologies and concepts for the disposal respectively for the utilization of different sewage-sludge have to elaborated, and the links with solid waste and contaminated sites management have to be analyzed and considered. Based on this and the pilot test plant results, an overall Management Concept will be elaborated for AKIZ, which shall cover the technical as well as the economic, financial functions of all facilities and organizations within the IZ. The decentralized pre treatment measures within the research project have to involve, protecting and accomplishing the central sewage treatment plant, starting with a sound monitoring and control system (analytical laboratory container, specified for IZ and ready to work in tropical climate) and ending with a reliable quality control of the day-to-day operations, including cost calculations and re-financing. The sustainable implementation of AKIZ shall be supported through capacity building with stakeholders and local partners. Contact Details: IEEM - Institute for Environmental Management and Engineering at the University of Witten / Herdecke gGmbH (IEEM) Prof. Dr. mult. Karl-Ulrich Rudolph, Mr. Nguyen Van Long, Dipl.-Ing. Sandra Kreuter, Dipl.-Ing. René Heinrich Alfred-Herrhausen-Street 44, 58455 Witten / Germany Tel.: 0049 – 2302 – 91401 - 0 or AKIZ – Project Office, Tra Noc Water Supply Co., Industrial Zone Tra Noc II, Can Tho City / Vietnam Tel.: 0084 – 7103 - 744003 E-Mail: akiz.cantho2@gmail.com Web: www.akiz.de

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Topic: 10. Impacts of urbanization and industrialisation on agriculture and water resources

Modelling the urbanisation-driven change of the water balance: The case of Ho Chi Minh City

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For fast emerging Asian megacities, knowledge of water resource conditions is indispensable for sustainable water balance management and planning. Urbanisation results in the sealing of surfaces to different degrees in relation to the urban densities and structures developed and ultimately to an alteration of the urban hydrograph. In recent decades urban flooding in Ho Chi Minh City has become one of the most pressing issues.
To exemplify the water related environmental indicators the precipitation-runoff regime of the southern Vietnamese metropolis of Ho Chi Minh City was investigated the first time. On the basis of high resolution digital databases, the model ABIMO was used to calculate the long-term annual means of individual water balance components of total run-off, surface run-off, evapotranspiration and infiltration for the entire administrative area of the city. Current conditions were modelled as well as two further time-series of future urban development scenarios as set out in the draft landuse plans up to the years 2010–15 and 2025–30 over static climate conditions. ABIMO calculated water balance component values on the basis of the geo-information system ArcGIS and the central instrument, a previously generated urban structure type map. Results were calculated and mapped for each of the individual 16,282 land-use blocks of the city's official land use plan.
For the current conditions, a total annual precipitation input of 1572 mm results in an amount of 225 mm (approx. 11%) that is unable to infiltrate or evaporate and converts into surface run-off. The share of surface runoff increased to 19% and 32%, respectively, (297 mm and 490 mm), with the implementation of the land-use plan 2010–2015 and the draft land-use plan 2025–30. The results highlight the current and future impact of officially planned development upon the city's water balance. For the Ho Chi Minh City´s planning authorities these initial but significant findings are a valuable tool and contribute to the city's adaptation strategy for flood risk.

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Topic: 10. Impacts of urbanization and industrialisation on agriculture and water resources

Managing Urban Water Systems of Medium and Small cities – lessons from Can Tho

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It is a well recognized fact that the more than half the world's population live in urban areas. Among cities in the world, ones that most spectacularly grab attention of media and experts are the megacities. However, close examination of world's population data reveals that while only 10% of the urban population live in mega cities, an overwhelming 60% live in cities and towns with population less than two million inhabitants (Brinkhoff, 2012). These smaller cities, particularly in the developing world, are growing fast, and hence their current problems are likely to be further aggravated. While hosting most of the urban population in the world, these small and medium urban centres (SMUCs) often fail to capture the attention of the global debate on human security or that of the national policies. What further aggravates this state of lack of attention is the fact that individual SMUCs do not often possess the capacity to manage their own research programs that could provide indications on their transformation over time and the response to changing global drivers. Close examination of the evolution SMUCs in Asia shows the remarkable fact that the urban transformation and related problems have many similarities across cities. There are many generic lessons that any city could learn by understanding problems of others that have undergone/undergoing similar trajectories of development. We discuss the case of Can Tho (Huong and Pathirana, 2012), the largest city in the Mekong Delta faced with multiple future challenges, namely: (i) climate change-driven sea-level rise and tidal effect, (ii) increase river runoff due to climate change, (iii) increased urban runoff driven by imperviousness, and (iv) enhancement of extreme rainfall due to urban growth-driven micro-climatic change. Several scenario studies using a number of numerical models set up for Can Tho city, provides insights into the possible future changes in the local hydrological cycle due to external and internal drivers of change. These lead to many aggravated problems like flooding and urban pollution. In providing solutions for these future problems, it is important to keep in mind that the current water management situation in the city in far from acceptable. Therefore, climate proofing can Tho should be balanced with solving its current water management issues. We point that following flexible and robust set of solutions can make progress towards achieving both these objectives. While there are many unique features of Can Tho city, we argue that nature of present and future problems of the city are quite generic for a typical Asian delta city. We believe that towns like My Tho, Tra Vinh and Vinh Long in the Mekong Delta as well as many other SMUCs in Asia can benefit from understanding the problems faced by Can Tho City.

Grand Ballroom II

07.03.2013

13:30 - 15:15

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Topic: 10. Impacts of urbanization and industrialisation on agriculture and water resources

Increasing the benefits to rural households in the Mekong Region from contract farming: insights from studies of rice and sugar – for book chapter

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Contract farming is one of the mainstream free-market mechanisms advocated by Mekong riparian governments for raising the prospects of marginal rural communities; it promotes co-investment by private enterprise companies and farmers in production and trade of key agricultural commodities (Setboonsarng 2008; Cai et al. 2008; Manoram et al. 2011). Rice and sugarcane are two crops grown extensively in the region that are presently targeted by such contract farming methods. Study design: Here we report results from a study on the status of contract farming in the Mekong region; on how contract farming can benefit rural households; and on policy implications for improving it. The investigations focused on rice contract farming in Cambodia and Myanmar and on sugarcane in Lao PDR and Thailand. Socio-economic surveys of 844 households from selected rural communities in the four countries were followed by in-depth interviews, focus group discussions and policy development workshops. Quantitative statistical analyses compared the perceptions of farmers from two groups: those with current or previous engagement in contract farming and those who had never been contract farmers. Main findings: Approaches to contract farming in the study areas ranged from centralised contract farming models (e.g. in the Thai sugar Industry), through the nuclear estate model for sugar production in Savannakhet Province in Lao PDR, to multipartite models involving local government or NGO agencies alongside contractor companies and farmers in organic rice production in Cambodia, rice production in Myanmar and sugar production in Luang Namtha, Lao PDR. Characteristics of contracts – duration; availability of credit; access to inputs; provision of technical training; presence of third party support; degree of formality (e.g. signed or unsigned); and regulatory frameworks – varied markedly across study locations. Significance and conclusions: Among important factors determining the degree of satisfaction with contract farming reported by farm households was the amount of support available through third parties such as local government committees, farmer associations, and informal farmer networks. Without such support, entrants into contract farming are unlikely to fully understand the commitment they are making and their degree of exposure to stringent produce quality standards, tight operational scheduling, and potential indebtedness. This empirical study within four countries of the Greater Mekong Sub-region has given support to findings from international studies that contract farming is an enabling mechanism for subsistence farmers to enter into commercial agricultural production, creating opportunities to increase on-farm income (Eaton & Shepherd 2001; Prowse 2012). Contract farming is an investment in people, involving vertical linkages along value chains and horizontal linkages between farmers and their communities.

Session: 233 - 2

Topic: 10. Impacts of urbanization and industrialisation on agriculture and water resources

Challenges and opportunities for risk-adapted land-use planning in Ho Chi Minh City: Balancing rapid urban growth and resilient water management.

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Asian cities located in deltaic settings such as Ho Chi Minh City, Vietnam, exhibit higher exposure levels to flood risk primary as a result of their location, their low elevation and if located in tropical regions, the significant annual variations in climatic and weather extremes they incur. Additionally these urban agglomerations have a specific urban climate, with their extensive and highly dense built-up areas exhibiting a strong influence upon local weather parameters. Furthermore the urban areas are sealed to different degrees according to the related urban densities and structures present. Normally a large proportion of rainfall is quickly converted to surface runoff. The result is that often the existing drainage and sewer systems do not have the capacity to cope with large surface runoff volumes following heavy rainfall events. Together with the superimposition of natural retention areas, the water balance is altered, so that a compelling need for dedicated site specific risk assessment and urban planning arises. In the emerging mega-urban regions of Southeast Asia, both planned and unplanned urbanisation into flood prone areas appears to be an unavoidable consequence of socio-economic development. These risks occur, often not due to a lack of risk awareness or weak planning instruments, but seem to be an accepted consequence of maintaining current economic success and social progress. Flood risk protection and implementation of costly mitigation measures are often shifted to a future development cycle, where implementation is not seen to constrain the economic goals. Disasters like the recent flood in Bangkok in 2011 have shown that this development strategy cannot be justified any longer, especially in the times of a changing climate. Associated economic losses and social implications are simply too high. Our results are an outcome of a 5 year research project funded by the German Federal Ministry for Education and Research in Ho Chi Minh City, focused on developing adaptation options to climate risks that could be subsequently implemented into the existing land-use planning framework. Based on the development of core indicators describing future urban structural changes in relation to the changing patterns of risk exposures, spatially explicit planning recommendations have been compiled in close cooperation with the responsible city authorities. Our contribution focuses on how to overcome the current limitations in implementing scientifically-founded and evidence-based adaptation planning to flood risks by communicating the importance in realising the present and plausible opportunities to influence future urban land-use.

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Topic: 10. Impacts of urbanization and industrialisation on agriculture and water resources

Water Systems in Vietnam

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Water Systems in Vietnam A proper knowledge of water systems is a vital precondition for any adequate water information system and - based on this – of water resources management. The water systems of Vietnam are shaped by the tropical or subtropical climate, by climate change, by their vulnerability and by human impacts such as land use (agriculture, industry, settlements etc.) and land use change (intensification of agriculture, deforestation, increasing urbanization and industrialization etc.). The water systems of Vietnam are very diverse and cannot be generalized. Fife relevant examples of water systems in Vietnam are shown and characterized. Essential natural and anthropogenic influenced interdependencies regarding water balance and water quality are each briefly presented: - Mining affected marine water in the Quang Ninh province: Contaminated mine water are affect the marine water and the ecosystems of the UNESCO world heritage Ha Long Bay. The treatment of mining wastewater is to stop this impact. - Polder management in the Nam Dinh province at the red river: The polder water management is used for irrigation during the dry season and for drainage during the rainy season and it is used for avoiding influences of saltwater intrusion on agriculture. - Weir-controlled water management in the Quang Nam province (Vu Gia river, Thu Bon river): A system of weirs combined with salinity observation by the irrigation companies enable rice cultivation despite increasing salt water intrusion from the sea. - Surface water and ground water exploitation in the Dong Nai River Basin: Various increasing human impacts influence the water system in the Dong Nai Basin: Newly constructed reservoirs for electric power and for irrigation, intensified agriculture, increasing population, bauxite mining, industrialisation etc. urgently require an integrated water resources management. - Mekong delta surface water and ground water system open to influences from upstream and from the sea: The water system of the Mekong delta is dominated by the transboundary discharge from upstream, by the downstream influence of the sea as well as by human impacts within the delta like irrigation demand, water way and harbour building etc. The future water management will be a huge challenge. The listed water systems are not the only water systems in Vietnam. The characterization should be completed by future research and project work in Vietnam. Prof. Dr. Harro Stolpe eE+E Environmental Engineering and Environment Faculty of Civil and Environmental Engineering Ruhr-University of Bochum www.rub.ecology.de Harro.Stolpe@rub.de

Session: 233 - 4

Topic: 10. Impacts of urbanization and industrialisation on agriculture and water resources

Mekong Metropolis: a Dutch perspective on urbanization in a water based landscape

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The Mekong Metropolis project examines the impact of rapid urbanization on a water based landscape. The research focuses on Vietnam's Mekong Delta and the Ho Chi Minh City metropolitan area. This territory is structured by a system of spatial components, like settlements, ports and agricultural areas, which are connected to a network of roads and waterways. Urbanization transforms the pattern of this dynamic delta system, driven by population and economic growth, industrial expansion, migration and the improvement of an infrastructural network. Besides the effects of urbanization, the natural environment faces severe impacts of climate change. Mekong Metropolis can be characterized as a dialectic delta-area, in which rural and urban transformations are subject to both, 'strategic' and 'tactical' forms of spatial planning and water management. The strategic top-down approach is carried out simultaneously with the tactical bottom-up approach, which is an endogenous part of the everyday behaviour between people and their natural environment. Until recently, debates on water challenges in urbanized deltas concentrated between technical and ecological objectives. This results in a water management strategy for combining flood-control techniques, like dikes and dams, with an adaptation philosophy, like 'building with nature'. The Mekong Metropolis project focuses on this integrated approach from a more tactical or societal perspective, because of its critical importance to achieve a robust strategy. The purpose of this research project is to explore and understand the different spatial logics and layered history of water management within an urbanized landscape. What is Mekong Metropolis? How has the Mekong Metropolis developed over time due to rising waters and increasing urbanization? Which water-related adaptation and control strategies could be used to improve the quality of urban life? This project investigates these questions on the basis of a 'thick description' method, built around a kaleidoscopic range of presentation tools, visual and textual, photographs, postcards and maps. In this method the focus has been put on a balanced relationship between panoramic observations and in-situ explorations to understand the ways in which transformations become manifest in resident's daily life. This exploratory research is intended to provide insight on the spatial development in the Mekong Delta. In order to do so, the spatial components of the Mekong Delta are put into a Dutch perspective by showing some relevant examples from the Netherlands, like 'Plan Ooievaar', 'layer-approach' and artificial dwelling hills. These comparisons stimulate the debate on new thinking concerning spatial planning, water management and engineering in the Mekong Delta. It is argued that 'tacit knowledge' is needed to improve the policy for delta programs. A further collaboration and exchange of adaptive strategies and tactics across delta countries could support this reform.

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Topic: 10. Impacts of urbanization and industrialisation on agriculture and water resources

Water pollution due to industrial production and processing sites in the Mekong Delta / Vietnam

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Vietnam benefits from the rapid economic growth rate of currently 7.5%, holding the potential to double every 10 years. The global demand for low cost mass production of industrial goods on a large scale causes un-centralised industrialization tendencies of vast areas in the Mekong Delta (MD), putting enormous pressure on natural resources and on water resources in particular. The MD itself represents the third largest industrial centre of the country (ADB 2007) with Can Tho, holding the highest capacity in production. Water resources are increasingly contaminated by waste water, waste gas and solid waste. The ADB estimates, that 80–90% of waste water is discharged untreated (ADB 2009). Two main developments in the sector of industrial production are considered to be responsible for this tendency, uncoordinated small and medium enterprise (SME) using their homes as production facilities and the improper design and management of industrial parks. Many of low cost products, especially for the domestic demand, are produced in SME's. Those SME's are mostly family run business with a low financial background, no control on the production methods and waste treatment. The huge uncontrolled amount of such SME's as well as the location of processing/production facilities in residential areas makes it uncontrollable in terms of what kind and to what extend waste is emitted to water resources in domestic areas. The second major factor for deterring the water quality of the Mekong on the industrial production side is the improper planning of industrial parks in terms of weak infrastructure such sewage, drainage and real required capacity or even lacking in waste water treatment plants at all (Herbst 2009). In recent years it became for municipalities fashionable to allocate industrial parks. Those industrial parks are planned for a certain kind of industry; however it showed that there is huge discrepancy in practice in terms of demand for such areas and provision. Since those parks are assigned a certain kind of industry, waste water treatment facilities are tailored to this industry. Most of those industrial areas, however, are not fully used and the municipalities try to fill it up by attracting other industrial branches. Hence, the waste water treatment plants cannot cope with the large variety of contents of the waste water and leading to a reduced efficiency or even a collapse of the waste water treatment facilities. To sum it up,water resources especially in Deltas such as the MD are impacted by industrial production heavily by numerous SME's located in residential areas, insufficient planning for infrastructure in industrial areas and the recent tendency to fill up capacities in those areas by permitting production and processing companies to settle down in areas, not designed for their industry. The Vietnamese Government has recognized the need to act and came up with a program to improve organizational, financial and technical effectiveness till 2015.

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Topic: 10. Impacts of urbanization and industrialisation on agriculture and water resources

Monitoring Survey of Industrial Discharges in the Drainage System of Tra Noc Industrial Zone, Vietnam and in a nearby located Raw Water Intake

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In the last years, nearly 300 industrial zones (IZ) have been established in Vietnam, out of which 180 IZ are in operation today. According to Article 34 of the Vietnamese Circular 08/2009/TT-BTNMT, all industrial zones have to build and commission centralized wastewater treatment plants (CWWTP) before 31 December 2010. It is a fact that in most economic zones and industrial parks in Vietnam, this circular is not implemented until today. Tra Noc IZ, located approx. 10 km north of Can Tho City, has a CWWTP neither, yet its construction of the CWWTP Tra Noc is scheduled for 2013. Today, Tra Noc IZ contains about 150 companies, out of which 40 companies have wastewater pre-treatment facilities. There is no separate sewer network in place yet, so the wastewater is (either pre-treated or not) discharged into the stormwater drainage channels or directly into surrounding water courses. In the framework of AKIZ project ("Integrated Wastewater Concept for Industrial Zones"), funded by BMBF and MOST, wastewater grab samples have been taken at different points in the sewer system and outlets (partially influenced by Hau River) of Tra Noc IZ. The objective was to assess the current wastewater pollution in the existing sewer system of IZ Tra Noc. All samples have been analysed in the laboratory of AKIZ project (for BOD in the Advanced Laboratory of CTU) according to relevant wastewater parameters, such as ammonium (NH4-N), nitrate (NO3-N), total nitrogen (TN), total phosphorous (TP), BOD and others. The analytical results have been compared with the limit values for direct wastewater discharges, defined in standard QCVN 40:2011/BTNMT (National Technical Regulation on Industrial Wastewater). They show that in many samples, the limit values have been exceeded: for total nitrogen, the limit value of 20 mg/L has been exceeded in 73 % of the samples, for phosphorous (with a defined limit value of 4 mg/L) 61 % of the samples did not meet the standard. Due to these results, it has been decided to do further investigations regarding the raw water quality of Hau River. A raw water intake at Hau River is situated downstream of an outlet from the sewer network of Tra Noc IZ. Here, grab samples as well as 24 h composite samples, taken by an automatic sampler, have been analysed according to important parameters (e.g. BOD5, ammonium, total nitrogen, phosphate, chrome) whose threshold values are defined in standard QCVN 08:2008/BTNMT (National Technical Regulation on Surface Water Quality). Results of this research will be presented in March 2013 at the Mekong Environmental Symposium in Ho Chi Minh City.

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Topic: 10. Impacts of urbanization and industrialisation on agriculture and water resources

Socio-Cultural Food Dynamics in the Context of Urbanization, Industrialization and Agricultural Change in the Mekong Delta, Vietnam

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Rapid processes of industrialization and urbanization in the Mekong Delta, technological innovations of the Green and Blue Revolutions and the export-oriented agricultural sector have implications for local patterns of consumption. The sharp decrease in wild fish resources gets compensated by aquaculture production. In favor of high yield varieties, manifold traditional rice species got lost. Food security, agricultural-based economic growth and rural development have been extensively discussed as dominant rationalities behind such changes in biodiversity. In contrast, what has been neglected so far is the impact of such processes of change on food as a cultural resource. Wild fish and floating rice species are highly valued for its good taste and scent. E.g. whereas cultured fish is associated with a flabby texture and peculiar smell, health and freshness are common characteristics ascribed to wild fish. A similar differentiation is made between traditional rice varieties and high yield crops: whereas the old rice species are usually remembered as soft and as having an aromatic scent, 'modern' crops are described by a hard consistency and a rather neutral taste and scent. Interestingly, if affordable, farmers prefer to buy other rice species for their consumption than the ones that they produce for the (export-) market. Due to the great success of economic growth in the Mekong Delta, food nowadays is no longer a question of survival as compared to the years of famine after the Vietnam War. Food becomes more and more an issue of taste and quality – aspects which will be put central by the proposed paper on the basis of ethnographic research findings and literature review. In this regard, the paper elaborates how agricultural change and processes of industrialization and urbanization impact on rural and urban eating and consumption patterns as well as on people's lifestyles.

Poster Abstracts

Foyer

06.03.2013 from 09:45 – 10:15

Poster 302 – 02. Hydropower development and impacts on economy

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Topic: 02. Hydropower development and impacts on economy

Design of 10 kW cross flow turbine for micro hydro power plants (casing)

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There are various electrical resources such as water, air or solar on Myanmar. Of all the renewable energy options, water provides the possibility of a continuous supply of energy without the need for storage. Moreover, cost of production from water resources is relatively cheaper than the compared with other resources. In this research design data 10 kW electric powers, 14m available hydraulic head, 0.123 m3/sec flow rate of water. Casing design is carried out with total length 378 mm, total width 440 mm and total height 223 mm. For casing, mild steel is used with thickens of 7.5 mm. This casing is split into three parts. These parts are jointed by bolts and nuts. M-10 steel bolts are used and 65 bolts are mounted the whole of the casing. To prevent leakage a 3mm thick packing is used between the joints.

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06.03.2013 from 09:45 – 10:15

Poster 303 - 03. Mekong Basin forest dynamics and REDD+

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Topic: 03. Mekong Basin forest dynamics and REDD+

Household forest plantation in the northern uplands of Vietnam

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Forestry is an important sector in the mountainous area of Northern Vietnam, providing significant economic benefits to sustain households' livelihood as well as generating ecological benefits. Planting forest supplies rural households with timber and non-timber products for their own consumption and for generating cash income. Planting forest is also viewed as one way to promote sustainable land use by reducing soil degradation as well as improving water flow to the downstream areas. Vietnamese government has been allocating land and providing support for forest plantation to individual households through several program in mountainous area for decades. For the support from government and donors to be effectively encourage households to plant forest, it is very crucial to understand the current situation of forest plantation in local context. The objective of our study is to investigate the determinants of households' decision to plant forest as well as challenges and needs that they faced in order to explore the most important factors that would increase the propensity to plant forest. The study area is located in Da Bac district, Hoa Binh province in the north western region of Vietnam where farm households are engaging in both agricultural production and forest plantation. We collected wide range of household level information including comprehensive list of inputs, costs and revenues from forest plantation and management as well as the details on supports from the government. The information on land allocation, land tenure, social capital and socio-economic indicators are also taken into account for analysing farmers' behavior on forest plantation. Descriptive statistic is employed to capture the main features of forest management including perceptions towards forest as well as difficulties and type of supports farmers need from the government. The gross margins of forest plantation compared with the cultivation of their main crops is calculated. The linkage between poverty and decision to plant forest is analyzed using Principle Component Analysis. Regarding the determinant of forest plantation, we take into account two behaviorial aspects of tree growers; the decision on whether or not to plant trees and how many trees they have planted. We use probit regression to analyse the attributes that contribute to households' forest planting decisions. We expect that the extent of benefits the farmers obtained from forest products would significantly determine the decision to plant forest and the amount of trees the farmer planted. Support from various government programs are not expected to have conclusive pattern on the number of trees the farmers planted since there would be a mixture problems on geological features and climatic condition as well as the monitoring capacity of farm households and local authorities. These results can be used by policy makers to promote forest plantation in the study area.

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Topic: 03. Mekong Basin forest dynamics and REDD+

The Role of State Forest Enterprises on Benefit Sharing through Payments for Environmental Services in Vietnam: A Paradigm Shift

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One challenge to overcome in implementing payment for environmental services (PES) in Vietnam is the high transaction cost associated with many contracts with small scale ecosystem service providers. In order to promote pro-poor PES, it is necessary to identify institutional options that reduce transaction costs and organizational problems. State Forest Enterprises (SFEs) play an important role in the forestry sector and the livelihoods of many rural poor in the country. The government of Vietnam has issued Decree 200 in December 2004 to develop provincial SFE reform plans. SFEs were given much greater autonomy and the government expected an increase in land managed directly by households (and possibly communities) under district level administration rather than the provincial level aimed at improving economic and social opportunities in the locality of SFEs. The main challenges to implement the reform were availability of government funds and availability of loans for SFEs (EASRD, 2005). The Development Assistant Fund recently increased interest rates and introduced more stringent lending criteria making access to financing difficult for SFEs. By linking available revenue sharing funds from hydropower dam projects to SFEs, these SFEs may be able to expand and implement PES programs cost-effectively. Therefore, we are looking into the policy and legal framework of SFEs in Vietnam as well as its operational procedures to look into potential application of benefit sharing through PES. The study undertakes three stages: First, a review on policy and legal frameworks of SFEs enables us to determine if the system is conducive to managing benefit sharing of hydropower dam projects. Second, on-going SFE models in Vietnam are reviewed and evaluated in terms of benefit sharing applicability within the hydropower dam context. Finally, empirical data from Tu Ly SFE is analysed to draw on a mechanism of benefit sharing through PES. Households who participated in the loan program of the Tu Ly SFE are interviewed to elicit information on household characteristics, cost and benefits of joining the Tu Ly SFE loan program, and their loan use. In addition, individuals paid by the Tu Ly SFE to plant and manage the forest are interviewed. Finally, the study presents a framework of benefit sharing of hydropower dam projects through payments for environmental services managed by SFEs developed from the above analysis with an assessment of advantages and challenges in its implementation.

Poster: 303 - 3

Topic: 03. Mekong Basin forest dynamics and REDD+

Evaluating the influence of Kunming-Bangkok Road on forest ecosystem in Lancang River Valley

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Kunming-Bangkok Road, as a great international passageway, plays an important role in economic and cultural communication between China and ASEAN, but it also imposes a threat to local natural ecosystems. Accounting for such an effect is emerging for ecosystem conservation. This paper analyzed the changes of the forest ecosystem (the main natural ecosystem in this region) caused by Kunming-Bangkok Road construction. The analysis was based on Landsat TM images and spatial indicators to quantify the structural characteristics of the forest ecosystem. The results showed that after completion of the road, the forest ecosystem was more fragmented, with the average patch area decreasing from 1.95km2 to 1.78km2, more isolated with the average edge-to-edge distance of congeneric patches increasing from 254.5m to 266.8m, and more disturbed with average distance from the surrounding disturbance decreasing from 2757.1m to 1116.4m. Comparison of the forest ecosystem's spatial settings in different road buffers showed that there was a strong correlation between road effects and the distance to the road. With the distance increased, the fragmentation of the forest ecosystem reduced, the connectivity enhanced, and the disturbed possibility decreased. Among the aforesaid three effects, the last one (the disturbed possibility) was the most significant. The methodology in this study could be used to compare alternative road projects to identify the least impacting one, so as to strengthen the consideration of ecological issues in the decision-making for new development.

Poster: 303 - 4

Topic: 03. Mekong Basin forest dynamics and REDD+

Mangroves of the Mekong: Annual mapping of the status and changes of the world's mangroves

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Mangroves are one of the most productive ecosystems globally, providing a wide range of ecosystem services and providing critical support to livelihoods. Although often associated with highly productive natural fisheries, mangrove forests are threatened in Southeast Asia in particular due to conversion to aquaculture. Despite their importance for livelihoods, carbon cycling and ecology, large uncertainties exist regarding the status and extent of mangroves globally. In addition changes in mangroves occur fast and updated information about their change status is required; for countries participating in REDD+, UNFCCC requires reporting at least on a bi-annual basis. Existing assessments of mangrove dynamics have typically focused on a limited number of discrete locations at fine detail using a variety of data types, and have not been documented and presented holistically. Until recently, routine detection of change in mangroves was problematic in many tropical and sub-tropical regions because of the persistence of cloud. Radar satellites can acquire data regardless of clouds, smoke and haze. The Global Mangrove Watch is an international collaborative project which aims to produce updated information about the worlds mangrove areas on an annual basis, and is being undertaken within the framework of the ALOS Kyoto and Carbon (K&C) initiative. This initiative revolves around the use of data gathered from JAXA's Phased Array L-band Synthetic Aperture Radar (PALSAR) on-board the Advanced Land Observation Satellite (ALOS) platform to support the information needs raised by international environmental conventions, carbon cycle science and the conservation of the environment. The K&C initiative builds upon the experience gained from the JERS-1 Global Rain Forest and Boreal Forest Mapping (GRFM/GBFM) projects which demonstrated the ability of L-band SAR for mapping and monitoring wetland areas at a spatial and temporal consistency. Under the Wetlands Theme of the K&C initiative, a set of key products are being generated, mapped and made publicly available, including the development of inventories of mangroves and associated peat swamp forests. An updated mangrove baseline and subsequent annual change maps is being produced using spaceborne radar images, primarily gathered from PALSAR. The dataset will be supported with additional radar imagery from the Japanese Earth Resource Satellite (JERS-1) where available. The Global Mangrove Watch is the first assessment of mangrove dynamics across the tropics, with results that are directly comparable between regions due to the consistency of the time period over which the imagery was gathered. This dataset will enable a comprehensive assessment of the status of and changes in mangrove ecosystems globally.

Poster: 303 - 5

Topic: 03. Mekong Basin forest dynamics and REDD+

Mapping burned areas in the Golden Triangle using Landsat imagery

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Slash-and-burn agriculture (also known as swidden farming or shifting cultivation) involves clearing forests or woodlands by means of setting fire or clear felling and growing subsistence agriculture crops (Mertz et al., 2009). Currently, slash-and-burn cultivation is very common worldwide which supports millions of population. Ecological and environmental effects of the slash-and-burn farming on tropical rain forest can be devastating, like loss of forest system carbon, soil degradation (Bruun et al., 2009), and biodiversity loss (Padoch & Pinedo-Vasquez, 2010). Therefore, updated and timely information on the spatial pattern of burned sites will be very essential to forestry protection and sustainable utilization. In this paper, we used the Landsat ETM+ image (Path/row 130/46) which covers border region of Laos, Myanmar, and Thailand (also called Golden Triangle) acquired on April 18th, 2001 to distinguish burned sites in the mountainous area. Considering the issue of bad data values along edges, a rectangle test area of 30954 km2 was trimmed from this scene. This study area consists of three parts of Laos, Myanmar, and Thailand, the corresponding area for each is 16292km2, 4551km2, and 10111km2, respectively. A decision tree method based on the parameters of Normalized Difference Vegetation Index (NDVI), Modified Normalized Difference Water Index (MNDWI), and spectral logical operations was used to discriminate fire burned area from farmland, forest land, and water body. Meanwhile, ASTER Global Digital Elevation Model (GDEM) with 30 m spatial resolution was applied as a mask for land cover classification. Then, we analyzed the relationship between burned sites and topographic attributes, such as elevation, slope, and aspect. The results showed that the total area of fire burned sites was about 1078 km2 for this test area. Among then, about 581 km2 was from Laos, 128 km2 from Myanmar, and 369 km2 from Thailand. As for the distribution characteristics, forest burnt sites in both Laos and Myanmar were small and sporadic, while those in Thailand were concentrated and continuous. These phenomenon may have According to the DEM, we found that: 1) about a half distributed at an elevation of 400 - 639 m, and over 80% of burnt sites distributed at an elevation of 400 - 900 m. 2) Near 50.8% of burnt sites distributed at a slope of 15 degrees, 71.2% at 20 degrees, 86.1% at 25 degrees, and 94.5% at 30 degrees. 3) The locations of burnt sites were mainly occurred in the directions of Northwest and North, namely, 15.1% and 14.5%, respectively. Only 9.8% of burnt sites were in the direction of East. And the other five directions were almost equal, near 12%. Follow-up studies may give more attention to the extensive slash-and-burn at the meso-scale (region, country) in the mainland and whole Southeast Asia. Using time-series Landsat imagery to delineate the spatio-temporal changes of burnt sites and understand the socio-economic drivers of land use change.

Poster: 303 - 6

Topic: 03. Mekong Basin forest dynamics and REDD+

Guideline for integrating community-based participatory carbon measurement and monitoring with satellite remote sending and GIS in REDD+ MRV system

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Forests play a critical role in mitigating climate change though the sequestration and storage of carbon in perennial woody biomass and soils. Recent estimates show that deforestation and forest degradation accounted for 7 to 14 percent of global anthropogenic carbon dioxide emissions for the period 2000 to 2005, with 32 percent of deforestation emissions coming from South and Southeast Asia (Harris et al. 2012). Governments implementing REDD+ activities are aware that consultation and inclusion of indigenous people and local communities is essential. The involvement in measurement and monitoring of forest carbon by local people can empower them as co-managers of areas under REDD+ projects. Our research team has piloted an approach in three project areas, one each in Laos, Thailand and Vietnam, to integrate community-based participatory carbon measurement and monitoring with satellite remote sensing and GIS to support a REDD+ monitoring, reporting and verification (MRV) system. In this presentation we report the findings of the three pilot activities highlighting the common elements successful in all three pilot areas and noting the aspects that appear to require context-specific or nuanced approaches . We stress that while there are common elements to integrating community-based participatory carbon measurement and monitoring with satellite remote sensing and GIS in REDD+ MRV systems, there is no “one-size-fits-all” recipe. The guidelines we suggest, we hope, will prove useful to others, including policy-makers as they continue to develop REDD+ in each of their respective countries.

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Topic: 03. Mekong Basin forest dynamics and REDD+

Traditional Ecological Knowledge (TEK) and behavior concerning local forest management in the lower reaches of Lancang river basin, China

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Traditional Ecological Knowledge (TEK) is considered as an effective basis for the ethnic groups looking after the local forests in the downstream of Lancang river basin. This study documents the TEK and behavior about local forest management by the inhabitants of 20 indigenous minorities in the study area. It presents data on the cultural diversity and traditional knowledge on plant use, forest ecosystem management and protection collected through literature and key informant interviews. Food, economic products, and wood are the main outputs from the forest; most of them have multiple uses, such as food, medicine, raw materials, source of energy etc. Through a case study we did in a village of Bulang people, it shows that tea and the some wild food are supplementary and nutritionally important to the local communities. Climate control, soil conservation and air purification are also known as the significant functions by the residents. Tea trees are belonging to the households and well managed. Preliminary results are that elder men are the most knowledgeable group, being able to describe the most of traditional forest management ideas as compared to only a few described by young women; almost all ages people take part in the work, but only the prime labor do weeding and cutting. With the process of modernization, TEK is noticed less and considered outmoded. However, some scientists find out the principle and the mechanism how TEK works. Meanwhile, the government encourages people in the study area to build some kind of new forest ecosystem, which would follow the good ideas from TEK, pursuing not only economic value but also ecological and social benefits. Taboos and traditions continue as well, which maintain the features in different cultures of ethnic groups and the cultural diversity in the study area.

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Poster 304 – 04 Mekong Basin landuse (non-forest) dynamics

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Topic: 04. Mekong Basin landuse (non-forest) dynamics

Assessing geographical shifts in climate suitability for agriculture in the Lower Mekong Basin by 2050

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Despite the recent intensification of Mekong agriculture, it remains predominantly rain-fed and hence highly sensitive to changes in climate and water availability. Changing climate can have major implications for the Mekong farming systems and modeling can be used to identify threats for crop production. This study adopts a basin-wide approach by quantifying shifts in the geographical suitability of the key crop species by 2050. Statistical downscaling was used to regionalize global climate projections. The IWRM watershed model, developed by the EIA Ltd, MRC, World Bank, Aalto University and ICEM was applied for the whole Mekong Basin. The Land Suitability Evaluation Tool (LUSET), developed by IRRI, was coupled to the IWRM model to assess the suitability of each grid cell to a range of crop species, including rainfed rice, soya, maize, cassava, robusta coffee and rubber. Lastly, the AquaCrop yield model developed by FAO was also coupled to the IWRM model to estimate impact of climate change on rice and maize yields in 8 locations across the basin. The eight case study "hotspots" represent areas most exposed to changes in climate, including: Chiang Rai, Sakon Nakhon (Thailand), Champaksak, Khamuounae (Laos), Mondulkiri, Kampong Thom (Cambodia), Gia Lai and Kien Giang (Vietnam). Climate change will induce geographical shifts in the suitability of the basin for several all crop species assessed except for low land rain fed rice. Suitability of industrial crops like rubber, robusta coffee and cassava, will shift to areas of higher altitude with optimal suitability in 2050 centered on northern Thailand, northern Lao PDR and central highlands. Plains and lower altitude areas will becomes less suitable for rubber, robusta coffee and cassava, especially in eastern Cambodia. Dramatic increases in precipitation will be important in central Lao PDR and central highlands, affecting cassava, soya and maize culture. For these crops, the rainfall suitability also decreases in central highlands and eastern Cambodia. An increase of suitability is projected in northeast Thailand due to an increase of rainfall during the crop. Compared to a baseline of 1980-2005, crop yield modeling shows significant positive changes for rainfed rice in Ken Giang province in the Mekong Delta (+18%) and negative change in Gia Lai province (-12%), Champasak and Chang Rai province in Northern Thailand. Maize yield projections show a general decreases across the basin, with Gia Lia (-12%), Mondulkiri (-6%), Kampong Thom (-6%) provinces being the most severely affected of the "hot spot" areas. This spatial approach helps to highlight areas with major changes in crop suitability due to climate change and identifies the priorities for adaptation response. The coupled IWRM-AquaCrop model will be used in the Mekong Region to evaluate climate adaptation measures such as required water storages and selection of crop varieties and planting schedules for optimal production.

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Topic: 04. Mekong Basin landuse (non-forest) dynamics

Impact of climate change on vegetation in Lantsang River source region at a decade scale

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The source regions of the Lantsang River are located in the middle east of the Qinghai-Tibet Plateau. With relative less anthropological disturbances, vegetation variation in this area is a suitable index for studying the effect of global climate change on ecosystem at regional scale. In this paper, MODIS Normalized Difference Vegetation Index (NDVI) and Net Primary Productivity (NPP) products were used to analyze the vegetation change in the Lantsang River source region from 2000 to 2010 years. The surface solar radiation (SSR) data, which was computed by an improved parameterized model for predicting all-sky global solar radiation on rugged surfaces using MODIS atmospheric products and DEM, and Tropical Rainfall Measuring Mission (TRMM) precipitation data were used as climate change factors. The results show that during the past ten years, an overall increasing trend was observed in NPP of the Lantsang River source region. The highest NPP was 116.98 (gC/m^2/yr) in 2010, while the lowest was in 2003, about 77.55(gC/m^2/yr). Spatially, about 91% of the source regions experienced NPP increase. According to NDVI variation, vegetation in the study area increased in density between 2001 and 2010 in the north and east source region. However, a little degree of vegetation degradation happened in the south part. Through the spatio-temporal correlation analysis of vegetation variation to climate change, we can see that at a decade scale, precipitation has a direct effect on NDVI in the source region. Precipitation during spring and autumn , especially in April and October, is most important for vegetation growth in the alpine area. However, NPP was influenced by both the surface solar radiation and the annual average precipitation, and the lag time between NPP and climate change is about 1-2 years in the study area. The paper also found that impact of precipitation and radiation on NDVI and NPP differs between vegetation types, with the greatest impact observed in alpine grassland areas over forest and shrub areas.

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Topic: 04. Mekong Basin landuse (non-forest) dynamics

Land Surface Temperature Time Series in the Upper Mekong Basin

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Land surface temperature (LST) is an important indicator for climate change and can be sensed remotely by satellites with a high temporal resolution on a broad spatial scale. In this research MODIS LST are used to derive an 11 year time series from the upper Mekong delta to analyse the development of LST. The data shows the regular annual curve of surface temperature with maximum values in summer and minimum values in winter. Average temperatures in Southern parts of the basin are higher than in the Northern part. To assess temporal variations, maps of monthly anomalies are created. In a selected area in the province Qinghai for example the daytime monthly anomalies range from -25 K to +19 K, what are exceptional values however. Average deviations are found in the range between -6 K and +5 K. Daytime monthly anomalies were also compared with monthly anomalies of NDVI and a correlation coefficient r2 = 0.39 was found for the test area: In warmer month also the NDVI tends to be higher. Nighttime anomalies correlated with r2 = 0.18 only. Some inter-annual variations occur mainly during summer: in some years a two peak distribution is found, which could be traced back to the low number of observations in the respective months. A main challenge of optical satellite data is the cloud contamination over the area in the summer months, where peak rainfall occurs. In the test area of the province Qinghai for example, the average number of available daytime observations of MODIS LST in July ranges between 9 and 16 observations per month. It can be assumed that any climate statistics calculated from such data might be biased and an appropriate gap filling method would be helpful. In this context, an algorithm was developed to overcome this problem. It estimates missing LST from existing LST data from a given environment in the same scene using stable neighbourhood relations and is to create a set of clear-sky LSTs. Modelled daytime LST correlated well with the original data for the selected test area (r2 = 0.75) but showed quite a high RMS (= 5.6 K). The newly created set is analysed in terms of its suitability to fill the gaps in the LST time series. Another issue with MODIS LST data are day-to-day differences in the acquisition time. A temporal homogenisation was applied to all LST data, converting them to one fixed acquisition time using adjusted ECMWF ERA Interim skin temperature data. The daytime original and the homogenised dataset are still well correlated (r2 = 0.97 for the selected test area) and the effect on the daily/monthly mean is found to be small (RMS = 1.6 K/0.35 K).

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Topic: 04. Mekong Basin landuse (non-forest) dynamics

Mapping rubber dominated landscape in Xishuangbanna Prefecture, Southwest China

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Rapid expansion of rubber plantations has been a key factor of land use/cover change and natural forest loss in Xishuangbanna Prefecture, Yunnan Province, the second largest natural rubber producer in China and also an India-Burma biodiversity hotspot. As a consequence of government policy promotion and a booming market, rubber plantations started with state farm initiatives in lowland areas and rapidly expanded to highland areas and privately held plantations. Monitoring and mapping rubber plantation and its associated land use and land cover with remote sensing data can help researchers and policy makers understand the landscape dynamics and ecosystem services in the study area. In this study, land use mapping was conducted by using RapidEye 5m images of Xishuangbanna from 2010 with an object-based classification. The result indicates an area of 424,552 ha of rubber plantation accounts for 22.2% of the total land area in 2010, which has expanded twenty-fold compared to 1976, while the proportion of forestland in total land area decreased from 70.0% to 55.6%. Open canopy and close canopy rubber plantation take up 11.4% and 88.6% of the total area of rubber plantation respectively. The years between 2003 and 2010 was the boom-time for rubber expansion, when approximately 50.0% of this area's rubber plantations emerged. The distribution of rubber plantations is associated with altitude, the overlay analysis shows 72.9% of rubber trees are growing in lowland areas below 900 meters above sea level (masl). Rubber plantations have expanded from lowland to highland, up to 1400 masl, and rubber plantations dominate the landscape below 900 masl, accounting for 47% of the area. An area of 23,616 ha of rubber plantation was found to be growing in the nature reserves, which poses challenges to biodiversity conservation.

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Topic: 04. Mekong Basin landuse (non-forest) dynamics

Study on the spatial differences of landscape change and the response of ecological environment to the change in the Lancang River Basin, China, in the 1990s

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Lancang River Basin (LRB), China, which is the upper reach of Mekong River, is one of eco-regions with rich biodiversity and high ecological values in the world. During the past few decades, with the accelerating economic globalization and technological development, the impact of human activities on this area has grown enormously, altering entire landscape with important ecological consequences. So it is important to quantifying the landscape pattern and its change for monitoring and assessing the ecological consequences of land-use/land-cover (LULC) change and human interference. In this study, a combination of landscape pattern indices and land-use dynamics indices based on landuse maps was employed to analyze and compare the spatial and temporal dynamics of the landscape pattern in LRB, in the 1990s. During this decade, the change in the landscape pattern was mainly driven by intense human-induced alterations. We chose the number of patches (NPs) and Shannon's diversity index (SHDI) as the landscape pattern indices to measure the fragmentation and diversity, respectively, of the landscape change across the LRB in this study and evaluate the effects of human activities on the spatial variation of landscape change. Because the change in landscape pattern varies between geographical locations due to different driving forces, special attention was given to three subregions located in different geographical positions. A transect (Subregion1) along the G214 national road was selected, which can be used to capture the spatio-temporal complexity of the landscape pattern and its change caused by human activities. The road facilitates the transportation of local people and advanced the region's economic prosperity. The three other subregions selected were located in Dali City representing a tourist hotspot, a mountainous landscape in Lancang County as a traditional agricultural area and a plain landscape in Changdu Prefecture as pastoral area. In order to better understand the ecological consequences of Landscape change, this paper also analyzed the effect of LULC change on the ecological environment in LRB from aspects of ecosystem services value, ecological environment quality index and the contribution portions of LULC type transformations. Referring to the equivalent table of Chinese terrestrial ecosystem service value per unit, the ecosystems service values of LRB in the year 1990 and 2000 were estimated by using Costanza's formulae.

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Topic: 04. Mekong Basin landuse (non-forest) dynamics

Monitoring the progress of flood affecting rice cropping calendars in the MeKong delta using Modis satelite images.

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The study used MODIS-MOD09 and MOD13Q1 satellite images, to monitor the rice sowing/harvesting stages and flood progresses as a basis for flood forecasting and planning of agricultural production in the Mekong Delta region. The results of MODIS image interpretation in the period from 2009 to 2011 showing that MODIS multi-MOD09A1 can be used for timeseries flood monitoring in the Mekong River Basin. Results also showed that there is a close relationship between the enhanced vegetation index EVI, the surface LSWI index and NDVI image with rice growing state and the evolution of the flood. Flood zone maps and current status of rice growing stages during the flood was established as the basis for monitoring the rice production under the impact of floods, which promptly propose the strategies for embankments, and rice timely harvested.

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Topic: 04. Mekong Basin landuse (non-forest) dynamics

Can eco-compensation tip the balance to forest recover from monoculture rubber plantation in Xishuangbanna,SW China

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Tropical landscape are being increasingly managed for the production of monoculture tree crops, such as rubber trees for latex, oil palm for food and biofuel, Eucalyptus and Acacia for wood pulp. Such plantations have expanded enormously in recent years, fuelling replacement of diverse, multi-use landscapes and rainforests with tree monocultures. In Xishuangbanna, south-west China, monoculture rubber plantations are lucrative and have expanded dramatically over the past two decades, particularly in the species rich lowlands. Replacing diverse rainforest and traditional agriculture landscape with monoculture rubber plantation is drastically degrading ecosystem functions and services across the landscape. Considering of rubber growth conditions, Xishuangbanna is located in non-traditional rubber growing area in tropical Asia, which means marginal area without suitable combination of high humidity and temperature rubber trees could not grow up to be tapped. Spatially-explicit model of carbon sequestration was conducted, water balance and opportunity cost of losing rubber plantations. While the use of eco-compensation mechanisms are an attractive idea, if the profitability of rubber plantations is greater in the short-term than benefits gained from either ecosystem services or other agroforestry options, then market-based incentives and eco-compensation policies are doomed to fail. How profitable are rubber plantations and what is the spatial variability in profitability? Where are the least productive rubber plantations and what is the opportunity cost associated with removing them from production? What scale of ecological compensation is necessary to promote forest recovery? Plantations above 900 m elevation or on slopes >24°were not profitable even with very high rubber prices in Xishuangbanna. Previous studies have shown that the opportunity cost of protecting tropical biodiversity could be very high in the future because of increased per capita consumption by human populations and the continued expansion of cash crops and monoculture plantations, e.g. oil palm, rubber, and eucalyptus. While a great deal of interest in compensation schemes based on carbon sequestration and water conservation, early evaluations indicate that the carbon market and market value of water cannot compete with the profitability of oil palm, my study highlights the spatial variability of economic benefit from rubber. Even though conversion can lead to substantial profits, the ultimate return is site dependent and a detailed spatially explicit analysis can identify those locations where NPV is negative or vulnerable to market fluctuations and eco-compensation mechanisms will work . Ultimately, the research can provide a spatial scheme of minimizing opportunity cost for the local community of smallholders and maximizing biodiversity conservation for the wider community of people in future land use planning.

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Topic: 04. Mekong Basin landuse (non-forest) dynamics

The necessity to carry out land use remote sensing dynamic monitoring of the Mekong Basin and little idea

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With the rapid development of the socio-economy, eco-environmental problems have become increasingly prominent. Traditional monitoring methods cannot meet the demand for dynamic and macro eco-environment monitoring. Remote sensing (RS) technology owns many advantages and has been widely used in eco-environment monitoring. In recent years, with the population growth and economic development, land degradation, water pollution, loss of biodiversity and other eco-environmental problems have become increasingly prominent in the Mekong Basin. Therefore, using RS technology to monitor land use changes, and then to study the impacts of land use on the eco-environment based on monitoring results, will contribute to the eco-environmental protection and rational utilization of land resources and provide scientific and technological support for the comprehensive management of the Mekong Basin. Under the promoting of the IGBP (International Geosphere-Biosphere Program) and the HDP (Human Dimensions Program), land use and land cover change (LUCC) has become a frontier and hot spot problem of global change study. Many countries and international organizations have started their own LUCC research projects. Since 1980s, China has done a lot of related work, especially the Chinese Academy of Sciences (CAS), using RS technology, had established a complete set of Chinese National 1:100000 Land Use Database from the late 1980s to 2010 every five years (each covering about 9.6 million km2). The Mekong Basin (almost 800,000 km2) also has some eco-environmental problems, but a unified set of high-resolution land use database has not yet appeared. Therefore, in order to eco-environment protection of the whole basin, we plan to establish one Mekong Basin Land Use Database according to the work experience of Chinese National Land Use Database. CAS has completed the land use RS monitoring of the upper Mekong Basin in China (almost 165,000 km2), Therefore, we plan to carry out land use monitoring of the whole basin still using the same methods. Specific as follows: Data sources: mainly adopt Landsat-TM/ETM (spatial resolution 30 m) satellite data from the late 1980s to 2005 and domestic HJ-1 (30 m) and CBERS (20 m) satellite images in 2010. Information extraction methods: Human-machine interactive interpreting. Land use classification system: basically adopt the land use classification system of CAS, including 6 first level classes, 25 secondary classes: Cropland (Paddy land and Dry land), Woodland (Forest, Shrub, Woods and Others), Grassland (Dense grass, Moderate grass and Sparse grass), Water body (Stream and rivers, Lakes, Reservior and ponds, Permanent ice and snow, Beach and shore and Bottomland), Built-up land (Urban built-up, Rural settlements and Others) and Unused land (Sandy land, Gobi, Salina, Swampland, Bare soil, Bare rock and Others). In the specific implementation, the program will make reasonable adjustments according to field situation.

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Poster 305 – 05 Mekong Basin hydrology and hydrography

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Topic: 05. Mekong Basin hydrology and hydrography

Potential Ecological and Social Tipping Elements in Asian Highland

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The Asian Highlands, known as Asia's water tower, is critically important for the livelihoods of over 3 billion people. Yet there is little known about what may be potential ecological tipping elements that could affect the region as climate change and other regional forces continue over the 21st century. And no attempt has been made to link potential ecological tipping elements with social tipping element counterparts that may result from feedback loops in this complex coupled social ecological system. To build a conceptual framework, we identify 8 ecological tipping elements in the region: glacial ice and snow; permafrost; wetlands and lakes; alpine rangelands; montane forests; upland agriculture; Indian summer monsoon; and stream and river flows. We also identify 5 potential social tipping elements: urban development; food security; rural energy; hydropower development; and human migration. We explore feedbacks between these various elements. Based on this analysis, we offer policy guidelines for sustaining ecosystems and human livelihoods in Asian highlands moves further in to what will likely be an ongoing period of increasing environmental uncertainty.

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Topic: 05. Mekong Basin hydrology and hydrography

Flood Hazard Trends in the Mekong River during the 20th century due to monsoon variability

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Flood trends were investigated in four stations of the lower Mekong River. Two types of changes were accounted for: trend in the mean and trend in the variance of the time series. A trend in the mean implies that the average flood events changed with time. A trend in variance implies that the frequency of low and high magnitude floods changed with time (Merz et al., 2012). Results showed that average flood events decreased during the 20th century. However, due to an increase in variance, the frequency of high magnitude floods increase towards the end of the 20th century (Delgado et al., 2010). This increase could not be detected by usual trend tests like Mann Kendall test or the ordinary least squares regression. The results agree with Katz and Brown (1992), who showed that variance changes are more important that changes in mean, when it comes to trends in flood frequency. To investivate possible causes for the detected changes in flood variance, we looked at several large scale atmospheric circulation patterns cited in the literature. The Western Pacific monsoon index (Wang, 2001) showed the greatest resemblance with the flood data. A test of step change in variance was conducted which revealed a coinciding step change in variance between annual maximum discharge and the Western Pacific monsoon. A statistical model where monsoon variance forces flood frequency in the 20th century was tested. The results were statistically significant. This has the advantadge of by-passing the use of precipitation, which in this region is collected in a rather sparse network. Concerning climate change projections, a dynamic index like the Western Pacific monsoon index is better simulated by climate models than tropical precipitation (Wang, 2004, Douville et al. 2005). Another important result is the attribution of the detected changes. The Mekong River basin is located in a transition zone between the Indian and the Pacific oceans. Our results showed that the interannual variability of floods in the lower Mekong are significantly more affected by the Western Pacific ocean than by the Indian ocean. Another important potential forcing was found in the Pacific Decadal Oscillation, although further research is still necessary to validate the hypothesis.

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Topic: 05. Mekong Basin hydrology and hydrography

The Southeast Asian water cycle: Challenges and opportunities of (sub-)seasonal foreshadowing

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Southeast Asia is a key region of seasonal advance and retreat of the Asian monsoon and its individual branches, and thus of the global monsoon and its seasonally evolving and fading dynamics. During boreal summer the regional water cycle underlies cooperative and competitive actions of South and East Asian monsoons, notably of their Bay of Bengal and Northwestern Pacific branches. Unfortunately, monsoon prediction from observation is not very successful as yet, and monsoon simulation by contemporary models of the general circulation (GCMs) is notoriously difficult. Indispensable elements and even the very nature of the phenomenon "monsoon" are under persistent debate. A dilemma arises with a view on projections of climate change: The hydrological cycle is not just an object of climate variability and change, but rather an active part, if not even a major pacemaker, of the present-day "monsoon climate" regime on Earth. Whereas asserted longer-term forecasting capabilities of GCMs may be posed into question due to their poor representation of the water cycle, however, monsoon dynamics may favour sub- to inter-seasonal 'foreshadowing' by itself, namely by the intraseasonal oscillation it bears in boreal summer, the 40-60 days active-break monsoon cycle. Though a broadband phenomenon, this cyclic activity is a salient, defining feature of the system's dynamical status which is of high agricultural and societal importance at the same time. Its signature is found in a broad diversity of parameters, from the river basin scale up to the Earth's rotation. Monsoon 'foreshadowing' means not just blurred forcasting due to data uncertainty or improper model performance. It bears a conceptual alternative in that it exploits a blend of qualitative and quantitative knowledge about the system's dynamical organization and actual status, based on both observation and modelling. Surprisingly correct prototype monsoon solutions have been found in a 'small' yet physically resolved tropospheric GCM. The system's complex motions, including related synoptic phenomena like typhoons or westerly wind bursts and their seasonal preferences, appear to be part of organized circumglobal dynamics carried by a hierarchy of synchronized planetary waves. The research program and progress to be presented combines conceptual GCM studies and observational data analyses using advanced techniques that may cope with frequency modulations and other vagaries of the data. For higher spatial detail, the GCM's monsoon solution is being traced into higher horizontal resolutions. Data analyses address the Southeast Asian water cycle and its predictability from intraseasonal to centennial scales, and extend from river runoff to the angular momentum of the atmosphere.

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Topic: 05. Mekong Basin hydrology and hydrography

Key Success Factors for the planning, installation and operation of hydro-meteorological measurement networks

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Key Success Factors for the planning, installation and operation of hydro-meteorological measurement networks The importance of hydro-meteorological monitoring information is ranging from flood protection and design tasks in the water sector up to forecasts and warnings to the public. Hydrological and hydro-meteorological monitoring networks provide the data basis for decisions taken at various levels in the administration authorities and water management agencies with regional or national impact. The reliability of measuring systems and networks is essential. Important groundwork for the successful operation of hydrological monitoring networks or flood warning monitoring networks is laid in various stages of the project implementation, such as planning, construction and commissioning. The presentation shows, which layout principles in the functional design of a measuring system or a gauging site need to be considered. It introduces the possibilities and the importance of redundant concepts in the fields of sensor layout, communication ways, and energy supply and provides some case scenarios. Particular focus is given to current transmission technologies such as GSM / GPRS, SMS, radio and satellite communication, especially in relation to application and combination with monitoring stations in remote areas. Furthermore, the presentation explains the potential of new IP-based communication solutions for the monitoring network management and the distribution of data. The second part of the lecture concentrates on the implementation of monitoring network projects in a country. Important aspects of successful project management are discussed, highlighting their importance in the process of installation and commissioning. Crucial for the sustainable success of a project is a strong capacity building on the user side. Illustrative examples show, how users are involved and guided step by step by experts to empower them to successfully operate measuring systems and networks. The sustainably successful implementation of monitoring networks is not a coincidence – this presentation by OTT Hydromet shares the essence of decades of experience in the implementation of monitoring networks providing many examples and vivid case scenarios.

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Poster 306 - 06. Hazards and disaster risk reduction in the Mekong Basin

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Topic: 06. Hazards and disaster risk reduction in the Mekong Basin

Towards measuring and understanding the vulnerability of agricultural production to flood: Some insights from Battambang Province, Cambodia

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The study aims to develop a methodology to measure and understand the vulnerability of agricultural production to flood. The pilot study area is the Sangkae River watershed (Battambang province, Cambodia), partly located in the Tonle Sap Lake and river hydrological system. The study is conducted in conjunction with the provincial spatial planning team hosted by the Provincial Department of Land Management and can be viewed as a first step toward a flood management decision-making tool for provincial authorities. Flood hazards are not restricted to the downstream lowland Tonle Sap plain; the study also considers river overflows and run-off flood events occurring mid- and upstream. We address the concept of vulnerability in three dimensions (exposure, sensitivity and adaption capacity) and operationalized it in a multi-scale framework including watershed-wide, commune and household level analyses. The analysis of time-series climate/hydrological and land use data puts flood hazards in the socio-economic context of the whole catchment area. At commune level (n=31), a participatory mapping process based on aerial photos allow comparing a minor [usual] flood event and a major [severe] flood (i.e. in 2011). We also take into account primary and secondary data relevant to the impacts of floods on the agricultural production and the adaptive capacity. The study identifies exposure, sensitivity and adaptive capacity indexes and analyzes them, both statistically and spatially with a geographic information system. We then combine these indexes in an overall commune vulnerability [composite] index. On that basis, we elaborate a commune typology to analyze the different types of vulnerability across the watershed. A household survey (n=114), conducted in specific agro-ecological regions in the watershed, allows revealing the variability of vulnerability between households in a given community. The results of the study show the link between the vulnerability of agriculture to flood and the different farming systems of rural communities, which depend on the agro-ecology and on their socio-economic status.

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Topic: 06. Hazards and disaster risk reduction in the Mekong Basin

Reconciling Perception and Reality: Vulnerabilities in the Mekong Delta

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Many climate sensitive regions and communities are unprepared for climate-induced natural disasters due to mismatch in perception with their respective risks. In order to properly use the knowledge gained from our understanding of climate change, there is a critical need to understand the social context and perception of those who are affected by climate change. Understanding these perceptions to natural disaster and climate change is crucial because how individuals, authorities, and communities perceive these disastrous flood risks will inform how they prepare for future threats. Using the Mekong Delta region in Vietnam as an example, we discuss our current efforts to assess vulnerability in threatened villages/communes and their perceptions to climate related threats at the community and individual levels. In this presentation, we show preliminary findings from our questionnaire survey in the Mekong Delta, which was carried out in coastal, inland, downstream, and upstream communities. Due to the diverse geography, each region faces its own forms of disasters and has subsequently developed different strategies to climate proof their economies. By understand the historical, geographic, and environmental circumstances, we explain the differences in real and perceived vulnerabilities. Generally, it has been found that perceptions are lower than actual vulnerabilities. While community based actions will play an important role in responding to disasters, there is a critical need to bring in technical, institutional, and financial expertise to design climate adaptation strategies that are appropriate for each community.

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Topic: 06. Hazards and disaster risk reduction in the Mekong Basin

Towards a pre-operational water-quality warning system for the Lower Mekong (Hau River)

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Explosions, huge fires, and storms often cause chemical spills in major rivers that eventually damage the economy and ecology of large and densely populated regions. Notorious examples are the Sandoz accident at Rhine River (1986) and the Harbin chemical spill at Amur River (2005). The talk describes scientific aspects of these events, namely a numerical simulation model for longitudinal and transversal transport and mixing processes of harmful matter in a network formed by the Hau and the Can Tho rivers. The network is taken as an abstract graph with 18 logical nodes and 23 edges. The tidally controlled discharges are assumed to be given half-hourly, e.g. by MIKE11. The region under study is bounded by Vam-Nao junction and East Sea. The presented model enables the prediction of the development and transport of a contamination plume along the Hau river. The derived information may serve as a decision support for disaster management and mitigation. The model has pre-operational status but may be coupled operationally with an existing MIKE11 hydrodynamic model of the whole Mekong delta.

Poster: 306 - 4

Topic: 06. Hazards and disaster risk reduction in the Mekong Basin

Investing in disaster risk reduction in the floodplains of the Lower Mekong River Basin: The Case of Safe Hills in Cambodia

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Some of the most marginalized and vulnerable communities who live in the flood - prone regions of Cambodia are affected by the changing hydrological conditions of the Mekong Basin and its tributaries. These changes are attributed to seasonal natural hazards as well as human-induced factors, notably environmental degradation. With the influence of global climate change, more people will be further impacted by the floods and other hydro-meteorological hazards and extreme events, particularly those who live in extreme poverty or are affected by powerlessness. One major consequence of this phenomenon is more unplanned movements to unsafe locations, as demonstrated in Cambodia's recent experiences with extreme weather events such as the typhoons Ketsana and Nesat in 2009 and 2011. Localized flooding from monsoon rains and rising river and coastal waters have also been driving these unplanned movements, many of them temporary, to higher grounds or what locals consider as 'safe hills." Literature on disaster risk reduction (DRR) argues that investing in effective disaster risk reduction strategies can substantially minimise the damage and loss from disasters. Strategic investments which are framed and carried out by mainstreaming DRR into development planning and budgeting are widely accepted. The use of safe hills in Cambodia had been referred to as part of traditional coping strategy of local populations during and after floods. In light of the recent floods, there have been calls to seriously invest in constructing safe hills or evacuation areas as a major disaster preparedness measure. Field data gathered from affected provinces in Cambodia, particularly in Pursat and Kratie, as well as in the North-East, show that there is a gap in strategic investments in disaster risk reduction, and there is hardly local expertise to address accompanying structural mitigation requirements. Structural interventions such as the designation of safe areas and access routes are essential aspects of effective flood risk management. In the light of the above, this paper will explore the strategies, approaches, and insights required for establishing safe hills as a robust disaster risk reduction measure. It then tries to locate safe hills in the context of larger resilience – building efforts by assessing past and present practices and mechanism and perceptions of safe hills/areas in the two provinces - Pursat and Kratie - of Cambodia. Lastly, the paper discusses some of the key policy and planning issues for greater inclusion of safe hills and related structural measures with respect to mainstreaming development and DRR mechanism and potential implications for policy makers and development agencies.

Poster: 306 - 5

Topic: 06. Hazards and disaster risk reduction in the Mekong Basin

Assessing vulnerability and the effectiveness of adaptation in the Mekong delta

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The Mekong Delta in Vietnam is expected to face challenges from various forms of climate change such impacts as sea level rise, storm surge, flooding, and saline water intrusion. However, a growing population, which currently stands at 18.6 million people lives in the Mekong Delta. First, the authors outline the current state of vulnerability assessment for the Mekong Delta in Vietnam, and propose the application of assessment in this area. Vulnerability to climate change is a function of the magnitude of the exposures, the resilience of the society to the exposures. Second, we evaluate some exposures such as sea level rise and storm surge, and the resilience using demographic data such as population, life expectancy, income, and education. Third, we clarify adaptation options in this area based on the field and literature surveys. Consequently, we discuss appropriate adaptation in accordance with local situations.

Poster: 306 - 6

Topic: 06. Hazards and disaster risk reduction in the Mekong Basin

What influences the decision of flood-prone residents in Can Tho City to protect themselves against flood impacts?

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Floods are currently the most frequent and most devastating climatic hazard world-wide (World Bank 2012). In the future, flood hazards and associated harm for people and economic assets is projected to increase further in many places due to the effects of climate change on water resources and a growing urbanization in flood-prone areas (World Bank 2010). Vietnam, and especially the Mekong Delta are considered as one of the most vulnerable regions in the world to the projected increase in flood hazards (Dasgupta et al. 2009). Against the background of the severe losses and the considerable uncertainty surrounding the projected changes in flood risk, a shift in flood risk management strategies could be observed in many countries toward more integrated flood risk management concepts (Few 2003; Buechele et al. 2006). In addition to adaptation strategies implemented on national and regional levels by governments, such integrated approaches often also envisage a contribution of private households to damage reduction by implementing flood mitigation measures. Common damage-reducing measures that can be adopted by private households are, amongst other things, flood adapted building use or the deployment of flood barriers. Previous studies have demonstrated that these types of measures are effective and often cost-efficient (Kreibich et al. 2011, 2012). However, despite the particularly high exposure of developing countries to current and projected flood impacts, insights into factors that drive flood mitigation behaviour in these countries are widely lacking (Bubeck et al. 2012a; Bubeck et al. 2012b). Here, we use empirical data from face to face interviews with 860 flood-prone residents in Can Tho City in the Vietnamese Mekong Delta to gain better insights into the factors that influence flood-precautionary behaviour. Amongst other things, we find that flood experience and flood coping appraisals influence the decision of flood-prone residents to undertake flood mitigation measures. Recommendations for the stimulation of flood-precautionary behaviour in the Mekong Delta are provided.

Poster: 306 - 7

Topic: 06. Hazards and disaster risk reduction in the Mekong Basin

Multi Temporal and Spatial delineation of Flood situation in the Lower Mekong basin using Modis satellite images

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MODIS satellite image data (MOD09A1, 500m spatial resolutions, 8 days composite) in the lower Mekong basin from 26/02/2000 to 27/12/2011 were used to monitor changes in flood situation. The results showed that Multi Temporal MODIS–MOD09A1 data has a great ability to detect changes in flood at the country and regional scales, which closed correlation with daily water-level data recorded at hydrological monitoring stations (R2: (0,79; 0,90)). There also have the close correlation between Enhanced Vegetation Index (EVI) and Land Surface Water Index (LSWI), and between growing stages of plants and surface water. The developed inundation maps was assited to evaluate the extent and temporal characteristics of annual floods in the Mekong delta.

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06.03.2013 from 09:45 – 10:15

Poster 312 - 12. Capacity building, education and outreach

Poster: 312- 1

Topic: 12. Capacity building, education and outreach

Improving Water Use Efficiency in Irrigation System of Mahaweli H in Sri Lanka

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High water losses and illegal tapping are common in cultivation areas of Mahaweli system H, Sri Lanka. Most often, farmers go for high water consuming paddy cultivation in minor season (Yala) in its place of low water consuming field crops. This situation occurs due to the fact of not giving a real value for water and not having a real sentiment on water among farmers. Therefore, the objectives of this study were mainly focused on investigating different solutions that can be used to improve the present status of water use efficiency in irrigation and to evaluate farmer's willingness to pay for a reliable water supply in Katiyawa area at Mahailluppallama, Sri Lanka. Clarifying the reliability of existing irrigation water supply provide the required amount at field after conveyance and investigation of the importance of training and awareness programmers are the other objectives to be fulfilled. Different Participatory Rural Appraisal (PRA) techniques were used to identify the problems and solutions for the situation of increasing water scarcity situation. According to the Resource map, land use Pattern and the type of crops cultivated along the field canals could be identified. This reveals that the crop pattern has not changed even at the tail end. This is because they use water in drainage canal for cultivation. The negative sign of the location dummy in statistical analysis indicates that the people in head end of the canal are against the water pricing and farmers are also significantly different from tail end farmers about water pricing. Farmers with higher income are willing to pay for the irrigation water. Education level of farmers reveals that most of them are not much educated. So it can be depicted that this could reflect in high water losses due to lack of knowledge. Water savings can be made through a change in cropping pattern via reducing the area planted with paddy. Tariffs could be introduced in Sri Lanka with the aim of reducing water consumption, although there is no sound international experience to show the effect of irrigation tariffs on consumption. If tariffs were to be introduced to farmers in Sri Lanka, the choice of tariff levels will require considerable extra social and technical studies as well as pilot projects. Ultimately this could lead to a sustainable Participatory Irrigation Management (PIM) system in Sri Lanka.

Person

Poster: 312 - 2

Topic: 12. Capacity building, education and outreach

Measurement for Sewage Sludge

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For measuring the effect of toxic substances in sewage against activated sludge a new short term measurement device was developed. For this purpose a new experimental setup of a respirometer with sludge recycling was used. Therefore sewage, sludge and air are pumped into its two continuously cascades (reference and measurement cascade). The measurement device is divided into four steps. The first two once are used to sensitize the activated sludge and the following once for waste water exposure and data collection. The toximeter will be equipped with an online turbidity measurement device, to determine the activated sludge concentration and growth. In a first experimental step the endogenous respiration of the sludge ("ASR") is measured continuously with two oxygen sensors. It could be shown that toxic substances lower the ASR value. In this work, the influence of concentration, load and amount of toxic substances (e.g. KCN, dichlorophenol) were investigated. The measurement process was optimized by improving the residence time, to consider the toxins exposure time is appropriate and the rapidly degradable nutrients were not consumed in the first two steps of the measurement device. Also the air supply of the two cascades was optimized, due to the oxygen consumption of the micro-organisms with a high growth rate. In a further step the toxicity measurement was made more sensitive by influencing the bacterial population of the sludge by using of special nutrient solutions which were added at various points in the analytical device (cascade pots of sludge recycling). The growth rate of the micro-organisms is an important parameter to sensitize activated sludge. Therefore peptone, a nitrogen and phosphorous source were added directly into the sludge recycling and a rapidly degradable source such as sodium acetate to the continuously cascade. Additionally the influence of nutrient limitation will be investigated. The results were compared with an online nitrification respirometer the "Nitritox" and also with results described in the literature.

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07.03.2013 from 09:45 – 10:15

Poster 307 - 07. Mekong Basin aquatic ecology, biodiversity and water quality protection

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Topic: 07. Mekong Basin aquatic ecology, biodiversity and water quality protection

Study on community based water management model in Phu Tan and Tan Chau districts, An Giang province, Vietnam

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The objective of this study was to find out the effectiveness of the water resources management based on the community compared to the traditional management in Angiang Province. Using qualitative and quantitative analysis methods based on household interviews, group discussions, KIP interviews and water sample analysis have been conducted in Phu Tan and Tan Chau Districts. According to this research, these areas have implemented new water management model obtained achievement significantly in terms of socio-economic and environment. After establishing this model in 2009, the results of this study are that (1) declining the numbers of labor-days about 5 days.crop-1 and (2) reducing the costs of irrigation due to decrease the numbers of waterlogged crop than before, in 2005, with about 2 times.year-1; (3) the average capital efficiency.crop-1.1000m-2 was higher, compared between 0.85 in 2009 and 0.71 in 2005; (4) Awareness about enviroment protection within local people has also been improved than before; (5) Increasing of the social efficiency; the new monitoring way created the connection with other regions and increased community relationships that solved conflicts within local people in terms of local irrigation system. Beside that, in order to be better water management system, the role of the community should be strengthen and raised their awareness about this model as well as facilitated sub-regional management board whose have opportunity to improve skills of community management, and knowledge of hydrology and irrigation systems.

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Topic: 07. Mekong Basin aquatic ecology, biodiversity and water quality protection

Water quality indicators for sustainable rice production

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The Sustainable Rice Platform is a multi-stakeholder international platform which aims to develop science-based sustainability guidelines for rice production and to provide tools to monitor and improve the performance of rice-based cropping systems. The sustainability of fertilizer and pest management options is assessed in part by farm- and landscape-level water quality indicators. Based on their relevance to rice farming practices and the feasibility of wide-scale monitoring, we propose a set of water quality indicators to monitor over time. We would like to receive feedback from symposium participants to prioritize and improve these indicators.

Poster: 307 - 3

Topic: 07. Mekong Basin aquatic ecology, biodiversity and water quality protection

Study of environmental flow in IWRM for Ayeyarwaddy River Basin

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Ayeyarwaddy river is the most important lifeblood river in Myanmar. It is about 1350 miles or 2170 km long and has a drainage area of about 413,000 square kilometers which covers about 55 percent of the total land area of the country.Water- Energy-Food security of Myanmar depends mainly upon the ecosystem of the Ayeyarwaddy river. Different water users (i.e. rural, urban, irrigated agriculture, commercial industry, foresty , cultural sites are present along the Ayeyarwaddy river. Aquatic ecosystem of Ayeyarwaddy river is being threaten by the implementation of new water infrastructure for electricity, increasing population growth . Therefore, assessment of environmental flow is essentially required for Ayeyarwaddy river basin as it provides contribution to river health and aquatic ecosystem. Assessing environmental flow is in order to guarantee sufficient flows at all times to meet basic human water needs and sustain aquatic ecosystem. Maintaining the natural flow variability plays a major role in conserving native riverine biota and river ecosystem integrity. Hydrological Desktop Analysis method is used for assessing the environmental flow requirement. Daily discharge is used in estimating environmental flow. Scenario analysis approach is performed by using the Water Evaulation And Planning (WEAP) models in order to access the impacts due to possible future water demand. Assessing the amount of environmental flow requirement for Ayeyarwaddy river will be more highlighted and strengthen the integrated water resource management (IWRM) approach to build capacity building, institutional arrangement and public participation for Myanmar Water Sectors

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Topic: 07. Mekong Basin aquatic ecology, biodiversity and water quality protection

Several caisson sluices and pier sluice technology, feasible solutions for discharge sluices in a large estaury at Mekong Delta, Vietnam

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In the Mekong Delta Vietnam, the construction of sluices with the purpose of retaining fresh water and preventing salt water intrusion potentially play a very important role. However, the structures constructed in small rivers according to local or traditional technology revealed many disadvantages related to the economical, evacuations and ecological conditions. Hence, the demand for large sluices in the larger rivers and estuaries is increasing. In the Netherlands, several units of sluice caisson have been applied but their main function was only to permanently close the basin, while in Viet Nam only single caissons are applied as small river barriers. It is to noted that a large discharge sluice with several units of caisson has never been built so far in Vietnam or in the Netherlands. In contrast with this type of structure, most discharge sluices and barriers in the world have been built according to the “pier structure type”. In the Netherlands piers and bottom slabs are normally placed on batter pile foundations. In Viet Nam, piers are often placed on vertical pile foundations and a bottom slab is replaced by supporting beams. Both “proven structure”- caissons and piers have their own strong and weak points; by combining the best features of “proven sluice technologies” of the Netherlands and Viet Nam, appropriate structure types were designed and the most critical concerns related to them were checked. The final results show that they are feasible solutions for the sluices in the large estuary branches in the Mekong Delta Vietnam, which can be applied to discharge a large amount of water, prevent tidal penetration and retain fresh water.

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07.03.2013 from 09:45 – 10:15

Poster 309 - 09. Mekong Delta: Climate change related challenges

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Topic: 09. Mekong Delta: Climate change related challenges

Improving adaptive capacity of small-scale rice farmers: Comparative analysis of Lao PDR and the Philippines (SUMERNET AN-14)

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Lao PDR and the Philippines are among the Asian countries whose exposure to climate risks seriously threatens livelihood, particularly of those in the agriculture sector. The paper presents a comparative analysis of the adaptive capacity and current adaptation strategies of small-scale rice farm households in these countries. The objective is to determine specific interventions that would improve household adaptive capacity to a changing climate, particularly extreme events, and draw comparative lessons for possible uptake of other countries. Adaptive capacity is the property of a system to adjust its characteristics or behavior, in order to expand its coping range under existing climate variability, or future climate conditions (Brooks and Adger 2005). The analysis focused on two top rice-producing provinces in each country that are vulnerable to climate risks. It covered three rice production environments or ecozones – irrigated lowland, rainfed lowland, and rainfed upland in two cropping seasons, wet and dry. Sources of data include survey of rice farmers; key informant interviews of local government officials; focus group discussions with farmer and village leaders and extension workers; and local government reports. Calculation of adaptive capacity index adopted the procedure applied by the United Nations Development Program (cited in Swanson et al. 2007) on the Human Development Index. Indicators of household adaptive capacity include natural resources (land and water); physical assets (housing, services and communication facilities); economic assets (income, access to credit); social capital (membership in associations); and human capital (education, skills and knowledge). The analysis links the farm households and local government units by finding out where interventions would matter the most. The losses and damages experienced by the households show that livelihoods of poor farmers are largely natural resource-based and thus highly vulnerable to climate risks. The impacts of extreme events (e.g., of drought, typhoon) vary by location, ecozone, and cropping season. Farmers, particularly in ainfed areas, have limited access to adaptation technologies and alternative livelihood sources. In the Philippines, farmers expressed the need for improved farming technologies, funding, skills and knowledge on adaptation to changing climate, and advance warning of climate events. In Lao PDR, farmers need support for flood resistant rice varieties and better infrastructure because of vulnerability to flooding and landslides. Being at the front line in providing services to the community, local governments should implement policies and programs that cater to the specific needs of households to cope with and adapt to a changing climate. They should also be able to leverage and harness external support when their own resources are limited.

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Topic: 09. Mekong Delta: Climate change related challenges

Application of livelihood vulnerability index to assess risks from flood vulnerability and climate variability – A case study in the Mekong Delta of Vietnam (SUMERNET AN-05)

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An Giang of the Mekong Delta is one of the most vulnerable provinces to flood vulnerability, climate variability, and annual flood. Several thousand households are living in a high risk area of serious flood damage. Current management interventions remain a challenging task for decision makers and local communities have a limited understanding about them, leading their livelihoods more vulnerable to flood and poverty. This study applied the livelihood vulnerability index (LVI) that developed by Hahn M.B., et al. (2009) to estimate flood vulnerability in An Phu and Tri Ton districts of An Giang province. We surveyed 120 households in each district to collect data on socio-demographics, livelihoods, health, social networks, physical and finance, natural resources, natural disasters and climate variability. These data were used to calculate the LVIs of two districts with a composite index and differential vulnerabilities. These results show that the overall LVI of An Phu is higher than overall LVI of Tri Ton district. This practical method can be applied also for other purposes, for examples, to monitor vulnerability, evaluate the effectiveness of potential programs or policies by introducing different scenarios into the LVI model for a comparison with the baseline conditions.

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Topic: 09. Mekong Delta: Climate change related challenges

Recent morphological changes in the deltaic Mekong and Bassac river channels: natural or anthropogenic?

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Although climate change, notably via sea-level rise, will have considerable impacts on deltas in the coming decades, these negative effects, which include vulnerability to flooding, increase in conversion of lands to ocean, and shoreline retreat, are strongly exacerbated by human activities (Syvitski et al., 2009). On many of the world's deltas, the importance of direct anthropogenic effects in determining effective sea-level rise play a more important role than the more comprehensively studied climate change–sea-level rise question (Ericson et al., 2006). The Mekong river is undergoing significant changes related to various activities, including, agriculture, hydropower dams and river-bed aggregate extraction, among others. Changes in the morphology of the two main channels of the Mekong River in the 250 km-long delta reach from the Cambodian border to the sea, the Mekong and Bassac channels, were analysed using maps and Landsat® and SPOT® satellite images from 1965 to 2008/2009. The results show a significant increase in the mobility of the riverbanks since the early 1990s, with important accretion. The geometry and morphology of the two channels, analysed from bathymetric data for 1998 and 2008, display important irregular bed incision, with expansion and deepening of numerous pools. These changes probably explain the more rapid bank mobility. The mean depth of both channels has increased by more than 1.5 m between 1995 and 2008. Mean longitudinal bed incision rates in the Mekong channel are similar to those in the Bassac channel even though the former conveys more than 15 times the liquid discharge of the latter. Correlations between bed incision and hydraulic parameters are extremely weak, suggesting that the marked morphological changes are not in equilibrium with flow and sediment entrainment conditions, and are therefore not related to changes in river hydrology. We assume that aggregate extraction, currently practised on a very large scale in the two channels, is the main driver of these recent morphological changes. A similar impact has been shown by Luo et al. (2007) for the Pearl River. Future large-scale hydropower dam development on the Lower Mekong mainstream will have cumulative effects, leading to increased morphological changes that should be felt rapidly as the system is already impacted. As the banks of the Mekong delta channels are the most densely inhabited areas of the basin, these changes will have significant socio-economical consequences. They will also strongly impact on the Mekong delta. References Ericson, J.P. et al., 2006. Effective sea-level rise and deltas: Causes of change and human dimension implications. Global and Planetary Change 50, 63-82. Syvitski, J.P.M. et al., 2009. Sinking deltas due to human activities. Nature Geoscience 2, 681–686. Luo et al., 2007. Effects of in-channel sand excavation on the hydrology of the Pearl River Delta, China. Journal of Hydrology, 343, 230– 239.

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Topic: 09. Mekong Delta: Climate change related challenges

Inorganic and organic amendment related to CO2, CH4, N2O emission from Rambutan (Nephelium Lappaceum L.) orchard in the Mekong Delta

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Agricultural production contributes to greenhouse gas emission through pesticides spraying, fertilization and water management. Fruit orchards are cultivated in large areas in the Mekong delta where farmers have applied large quantity of fertilizers. The gas emission due to fertilization for fruit orchard has not been documented. The objective of this study was to determine the emission of CO2, CH4 and N2O by organic amendment on rambutan orchard in Ben Tre province. Three different composts, 10 Mg.ha-1 in combination with a low dose of inorganic fertilizers were applied in comparison with farmer's practice. Gas sampling was executed after organic amendment and four nitrogen split applications during plant growth of two crop seasons. Results showed that organic amendment released from 84.8- 171.9 tons of CO2.ha-1 higher than farmer's practice, 51.2 tons of CO2. ha-1 ($P < 0,05$). Among three kinds of organic substrates, biogas slug released highest amount of CO2 compared to sugarcane filter cake compost and vermi-compost. A high dose of inorganic nitrogen application from farmer's practice led to large content of N2O emission, 425 tons CO2-eq ha-1 in comparison to 250 tons CO2-eq ha-1 ($P < 0,05$) in organic amendment. The high content of available NH4+ và NO3 in soil can be the explanation for high N2O emission from farmer's practice field. Besides, CH4 emission was not detected, except low level was found in the initial stage of biogas slug application. In terms of CO2-equivalent, organic amendment of 10 Mg.ha-1 in combination with a low dose of inorganic nitrogen fertilizer resulted in a much lesser extent of greenhouse gas emission compared to application only inorganic fertilizer as farmer's practice. In addition, application sugarcane filter cake compost resulted in the highest fruit yield ($P < 0,05$).

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Topic: 09. Mekong Delta: Climate change related challenges

Seasonal and inter-annual bio-optical variability of the Mekong delta region and neighboring coastal waters as assessed from ocean color satellite observations

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LOG

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Coastal river plumes represent one of the final stages of material transport across the land-sea interface. The high nutrient fluxes from the land uses via river runoff directly impact the concentration of phytoplankton in coastal areas. Chlorophyll-a concentration, Chl-a, a common pigment of all phytoplankton species, can be used as a tracer of nutrient enrichment and related eutrophication processes. Satellite remote sensing of ocean color, from which Chl-a and other biogeochemical products can be estimated, is a very powerful tool for the management of resources and activities of continental shelf waters. Satellite data are not as accurate as in-situ measurements and are limited to the surface layer. However, the latter limitations are largely compensated by the spatial and temporal coverage offered by the satellite observations. The present study is dedicated to the analysis of the spatio-temporal variability of the biogeochemical composition of the Mekong delta region and neighboring coastal waters from the MERIS ocean color mission. MERIS was launched in 2002 and offers today long-term observations of almost 10 years at a full resolution of 300 m. We will particularly focus on the evolution of the phytoplankton biomass, suspended particulate matter, colored dissolved organic matter, as well as particles size index. The retrieval accuracy of these different remotely sensed parameters will be performed using field bio-optical data collected in the studied area.

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Topic: 09. Mekong Delta: Climate change related challenges

Climate change adaptation through climate sensitive flood management in the Lower Mekong Basin

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The Mekong River Commission (MRC) is an international, country-driven river basin organisation that provides the institutional framework to promote regional cooperation in order to implement the 1995 Agreement between the Governments of Cambodia, Lao PDR, Thailand and Viet Nam. Under the MRC umbrella, the Regional Flood Management and Mitigation Centre (RFMMC) plays an important role in maintaining the availability of important flood-related tools, data and knowledge; producing accurate regional forecasts with suitable lead time and a timely and effective dissemination; and providing accurate, well documented and consistent tools for basin-wide flood risks assessment and trans-boundary impact assessment. Flood forecasting, and thereby flood management and mitigation is one of the core functions of the MRC. An increasing variability in water levels over the recent decade and an increase in extreme floods (2000, 2001, 2008 and 2011), this has caused widespread damage and continues to threaten people's livelihood and even lives. It is a challenge for the MRC to develop customized flood forecasting systems that incorporate state-of-the-art climate data, information and modelling. The MRC and its Member Countries are currently lacking a sufficient body of reliable climate data and information as well as the technological systems to process this data and information. The existing forecasting system, which has already contributed to avoiding damage in the Lower Mekong Basin (LMB), needs to be upgraded. In this context, the Federal Republic of Germany is based on the Strategic Framework for the Cooperation between the MRC and the Federal Republic of Germany provides contribution and supports this initiative through the German Ministry of Environment (BMU) and Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ) GmbH. MRC-FMMP implement this together with MRC Member Countries. The support aim at enhancing institutional capacities on the regional, national and also on the decentralized level in climate sensitive flood management in order to reduce the damage caused by extreme flood events; to strengthen the capacities of relevant institutions to adapt to changes in flood patterns resulting from climate change in the LMB. On the long run, this will also contribute to protect the poorest and most vulnerable parts of the population in the four countries from physical damage and losses in income. Moreover, an establishment of sustainable, customized climate information systems should help to strengthen environmental stability of the intricate Mekong ecosystem under climate change conditions. The general approach, methodology and status of developments and progress within the cooperative MRC framework will be presented.

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Topic: 09. Mekong Delta: Climate change related challenges

Projected climate change in the Lancang River Basin using high resolution model under RCP 4.5 scenario

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Lancang River is the headwaters of the Mekong River in the territory of China, and it is not only one of the river in China's southwestern region, but also the ninth river in world, the fourth river in Asia, first long river in Southeast Asia. Based on the observed meteorological data and the high resolution regional climate model which named CCLM, this paper study the climate change including the past period during 1961-2010 and future period under RCP 4.5 scenario in Lancang River Basin. Firstly, observed data about temperature and precipitation will be analysis which came from China Meteorological Information Center. Secondly, assessment will be done about the data of the high resolution regional climate model in Lancang River Basin. Thirdly, some conclusions will be introduced about projected climate change in the Lancang River Basin based on the high resolution regional climate model. Yearly and seasonal climate change trends about temperature and precipitation will be analysis with Mann-Kendall test. And spatial characteristics will be showed using GIS method.

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Topic: 09. Mekong Delta: Climate change related challenges

The effect of biogro fertilizer and alternating wetting –drying irrigation on yield and greenhouse gas emission from a rice field

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Application of biofertiliser and saving irrigation water are two important techniques to sustain rice production in the Mekong Delta. The objective of this study is to quantify the impact of BioGro fertilizer and alternating wetting and drying irrigation technique (AWD) on grain yield and methane and nitrous oxide emission in a rice crop. Trials were conducted in two consecutive rice crops. A two-factors experiment was laid out in a split-split plot where the main-plots were water management practices: alternate wetting and drying irrigation or continuous flooding as farmer's practice. BioGro and N fertiliser were applied to sub plots at 3 levels: (1) 90 kg N/ha (100% treatment), (2) BioGro + 45 kg N/ha and, (3) 45 kg N/ha. Experiment 2 was designed as similar to experiment 1 except without level (3) of N fertilizer. This experiment was used for methane and nitrous oxide gas measurement. In the Summer-Autumn crop, grain yield of plots received BioGro was 5 tones/ha, equivalent to those received 100% of N fertilizer. The AWD method reduced 400m3 /ha, about 22% of irrigation water inputs and increased grain yield (170 kg/ha) compared to continuously flooding practice. In Autumn-Winter crop, the application of BioGro contributed to the reduction of methane and nitrous oxide emission compared with farmer's conventional method. Water saving irrigation practice helped to reduce methane gas emission but increased nitrous oxide emission. Results showed that BioGro biofertiliser application and AWD practice are feasible and economical for intensive rice production system in the Mekong Delta.

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Topic: 09. Mekong Delta: Climate change related challenges

Mainstreaming innovations in sustainable water management - The case studies of HCMC and Singapore

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Ho Chi Minh city (HCMC) is in the rear of Vietnam's Mekong delta region and is the most populated city of Vietnam. The city is also one of the world's cities most affected by climate change. During the recent years, this city has been undergoing severe water related problems, especially the urban flooding. Mitigating the urban flooding in this city requires more sustainable water manangement strategies to be mainstreamed into the city's structure. Among the world's successful case studies of mainstreaming sustainable water management, Singapore, offers good lessons that can be learnt for HCMC. Therefore, this research uses comparisons between Singapore and HCMC's water practices to analyse key challenges and opportunities in enabling sustainable water management in HCMC. Through this analysis, the paper suggests feasible strategies of mainstreaming sustainable water management in HCMC and gives references for other Mekong delta cities.

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Topic: 09. Mekong Delta: Climate change related challenges

Remote sensing monitoring of vegeation variability in the Mekong river basin

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The Mekong River is considered to be one of the rivers with most rich species in the world. It originates from the Tibetan Plateau and flows southward to the South China Sea through the Indonesia Peninsula. The main vegetation types are agriculture (rice) and forest (rainforest). Rice is the staple food grain for more than half of humanity, and it is the important agricultural product of the South Asia. Mangrove on the east coast of the Mekong delta is a typical tropical tree type, and can prevent the basin from soil erosion, maintain soil moisture, and protect the biodiversity. However, in recent years, the coverage of vegetation on the Mekong River Basin has changed drastically in its types and ranges. Primeval forest has been converted into economic forest for the higher economic value. Large scale of Mangrove has been destroyed, changing into farmland and ponds for aquaculture. Even though some of them have returned to mangrove trees, the replanting capacity is still weaker than the deforestation. In some area, triple rice-cropped style expands rapidly. Some farmers living along the basin abandon their traditional living way and change their rice field to shrimp farming. The main cause for these problems include socioeconomic factors (e.g. urban growth, excessive tree felling, construction of infrastructure, water pollution, agricultural chemicals) and natural factors (e.g. drought, sea level rise, climate change, annual flood). As the population in South Asia will definitely increase in the next few decades, the pressure on natural resources, especially on vegetation ecosystems, will increase dramatically. Thus, monitoring changes of vegetation at regional and global scales is vital to balance human need with the environment. Satellite remote sensing data offer a unique possibility to gain sufficient and practical observations of the earth over a long period. This study explores remote-sensing method obtained from multi-imagery to detect the spatio-temporal changes of vegetation conditions in Mekong River Basin. By analyzing all the information gained from images and other geographic data, this study detects the variability of different vegetation indicators (e.g. productivity, types, and phenology) in the Mekong River Basin. Our result indicates that different natural and socioeconomic factors have various impacts on vegetations in different area of the basin. This may help to evaluate and explain the historic and future ecosystem changes in the Mekong River Basin.

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Topic: 09. Mekong Delta: Climate change related challenges

The Mekong deltaic coast: past, present and future morphology

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This contribution addresses some important issues with regard to the future development of the Mekong Delta in the context of environmental and climate change. After a general review of present and future environmental and morphologic conditions, two highly relevant issues will be discussed in more detail. The first issue concerns the morphological impact of possible construction of discharge sluices in the three main branches of Tien River to prevent salt intrusion. The second issue concerns the impact of sea dike construction on the health of the existing mangrove forests. The Mekong Delta Estuaries play an important role in flood relief, water transportation, water management and land reclamation; however they are also the root of serious problems such as salinity intrusion and tide-induced high water levels. According to possible future development plans, discharge sluices could be constructed in the three main branches of Tien River to prevent salinity intrusion. To evaluate the consequences of these structures to the Mekong Delta Estuaries, an empirical relationship between tidal prism and river cross-section is derived. Based on field observations an important result derived for the Mekong Delta Estuaries is an empirical relationship between the tidal and river discharge prism, P and Q, and the river cross-section, Ac: Ac = 10-3 0.86 = 5.390.86 Using this finding, it is found that the two open branches of Tien River will deepen by more than 10 meters when all three other branches are closed. Thus, mangroves along the river bank of these two branches should be strengthened in order to prevent river bank erosion. Due to the need of land for agriculture and other economic sectors, sea dikes are always built close to or often even in the mangroves forest. Along the Southern Coast of Viet Nam there are many places where mangrove degradation and coastline erosion is observed on a large scale when sea dikes are built too close to or in the mangrove forests. Based on field observations a relationship is derived relating mangroves width and coastline evolution. It is concluded that a critical value of 300 to 400 meters of mangroves width is necessary for the stability of the East Coast of Viet Nam.

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Topic: 09. Mekong Delta: Climate change related challenges

Tilapia cage culture, business management practices and climate risks in the Ping River, northern Thailand

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This paper reports on a study of farming and business management practices of farmers rearing of hybrid red and Nile tilapia (Oreochromis niloticus L) in cages in the upper Ping River in northern Thailand. The findings are based on field surveys carried out between 2005-12 including: a quantitative survey of 275 farming households carried out in 2005; qualitative in-depth interviews with 82 stakeholders in 2005-2007; a follow-up study in 2011 of 80 households previously engaged in fish farming; and a study of risk management practice in late 2012. In 2005 mean stocking density was 49 ± 16 fish m-3, feed conversion ratio 1.47 ± 0.43 kg feed per kg fish and yield density 26.6 ± 8.1 kg m-3. Juvenile fish were reared in cages for 4.5 months. Input costs were dominated by feed (70%) and stock (16%). Most farms borrowed money. Many farms participated in contract farming arrangements in which a brokering firm, in return for a down-payment per fish, supplies fish stock, feed on credit and then purchases the final crop for resale to retailers or fresh markets. Fish farming was usually a component of a portfolio of household activities but for some a core business. To succeed there are several risks which need to be carefully managed including those related to floods, lows flows, episodes of poor water quality and disease outbreaks. In the six-year period 2005-11, 44% of households followed-up had given up fish farming. Economic losses, insufficient capital, and lack of access to good cage sites were the most common reasons for exit. State credit schemes and extension services together with private-sector contracts have turned a supplementary livelihood into a viable, but dynamic industry. Fish farmers manage a complex set of risks including several which are climate-related. There is a need for further study of the risks fish cage farmers in rivers face, as well as identifying how rivers and farms might be better managed to support sustainable aquaculture in a variable and possibly changing climate.

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Topic: 09. Mekong Delta: Climate change related challenges

Policy cycle analysis of drought policies and their impact in Yunan province to come up with suggestions for institutional redesign for improved adaptive capacity

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Policy cycle analysis of drought policies in China is used to find out how to improve the formulation, implementation, monitoring and evaluation of drought policies in particular in Yunan province and the Lancang River Basin. This will lead to suggestions for institutional redesign. Institutions play a major role in adapting to climate change and in this study we looked in particular at the role of the governance system, land allocation and water use institutions and different forms of collaboration between farmers. It was found that some of these institutions are dysfunctional or poorly functioning and institutional redesign is necessary. After summarizing the analysis, suggestions for institutional redesign are provided, emphasizing the role of different actors, different levels of government and new or emerging governance structures to deal with climate change and in particular with the consequences of more serious droughts in Yunan province to improve the situation of rural households in the Lancang River Basin. Results of a small household survey are used to identify the farmers perception of the drought and their strategies to deal with the new situation. Besides institutional redesign, suggestions are made for appropriate incentives in a situation where the government seems to be withdrawing at the local level, after abolishing the important agricultural tax system in 2007. The less important role of government organizations at the village level provides space for other actors, such as individual farmers, and new forms of collaboration between them. In particular the role of emerging governance structures, such as new forms of cooperation, local companies and community organizations will be analyzed. Using the policy cycle analysis framework allows to put the results in terms of feedback for formulating, implementing, monitoring and evaluating drought policies to ensure their effectiveness in achieving an improved adaptive capacity of the relevant governance structures and concerned farmers.

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Topic: 09. Mekong Delta: Climate change related challenges

Changed hydraulic and hydrology pattern in the flood season of the Mekong Delta

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Flood is one of the natural hazards involving serious disruption of functioning of a society but a flood is not necessary a disaster, unless and until it affects people. The physical conditions of the Mekong Delta are subjected to river flooding and high tides in combination with local heavy rainfall. Because of Great Lake regulation that makes flood flow come to the Delta gradually bring more advantages for the people living in the flooded areas where the farmers call flood in the Mekong Delta in Vietnam as “nice flood” or” floating season”. Because of pressure of population as well as development demand of a market economy and agricultural intensification for the country food security requiring implementing structure measures against flood to develop three crops per year resulting the hydraulic and hydrological mechanism of flood flow in the Mekong Delta has been changed since 1986. This changing mechanism demonstrates as the following phenomena: Maximum inflow to the Mekong Delta increased; drainage capacity of the main rivers reduced; flood distribution mechanism to the Plain of Reed and Long Xuyen Quadrangle changed; flood flow occurred at on farm areas; and Tien Giang province was from a shallow inundation area moved to the mean inundation area. The changing flood pattern should be considered and taken into account by the stakeholders.

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Topic: 09. Mekong Delta: Climate change related challenges

Floodplain sediment-nutrient deposition in the Mekong Delta and expected future changes

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Quantification of sedimentation in floodplains plays a very important role in assessment of flood advantages in sustainable agro-economic development in river deltas, especially in the change of sedimentation pattern by the interaction of sea level rise and fluvial sediment variation in the context of climate change. This research aims at a quantification of the sediment-nutrient deposition in floodplains in the Mekong Delta (MD), and to access the impacts of hydropower development in the upstream to the sedimentation change quantitatively. To achieve this, a suspended sediment transport model is developed based on the quasi-2D hydrodynamic model of the whole Mekong Delta developed by Dung et al. (2011). The model is calibrated and validated using observed data derived from several sediment measurement campaigns in channel networks and floodplains. Sediment data and hydrodynamic model quantify the spatial-temporal variability of sediment-nutrient depositions in spatial units: dyke compartments, Plain of Reeds, Long Xuyen Quadrangle and the area between Tien River and Hau River. It is shown that the distribution of sediment deposition over the delta is highly depended on the flood magnitude, that in turn drives the operation policy of flood control systems in floodplains of the Mekong Delta. Thus, the sedimentation distribution is influenced by the level of the dyke systems and the distance to the Tien River and Hau River. This enhances the main findings which were studied based on data analysis approach by Hung et al, (2011, 2012a). Moreover, the main channels also are an important function in sediment transportation into floodplains, and the deposition rate in floodplains is strongly driven by the intake locations and the distance from these to the main channels as well. In order to assess the impact of the proposed dams in the Mekong basin on the floodplain sedimentation in the Mekong Delta, published estimates of future suspended sediment concentrations after dam construction are used to drive the hydrodynamic model. By this the impact of the dams on floodplain sedimentation is estimated.

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Topic: 09. Mekong Delta: Climate change related challenges

Copula-based bias correction of regional climate simulations for Southeast Asia

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This paper addresses the problem of bias correction of RCM simulation for Southeast Asia. It is well known that climate simulations even with high spatiotemporal resolution are still biased. This is especially true for precipitation. Thus, the resulting model output cannot be directly used for impact studies. Gauge measurements are the best available source of absolute precipitation intensity while their spatial availability is limited. RCM models mimic well the spatial patterns of precipitation fields but can differ substantially from absolute precipitation intensities obtained by measurements. Therefore, a statistical approach is presented to improve the RCM modelled fields by assimilation of point information from rainfall gauges. In this study copula models are used to describe the dependence structure between gauge observations and rainfall derived from the WRF model at the corresponding grid cells. After appropriate time series transformation to generate "iid" variates, only the positive pairs (RCM >0, gauge >0) of the residuals are considered. As not each grid cell can be assigned to one gauge, the integration of point information, i.e. gauge rainfall intensities, is achieved by considering the structure and the strength of dependence between the RCM grid cells and all the gauges within the RCM domain. The proposed method finally allows to generate precipitation fields that mimic the spatial patterns of the RCM fields and correct them for biases in their absolute precipitation intensities. The performance of this new approach is analzed and discussed.

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Topic: 09. Mekong Delta: Climate change related challenges

Assessing the sensitivity of land use land cover changes on meteorological surface variables in Central Vietnam

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Accurate representation of land surfaces is an important factor for climate modeling studies as land surface is controlling the partitioning of available energy and water. In this paper, the sensitivity of trends of meteorological surface variables to Land Use Land Cover Change (LULCC) is analyzed. For this reason, the Observation Minus Reanalysis (OMR) approach (Fall et al., 2010) is followed. Instead of using the reanalysis data directly, the regional climate model WRF has been used to dynamically downscale the ERA40 reanalysis data to finally obtain surface variables of 5 km resolution. By comparison of the downscaled ERA40 data with trends of observations, the impacts of LULCC on meteorological surface variables can be derived. The results for the Vu Gia-Thu Bon river basin in Central Vietnam will be presented and discussed with respect to deriving future land-use change and "what-if" scenarios. This work has been conducted in the framework of the LUCCi project (Land Use and Climate Change interactions in Central Vietnam).

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Topic: 09. Mekong Delta: Climate change related challenges

Projected future IDF Curves, with RCM Simulations, at some Ungauged Sites in Mekong Riparian Country - Vietnam

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The impact of a changing climate is already being felt on several hydrological systems both on a regional and sub-regional scale of the globe. Greater Mekong is one of the regions strongly affected by climate change. With climate change, one of the anticipated impacts is an increase in the intensity and frequency of extreme rainfall which compounds existing threats affecting the region's economy, biodiversity and natural resources. Optimal mitigation measures can be taken only when stormwater systems are design using reliable rainfall Intensity-Duration-Frequency (IDF) curves. Developing IDF curves for the future climate is challenging especially for ungauged sites. The current practice to derive IDF curves for sites is, for example, to 'borrow' or 'interpolate' data from regions of climatologically similar characteristics. Liew et al. (2012) presented a novel (3-step) approach to derive IDF curves for present climate in which rainfall data were extracted from a high spatial resolution Regional Climate Model (RCM; 30 × 30 km over the study domain) driven by ERA-40 Reanalyses Datasets. This approach was demonstrated on applications at ungauged sites (e.g. Java Island, Indonesia) and the results are impressive and quite promising. In this paper, we extend the application of the approach to other ungauged regions particularly for Mekong riparian country, Vietnam. The study is performed by first identifying the nearest meteorological stations where IDF curves exist. Biases resulting from these meteorological sites are captured and serve as very useful information in the derivation of present day IDF curves for ungauged sites. The final product of the present day climate derived IDF curves fall within required range of bias correction values. This range allows designers to decide on a value within the lower and upper bounds, normally subjected to engineering, economic, social and environmental concerns. Deriving future IDF curves for Vietnam sites with existing IDF curves and ungauged sites with simulation data from RCM driven by global climate models (GCMs) (6-hourly results) with different emission scenarios are also presented in this paper. Approach discussed in this study is able to give policy makers better information on the adequacy of storm drainage design, for the current climate, at the ungauged sites as well as the adequacy of the existing storm drainage to cope the impacts of climate change. The proposed approach can be extended by downscaling more GCMs using higher resolution of RCMs so that a bandwidth of uncertainties can be assessed to create appropriate and effective adaptation strategies/measures to address climate change and its impacts.

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Topic: 09. Mekong Delta: Climate change related challenges

Need for robust observations - A challenge for the modelling community

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There have always huge uncertainties in validating climate models. The primary source of such uncertainties stems from observational data that are usually used to evaluate the performance of the modelled results. This is especially important because precipitation is a highly sensitive variable that is modelled, be it real-time numerical weather prediction or long term climate simulations. Most observed data are developed using information from the rain gauges and supplemented by satellite information wherever necessary. But when it comes to station data sparse regions, as in the case of the Mekong region in Southeast Asia, satellite data remain the only source of reliable observed records. Nevertheless, differences in spatial resolutions, available periods of records and quality amongst different satellite observations themselves give rise to uncertainties as do the uncertainties in ground truth rain gauges which arise due to incorrect measurements, lack of a dense network of gauges and overall poor data quality. But with advancing science and availability of more satellite data, validations of models have become easier than before although challenging. This is true when such validations are done over different periods such as over daily and climatological scales. Hence, this study investigates the uncertainties in available observational records for precipitation over the Mekong region.

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Topic: 09. Mekong Delta: Climate change related challenges

Adverse effect of saline waterlogging on soil properties: Laboratory experiment on alluvial soil

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The Mekong delta is predicted to be severely affected by climate change. The combined impact of sea level rise and Mekong River flow reduction has led to far inland salinity intrusion in the coastal areas in dry season. Questions have been raised on the changes and the extent of soil salinization and soil sodification in fresh-water areas caused by saline water intrusion. The objective of this study was to evaluate how soil salinity, sodicity and soil available nitrogen and phosphorus could change under submergence at different salinity. Laboratory experiment was conducted by submerging an alluvial soil with instant ocean at salinity concentrations of 0, 2, 4, 6, 8, 12, 25 ‰. Soil samples were taken from a paddy field in Thanh Phu district, Ben Tre province where it is anticipated to be affected by salinity intrusion. Salinity, exchangeable sodium percentage, availability of nitrogen and phosphorus in soil were measured once a week during a course of six weeks. Results showed that submerging soil at 8 ‰ salinity resulted in significant increase in electric conductivity (EC) of water and soil. At this salinity, EC of soil (1:1 w:v) reached at 4.5 mS.cm-1 in the first week. Soil pH maintained stable during incubation course and at different saline levels. pH of water reduced about one unit after six-week submergence. At 8‰ saline level, soil sodification occurred and severely affected after one-week submergence in 25 ‰ salinity treatment. Soil available ammonium increased during six weeks and was not significantly different among salinity levels. Available phosphorus content in soil at high salinity concentrations were reduced (P

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Topic: 09. Mekong Delta: Climate change related challenges

Benefit from flooding in Southeast Asian delta cities Combining water safety structures with better living conditions

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Cities in Southeast Asia are facing rapid urban changes. With an annual urban population growth of 3%, cities will almost double in population in the coming 20 years (World Bank, 2010). These expanding cities are located in fertile, but flood prone river deltas. Flooding has great advantages for the local agriculture, but becomes increasingly harmful when areas get more urbanised (Tran and Nitivattanon, 2011). The region is currently experiencing a rapid shift towards a liberalised economy and from a traditional society to a modernised one, resulting in a migration towards the cities. Traditionally, Southeast Asian delta cities were established on the high levees along rivers, as these were the safest places against flooding. Current city expansions show poor, high dense areas in low lying city regions which are the most vulnerable to flooding (Pham and Pham, 2011). An average annual sea level rise of 3mm and larger fluctuations in wet- and dry seasons will cause even more extreme inundation for the future of Southeast Asia (Deltares, 2011). The aim of this review is to explore the possibilities of water defences as an environmental and urban quality in expanding areas to prevent flooding and improve living conditions. This is presented in the context of the expansion of Southeast Asian delta cities where the need to develop flood protection and suitable city expansion is high. The study answers the question on how water can be used as a structuring element to improve the living environment in the expanding regions of Southeast Asian delta cities. Firstly, this review elaborates on the way how water shaped the urban structure of cities in the past. This is followed by descriptions of the social, hydrological and landscape challenges occurring in this region reviewing among others Friedmann (2007), Spencer (2010), Pham and Pham (2011) and Norberg-Schulz (1979). Later on, several integrated solutions are shown. Spatial flood defence structures have the potential to play an important role to structure urban growth and improve the living quality. This paper promotes the relevance of this topic, stimulate interdisciplinary thinking and increase the awareness for climate change in developing countries.

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Topic: 10. Impacts of urbanization and industrialisation on agriculture and water resources

Potentials and limitations of the NAM model in assessing future water availability in the Vu Gia – Thu Bon river basin under climate change

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The economic development together with population growth result in increasing water use demand for domestic, industrial and agricultural activities. This could decrease the availability of water resources. Moreover, in the context of climate change, water resources are subject to be significantly impacted. Therefore, the ability to accurately assess and predict future water availability in a country is vital in planning and implementing its water resources development activities. Hydrological modeling is one of traditional and robust approaches for projecting river flow. The availability of a number of climate change scenarios derived from various GCMs help to estimate expected future river flow projections. This study aims at investigating the capability of NAM model (MIKE Zero package developed by DHI) in the simulation of rainfall-runoff process in VuGia-ThuBon (VGTB) basin. This basin is located in the center of Vietnam covering parts of the Provinces of QuangNam, DaNang, KonTum and partly Quang Ngai. VGTB has a catchment area of 10,350 km2 and is one of the 9 largest river basins (the fifth largest in volume) in Vietnam. The model is calibrated against daily observed discharges using both manual calibration and auto-calibration. Furthermore, a sensitivity analysis of the key model parameters is performed to test the response of the basin to its generated runoff. Validation results indicate that the NAM model can be reliably applied to reliably reproduce the rainfall-runoff relationship in the VGTB river basin. The calibrated model is applied to estimate future water availability using regional climate simulations based on ECHAM5 and the A1B emission scenario. The results obtained for the region are presented and a transferability of the results to the Mekong river basin is discussed. Key words: future water availability, NAM model, rainfall-runoff, sensitivity, climate change, regional climate simulations

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Topic: 10. Impacts of urbanization and industrialisation on agriculture and water resources

Studies on Treating Industrial Sludge from the Industrial Zone Tra Noc, Vietnam

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The interest in environmental problems caused by polluted wastewater and untreated sewage sludge has been growing during the last years in Vietnam. Especially the contamination of the public drinking water systems due to untreated wastewater from industrial zones leading to people's death reinforced the urge to find suitable solutions to prevent the population of diseases and to protect the natural resources in the country. The development of adapted wastewater and sewage sludge management concepts for industrial zones is one-step to achieve the ambitious aims. Particular countries short on natural resources, like Vietnam, profit not only of a cleaner environment, they also benefit from the consumption of the raw-material potential in sewage sludge when implementing management concepts in industrial zones. Under the local conditions in Central Europe a variety of treatment technologies for industrial wastewater and sewage sludge have been established. If exporting this operating experience to different countries with other influencing factors and especially varying wastewater and sludge conditions, it is essential to focus on research and development to adjust the exported technologies to the predominant factors such as the technical, economical, socioeconomic, institutional, political and cultural circumstance. Therefore, the German and Vietnamese governments currently fund a joint research project that develops an integrated wastewater concept for industrial zones exemplified at the industrial zone Tra Noc, Vietnam. The main activities of the project render in the pre-treatment of wastewaters with toxic compounds, anaerobic wastewater treatment with energy generation, recuperation of valuables substances and water reuse from wastewaters as well as the treatment, reuse and disposal of the sewage sludge from various industry branches. With the development of an adequate sewage sludge management concept that particularly considers the interaction between wastewater (pre)treatment and sludge quality recommendations on sludge treatment, reuse and disposal can be determined for the industrial zone Tra Noc and will maintain a reduction of the environmental pollution by the industrial sector. Different sludge treatment technologies such as vermicomposting, anaerobic digestion and reed bed treatment will be tested over a three-year period with various sludge types from industrial companies in Tra Noc to implement a sewage sludge management concept, which can be transferred to other industrial zones in Southeast Asia. For each of these treatment technologies, the focus is set to different conditions like mixing ratios, choice of co-substrates, organic load. This allows an overall balancing of the nutrient and pollutant flows whichever is the basis to assess the potential treatment processes and chains according to scientific, technical and economic criteria.

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Topic: 10. Impacts of urbanization and industrialisation on agriculture and water resources

Characteristics of Spatial Differentiation and Development Modes for Tourism Resources in the Lancang River Basin

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Lancang river is the the world's 12th-longest river and Asian's 7th-longest river. It originates from the Zhaqu of the Guangguori Peak of Tanggula Mountain Range in Qinghai Province, China. It is called the Lancang River after it reaches Changdu city. The river has a total length of 2,354 kilometers and a drainage basin area of 164, 766 km2. There are diverse climate, peculiar landform, rich biodiversity and plentiful tourism resources within the Lancang River Basin. In recent years, the development and protection of resources in the Lancang River Basin has received increasing attentions of domestic and foreign stakeholders. The state and characteristics of tourism resources is the result of the interaction between natural evolution and human activities. To analyze the spatial differentiation characteristics of tourism resources from the perspective of watershed can parse the natural features and the changing rule of the tourism resources more systematically. It also contributes to the rational protection and development of tourism resources and promotes the healthy and sustainable development of the watershed tourism and socio-economy. Domestic and foreign scholars have done a great deal of empirical researches on tourism in the river basin, most of which are mainly focused on the protection of tourism resources, tourism development and sustainable development within a specific watershed, yet few scholars have studied the spatial variation of tourism resources and tourism development models in the river basin. This paper studies on the spatial variation characteristic of tourism resources in the Lancang river basin, the results showed that: 1) In terms of horizontal zonality, as latitude changes, all kinds of tourism resources represent the zonal space differentiation because of difference of the air temperature, soil and moisture conditions; 2) Along with the change of the altitude, local resources monomer landscape show vertical zonal differentiation characteristics; 3) Tourism resources distribute along the Lancang river and tributary of the River; 4) The main tourism resources show a distribution mainly following along the traffic trunk line G214; 5) Monomer tourism resources, such as buildings and facilities, distribute centralized around town. Based on the space differentiation characteristics of watershed tourism resources, the author propose three development models of tourism resources in the Lancang river basin from the perspective of spatial development, product development and tourism management: point–axis space development mode, thematic development of tourism products and integrated and cross-regional management model. The development modes presented in this study would provide certain guidance and references for proper utilization, development and protection of tourism resources in the Lancang river basin and even other areas.

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Topic: 10. Impacts of urbanization and industrialisation on agriculture and water resources

Responses of Hinterland Households to the Opportunities and Challenges of Urbanization in Khon Kaen, Thailand and Vang Vieng, Lao PDR

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In this paper, we examine the responses of households living in the hinterlands of two secondary urban centers, namely Khon Kaen city in Thailand and Vang Vieng town in Lao PDR, to the accelerating process of urbanization that has recently been experienced there. The results are drawn from mixed method quantitative and qualitative interviews with 739 households and key informants in 47 villages surrounding the two urban centers that assessed their responses to perceived changes due to urbanization. We identify multiple linkages between the process of urbanization and positive and negative changes in the hinterland, and responses by hinterland households including: changes to hinterland local agricultural and non-agricultural economies within the village and at the household level due to new market opportunities in urban areas, and new employment in urban areas resulting in circular daily hinterland-urban migration; positive social changes, including hinterland communities gaining access to better education and health services in urban areas, but also negative changes including rising crime and impacts on village culture and tradition; and mostly negative environment changes, including noise, air and water pollution and solid waste disposal in the hinterlands from urban centers, which has become a common complaint amongst hinterland communities yet to be fully redressed. We also examine the existing administrative structures that link urban areas to their hinterland and identify challenges due to administrative fragmentation. In the case of Khon Kaen, a split between municipal and provincial voting arrangements limits the hinterland communities' participation in urban area decision-making processes that affect them. Based on these findings, we propose the concept of "city-regions" for these secondary urban centers to overcome administrative fragmentation and deliberative dialogues to facilitate public participation and avoid under representation of hinterland communities in urban planning.

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Topic: 10. Impacts of urbanization and industrialisation on agriculture and water resources

The impacts of engaging in contract farming on rural households: a comparative study of sugar and rice in Cambodia, Lao PDR, Myanmar and Thailand

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We report empirical investigations into the economic, social and environmental impacts of contract farming mechanisms in smallholder rice and sugarcane production within the Greater Mekong Subregion. Research in Thailand, Cambodia and Lao PDR has demonstrated that contract farming of organically grown rice for niche markets is more profitable than conventional rice grown without contract (Setboonsarng et al. 2006, 2008; Cai et al. 2008). In the case of industrial sugarcane, Ekasingh et al. (2007) in Northeast Thailand and PEI-Lao PDR (2011) and LEAP (2011) in Savannakhet, Lao PDR, have reported on economic, social and environmental impacts of cane production but without detailed analysis of contract farming mechanisms per se. Our study sought to extend this research effort by separating out the impacts of contract farming as a mechanism from the specific context of crop, location, and farm household characteristics. It aimed to inform policy development. Design: Household surveys were carried out with sugarcane farmers in Lao PDR and Thailand, and rice farmers in Myanmar and Cambodia; in total, 844 households were surveyed. Logistic regression analysis of the survey data enabled contract farming households to be compared with those who had never been contracted; potential confounding effects of factors like country, area of land, and household characteristics were accounted for. Qualitative data from in-depth interviews and focus group discussions with industry stakeholders helped to explain these quantitative findings. Main findings: Current contract farmers were 1.4 times as likely as non-contract farmers to have experienced raised profits per hectare in the past 5 years. Perceptions were that contract farming: has increased workloads, but has not influenced social cohesiveness or produced any more adverse impacts on the environment than non-contracting modes of intensive commercial agriculture. Across countries, current contract farmers were more than 5 times as likely as non-contract farmers to believe that the balance of contract farming impacts in their community is positive overall, but there were large differences between locations in this regard. Significance and conclusions: Conditions provided by contractors were important to maximize the benefits to contracted farmers. These included: inputs such as seed, agro-chemicals and cash loans; the scheduling of production; and the provision of technical farm management skills training. Farmers who were able to adopt new skills and knowledge provided by contractors reported positive impacts and continued in their involvement with contract farming schemes. Benefit sharing (such as share-offerings) is a best-practice, encouraging farmers' involvement in contract farming.The implication of this research is that contract farming mechanisms must be finely tuned to specific geographic and socioeconomic conditions if they are to benefit rural communities and minimise negative impacts.

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Topic: 10. Impacts of urbanization and industrialisation on agriculture and water resources

The Sustainability of Industrial Policy in the Mekong Delta

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Industrialisation and modernisation is a leitmotif of Vietnamese development plans. The industrial zone (khu cong nghiep) has been adopted to this end. Certainly, industrial zones in other Asian economies have shown the prospect of foreign-investment driven growth through increased employment and export good production given the favourable provision of concentrated infrastructure for investor. In the implementation fervour, it appears that each Vietnamese province has at least one, if not more, industrial zone. The largely rural Mekong Delta is no exception to this trend. However, official figures vary from source to source. Complicating matters is the terminological confusion with the other Vietnamese variations on industrial clusters, such as the industrial park (cum cong nghiep) or the economic zone (khu kinh te). This poster presents the results of field research in the Mekong Delta between June 2011 and February 2012, conducted within the WISDOM Project. The research objectives were to obtain a true picture of the density and distribution of these sites of industrial production and their socio-economic effects. The results raise questions about the sustainability of Vietnamese industrial policy in the Mekong Delta, and the socio-economic returns on industrial zones. Too many industrial zones have been planned and fertile agricultural land sits fallow while provincial governments await interested investors in an unfavourable macro-economic climate. The eagerness to win investors also has negative repercussions for the enforcement of environmental protection obligations, and environmental pollution from industrial zones is becoming an important social issue.

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Topic: 10. Impacts of urbanization and industrialisation on agriculture and water resources

Agricultural impacts over Vietnam in changing climate

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This study presents a scenario and modelling approach that highlights future changes in agricultural capacity in Vietnam. This is significant for Vietnam because the agricultural land using sector in Vietnam accounts for a large share of GDP (approximately twenty per cent including forestry and fisheries) and a considerable portion of the Vietnamese population (over sixty per cent) resides in rural areas, who are involved in the production of paddy rice, making the agricultural sector key to poverty reduction and food security. In a climate change impact study, this paper applies a statistical downscaling method to downscale large scale climate change scenario obtained from global models over Vietnam and applies the downscaled climate estimates of precipitation and temperature to the CROPWAT model to study changes in agricutural yields.

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Topic: 10. Impacts of urbanization and industrialisation on agriculture and water resources

Studying the effects of hydropower dams and climate changes on land use and water use in Mekong River Basin – A Comparison between countries in the region

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In this article, effects of hydropower dams and climate change on land and water use have been tentatively studied in a dynamic approach. A quantitative comparison between countries in Mekong River Basin, focus on negative impacts of these causes on socio-economic and environmental development have been made in the hope of contributing to existing plan(s) for adaptation for each country, especially Vietnam, the most downstream unfavorable country in the region.

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07.03.2013 from 09:45 – 10:15

Poster 311 - 11. Collaboration platforms in basin management: Information Systems and Spatial Infrastructures

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Topic: 11. Collaboration platforms in basin management: Information Systems and Spatial Infrastructures

Six Nations, One River: Testing a Model of Perceived Effects of Inter-governmental Collaboration on Sustainable Tourism in the Greater Mekong Sub-region

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Collaboration is one of the most frequently recommended strategies to address many global issues such as climate change, disease, and terrorism (Gray, 1989) – but, does it work for sustainable tourism? The study tested a model of inter-governmental collaboration as it relates to sustainable tourism. Three hundred and fifty nine government officers from the Greater Mekong Sub-region in Southeast Asia participated in an online survey regarding the relationship of sustainable tourism and collaboration. Structural equation modeling (SEM) analyzed survey data. Both inter-governmental collaboration and sustainable tourism were conceptualized based on various related bodies of literature. Inter-governmental collaboration was defined by eight factors (resources, governance, administration, issues, attachment, mutuality, trust and leadership). Similarly, sustainable tourism was identified as having four factors (economic, environment, culture and societal). Sufficient theoretical support exists that sustainable tourism largely depends on inter-governmental collaboration. Empirical results reveal a modified model with eight constructs and twenty three indicators that appears to be a better fit to the data set than the proposed model. Inter-governmental collaboration was redefined by four factors rather than eight and significantly influenced sustainable tourism. The overall fit of the modified structural equation model and the acceptable-to-high standardized loadings of the constructs suggest empirical support for a relationship between inter-governmental collaboration and sustainable tourism. The study is significant for at least four main reasons. First, the study contributes to the existing body of knowledge by providing a more complete and deeper understanding of collaboration theories and their specific application in tourism. Second, it adds to existing work by expanding use of the SEM approach in tourism. Third, it informs policy development by providing scientific information on how to improve inter-governmental collaboration to achieve ST. Finally, it provides practitioners with specific and concrete measurements and indicators of sustainable tourism collaboration.

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Topic: 11. Collaboration platforms in basin management: Information Systems and Spatial Infrastructures

An Integrated Approach of Remote Sensing and GIS for the Groundwater Potential

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The Greater Mekong Subregion is not a geological region, but rather, a strategic region for development of the six states of the Mekong River basin, namely Cambodia, Laos, Myanmar, Thailand, Vietnam, and the Yunnan Province of China. It is considered a significant biodiversity hotspot and water insecurity and water-related disaster prone region. Nowadays water pollution in the rivers systems and lack of or very little rainfall in the dry zones of this region become solely dependent on groundwater resources. The laws and regulations to extract groundwater varies from country to country, however, it is possible to estimate the groundwater potential which can serve as both scientific data and a wakeup call to decision makers. For this reason this study is carried out by using a simple and widely available tool known as GIS and Remote Sensing while choosing the least data available spot of Nyaung Oo region in Myanmar. The study proved to be useful to quantify the groundwater potential in Nyaung Oo. It was checked against current data. The simple method used in this study use GIS and Remote Sensing tools and satellite pictures that are coupled with selected field investigations and the geohydrological knowledge of the area. The parameters such as drainage density, landcover, soil type, lineament density, slope steepness and elevation are considered as the thematic layers which are assembled in GIS platform to produce groundwater potential. This investigation of hydrogeological and groundwater potential for Nyaung Oo region is a pilot study. It will continue to estimate the national wealth of ground water in Myanmar and other Mekong countries in the future, which can be considered as taking part in regional integration and co-operation in the Greater Mekong Subregion.

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