APN Science Bulletin

Asia-Pacific Network for Global Change Research

Issue 2 | March 2012

Global Environmental Change

www.apn-gcr.org

Scientific Planning Group Executive Editors:
Dr. Madan Lall Shrestha, SPG Member for Nepal and SPG Co-Chair
Dr. Erna Sri Adiningsih, SPG Member for Indonesia and SPG Co-Chair

Managing Editor:
Dr. Linda Anne Stevenson, Executive Science Officer, APN Secretariat

Citation:
Shrestha, Madan Lall., Sri Adiningsih, E., Stevenson, L.A. 2012. APN Science Bulletin: Issue 2; pp156; Asia-Pacific Network for Global Change Research; ISSN 2185-761X.

Design and layout: Xiaojun Deng, APN Secretariat
Cover images: UN Photo/Kibae Park (front); Taniya Koswatta, APN Secretariat (back)

EDITORIAL

The present publication is the second APN Science Bulletin (2012) to be published in the APN's Third 5-year Strategic Phase, which runs until March 2015, and is a publication aimed to satisfy the keen minds of both the science and non-science communities with an interest in Global Environmental Change in the Asia-Pacific Region.

The 2012 APN Science Bulletin highlights those APN projects either funded and/or completed in the year of publication (the present year runs from April 2011 – March 2012). The Science Bulletin has four main sections: 1) Featured Articles; 2) Regional Research Projects funded under the Annual Regional Call for Research Proposals (ARCP) Programme; 3) Scientific Capacity Development Projects funded under the CAPaBLE Programme; and 4) Projects funded under the APN's Focussed Activities Programme.

In the second issue of the APN Science Bulletin, March 2012; all activities that were funded and undertaken since April 2011 have been included. Under featured articles, full scientific research papers have been written and cover a number of major themes in the APN's science agenda from looking at the effects of pests and diseases on agriculture in a changing climate; water resources and management practices to adapt and/or mitigate the impacts of floods and drought in various sub-regions of Asia and the Pacific; and the use of meteorological data for local farming practices, among others.

Sections 2 and 3 look at the work conducted under the APN's two main pillars of activities; the ARCP and CAPaBLE programmes, respectively. Section 4 highlights projects funded through two special focussed activities that began in late 2010 and are focussing on Forestry and REDD+ (4 projects) and Sustainable Material Societies (2 projects). These projects are due for completion in 2012 or 2013.

On behalf of the Scientific Planning Group (SPG), who advises the scientific programme of the APN to the APN's governing body, the Inter-Governmental Meeting; we, as the SPG Co-Chairs hope that you find the information contained in the second issue of the APN Science Bulletin both interesting and useful in your work.

CONTENTS

FEATURED ARTICLES

1

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

ARCP2008-07CMY-DUTTA

Flood Vulnerability Analysis in Coastal Zones: A Comparative Analysis across Five Asia-Pacific Countries

Dushmanta Dutta[1], Wendy Wright, Philip Rayment
[1]Corresponding Author
School of Applied Sciences and Engineering, Monash University, Australia
Email: dushmanta.dutta@monash.edu

ABSTRACT: There is increasing concern that the current management practices for many coastal regions are unsustainable. Very few countries have planned to deal with the exacerbation of problems of environmental decline in the face of climate change leading to more serious flood events caused by sea level rise, severe storms, tidal waves, etc. It is therefore necessary to assess socio-economic and environmental impacts of floods to better understand the vulnerability of the coastal zone, as part of devising adaptive and integrated management principles. The paper presents a systematic approach in which relevant stakeholders in five Asia-Pacific countries were actively engaged in identifying and prioritizing flood impact issues. Key issues of concern for flood impacts for coastal areas in Australia, Japan, Sri Lanka, Thailand and Viet Nam are compared.

KEYWORDS: *coastal zone, vulnerability assessment, flood hazard, flood impact, climate impact*

Introduction

Coastal areas are one of the most important regions from social, economic and environmental viewpoints. They are home to a large and growing proportion of the world's population. They include important ecosystems such as coastal floodplains, mangrove forests, marshes and tideflats, as well as beaches, dunes, and coral reefs (Costanza *et al.*, 1997). The coastal zone is also important for marine fisheries because the bulk of the world's marine fish harvest is caught or reared in coastal waters (Wilkinson, 2000). Coastal areas help prevent erosion; filter pollutants; and provide food, shelter, breeding areas and nursery grounds for a wide variety of organisms. Coastal regions also provide critical inputs for industry, including water and space for shipping and ports; opportunities for recreational activities such as fishing and diving; and other raw materials, including salt and sand.

Coastal regions are undergoing environmental decline due to the large growth of human populations, rapid urban and industrial development, overexploitation of natural resources and poor management. By 2025, it is expected that around 75% of the world's human population will live within 200 km of a coastline (Creel, 2003). There is an increasing concern that current management practices are unsustainable. Of particular concern are low-lying areas, which are also affected by sea water intrusion. The Intergovernmental Panel on Climate Change (IPCC) predicts that global mean sea level may rise as much as 88 cm by the end of the 21st century (IPCC, 2001). Several coastal zones are facing severe socio-economic and environmental problems due to their lower elevation. Very few countries have planned to deal with the exacerbation of these problems in the face of sea level rise.

This project involved a vulnerability analysis for selected key coastal zones in five countries: Australia, Japan, Sri Lanka, Thailand and Viet Nam. The vulnerability analysis required the identification of relevant flood hazard parameters and key issues for the study region; and the synthesis of impact responses using expert and stakeholder opinions. The outcomes of the vulnerability analysis are potentially useful as a basis for the development of adaptation measures for the region. The project required the engagement of experts and key stakeholders of the five selected regions in order to identify and prioritize the key issues. A significant outcome of the project is an insight into how stakeholders' knowledge and expertise (at regional and local levels) might be utilized for establishing such response functions for quantification of the likely impacts of climate change in coastal regions. This paper presents a comparative analysis of the results of vulnerability studies in the five selected countries to identify similarities and differences in the outcomes.

Study Areas

The following five coastal areas were selected from five participating countries in the Asia-Pacific region. The geographic locations of these study sites are shown in Figure 1.

1) Gippsland Coastal Region, Australia: The Gippsland coast is home to thousands of people who live in or near one of the many coastal towns and settlements located between San Remo on the eastern extent of Western Port Bay and Mallacoota near the New South Wales border. Away from these built up areas, the Gippsland coast remains in a largely natural state, being characterized by diverse natural and cultural values, and including an important habitat for a range of fauna species protected by National Parks, reserves and public foreshore land (GCB, 2008). The coast includes the Gippsland Lakes System, which is a series of coastal lagoons — large areas of shallow water that have been almost wholly sealed off from the sea by a coastal dune system.

2) Kushiro Coastal Region, Japan: Kushiro wetland, located on the eastern side of Hokkaido, is the largest wetland in Japan registered by the Ramsar treaty and the coastal area has been highly developed for industrial purposes. The main river flowing through Kushiro wetland is the Kushiro River whose length is 154 km. The river basin area is 2510 km^2. The incline of the Kushiro wetland area is relatively gentle. The human population in this highly developed coastal area is about 230,000. In recent years, changes in water

Figure 1. Locations of the study areas in 5 countries

circulation and mass transport have been considered problematic, causing damage to the ecological systems of the wetland. There is significant potential for damage in the Kushiro coastal region from disastrous storm surges or flood events.

3) Colombo, Sri Lanka: Climate change has clearly affected the weather patterns of Sri Lanka and this is evident in the climatological measurements of the last 3 to 4 decades. Overall, rainfall has not shown a significant change in most parts of the country, while some other indicators such as the length of rainy spells and average rainfall per spell have clearly changed. Studies have shown that rainfall intensity has increased (Herath and Ratnayake, 2004; Ratnayake and Herath, 2004). More frequent rainfall-induced disasters such as landslides and floods in the recent past can be attributed to this increase in rainfall intensity (Padma Kumara *et al.,* 2005). Colombo, the capital city and financial hub of Sri Lanka, is one of the major coastal cities adversely affected by floods and two of Colombo's highest rainfalls on record occurred in the last two decades. Such frequent extreme events have caught the attention of the public and have forced authorities to attempt mitigating work. Several drawbacks of the current management system have been identified and among the technical aspects, the inadequate capacity of drainage networks, loss of flood retention spaces and poor management is highlighted.

4) Bangkok and Gulf of Thailand: Bangkok, the capital city of Thailand, is one of the larger cities in Asia and is a regional hub. It is located on the lower flat basin of the Chao Phraya River, the largest and most important river in Thailand, which has a drainage area of 160,103 km^2 and an annual suspended sediment discharge of $11x10^6$ tonne (Milliman *et al.*, 1995). The river originates in the northern most part of Thailand and discharges to the Gulf of Thailand after flowing approximately 1,200 km. The average annual discharge is about 770 m^3/s with a peak of 4,560 m^3/s recorded in 1995 (Thammasittirong, 1999). The coastal environment of the Chao Phraya delta is classified as low-energy micro-tidal. Somboon (1992) showed that the shoreline has migrated about 90 to 100 km southward from the centre of the central plain in Thailand over the last 6,000 years, which corresponds to a migration rate of about 15 m/yr. Bangkok has a hot and humid tropical climate and the rainy season spans May to October, with an average annual rainfall of 1,500 mm. Floods, mainly caused by upstream inflow and high intensity rainfall, are the most frequent natural disasters in Bangkok. They affect a large number of people and cause huge economic damage almost every year. Due to its low elevation range from 0–4 m above mean sea level, the tidal effect is prominent in the Chao Phraya River up to several kilometres inside Bangkok and that contributes significantly to floods (Engkagul, 1993).

5) Nam Dinh Coast, Viet Nam: The Nam Dinh coast is one of the most populated coasts in Viet Nam. It has the most fertile soil in Viet Nam, which is very suitable for rice cultivation. The coast is also suitable for other marine-related economic activities such as salt production, fishing, shrimp and fish farming, etc. Additionally, the area is located near Hanoi, the capital city of Viet Nam and some of its beaches have become recreation sites for Nam Dinh and Hanoi city dwellers. The Nam Dinh coast was formed by the deposition of sediment from the Red River with its four branches — the main river, the Ninh Co River, the Day River and the So River. The sediment from the Red River consists mainly of silt and fine sand. Thus, near the river mouth, deposition of silt and fine sand has enabled the development of mangrove forests. There are several distinct ecological systems in the area such as marine, mangroves and estuarine ecological systems. Thus, the coast is ecologically very diverse. Presently, the coast is facing serious environmental problems, the foremost problem being accelerating erosion.

Methodology

A systematic approach was taken to develop a standardized methodology which was applied in the five selected regions across five countries. The methodology has been elaborated elsewhere (Dutta *et al.*, 2011).

The major steps involved in the methodology were:

- Selection of experts and stakeholders
- Identification of hazard parameters and key issues
- Questionnaire design
- Administration of the questionnaire
- Statistical analysis of the questionnaire results
- Sensitivity analysis

Two groups — "Stakeholder Reference Group" and "International Expert Group" — were formed in order to identify relevant flood hazard parameters and key issues for the study areas and their feedback was used to identify the most important flood inundation and water quality parameters (hazard parameters) associated with coastal zone flooding, and the key social, economic and environmental issues on which these hazard parameters could impact. The key issues were used to develop a set of criteria, indicators and appropriate response functions relating to various scenarios where the intensity of the flood hazard parameters varied due to climatic and anthropogenic influences in the study areas. Tables 1 and 2 show the flood inundation parameters (4), water quality parameters (3) and key issues (22) identified for impact analysis, respectively.

The questionnaire was designed to gather information regarding stakeholders' views of the likely impacts of various levels of flood severity on key issues and assets in the study areas. For the purpose of structuring the questionnaire, magnitudes of different flood inundation and water quality parameters were classified into three categories: low, medium and high. The stakeholder and expert groups were both consulted regarding the suitability of these categories, and a range of references were consulted to finalize realistic magnitude ranges for the flood inundation and water quality parameters within these three categories for coastal zones. The questions were designed by a group of international experts in order to generate data describing stakeholders' assessments of the differing impacts of the three categories of flood inundation and water quality parameters (Table 1) on key social, economic and environmental issues (Table 2).

The questionnaire was administered independently in each case study area by the country project leader of the on-going collaborative project sponsored by APN (Dutta, 2007). A similar approach was followed in Australia, Japan, Viet Nam and Thailand in administering the questionnaire. The questionnaire was sent out to stakeholders familiar with the study areas either by email or surface mail and anonymous responses were received from the respondents. However, in Sri Lanka, stakeholders were invited to participate in a seminar and the questionnaire was distributed to all the participants who completed their questionnaire on-site.

The questionnaire was lengthy and reasonably complex and required respondents to indicate their perceptions of the likely level of negative impact for each of the flood inundation and water quality parameters (Table 1) on each of the key issues (Table 2) for each of the three conditions (high, medium, low). Respondents used an impact ranking score in the range 1–5 to indicate predictions regarding the extent of impact in each case. The instructions within the questionnaire defined each of the ranking scores (Table 3). The participants were explicitly given the option of not completing those sections of the questionnaire that were perceived as beyond their expertise. The number of responses received from stakeholders varied from

Flood inundation parameters	Water quality parameters
Depth, Duration, Velocity, Frequency	Nutrients (TN, NO2, NO3, TP, PO4), Salinity, Turbidity

Table 1. Flood inundation and water quality parameters to be modelled under climatic change conditions

Table 2. Key issues in coastal areas identified for climate change impact analysis

Key issues (with abbreviations)	
Infrastructure	*Drainage (Dr)*
	Roads (Rd)
	Railways (Rl)
	Ports & Harbours (Pt)
	Dykes (Dy)
	Coastal protection structure (Co)
	Land-use planning (LU)
Buildings	*Residential (RB)*
	Non-residential (NR)
Potable water (PW)	
Water quality (WQ)	
Erosion (Er)	
Tourism (To)	
Population	*Short-term displacement (SD)*
	Long-term resettlement (LD)
Agriculture (Ag)	
Fishery (Fi)	
Fish habitat/distribution (FH)	
Wetland health	Extent (WEx)
	Flora biodiversity — no. of veg. species (WFl)
	Fauna biodiversity — no. of bird species) (WFa)
Mangroves (Ma)	

country to country (Table 4).

A statistical approach was designed to analyze the data obtained from the returned questionnaires from all five countries. In relating the impact ranking score for a particular flood inundation or water quality parameter, x, on an individual key issue (such as drainage or agriculture), the impact ranking score (1–5 integer scale) and hazard parameter, y, was analyzed, rather than its associated predicted percentage damage (Table 3). This was done in order to homogenize the spread of response scores across the low, medium and high levels of magnitude of each parameter. For each issue, x and hazard parameter, y, the Sensitivity is a measure of the impact on y of increasing x, averaged across all stakeholders' assessments, and the Disparity is a measure of the variation among individual assessments.

Results and Discussion

Similarity and Differences

Figure 2 presents the scatter plots of Disparity (x-axis) vs. Sensitivity (y-axis) for different hazard parameters against the 22 issues for five countries. Overall, the patterns among different countries are broadly comparable for the various individual hazard parameters, except for Sri Lanka.

For the Sri Lankan data, disparity was low for all issues and hazard parameters. For the inundation parameter "Depth," different issues showed similar trends for Japan and Thailand. For Viet Nam, more issues showed high sensitivity compared to other countries. For Australia and Sri Lanka, more issues were less sensitive to "Depth" than for the other three countries. The trend was similar for all countries for "Duration" with higher disparity for Australia for more issues than other countries. Similarly, for "Velocity" and "Frequency," disparity was higher for Australia compared to other countries. For Australia, more issues were less sensitive to "Frequency" than the other four countries. For water quality parameters, no issue showed any sensitivity to "Nutrient" for any countries. For Salinity, trends were similar for Thailand and Viet Nam; and for Japan and Australia. For Turbidity, trends were similar for Japan and Australia. More issues show higher sensitivity against Turbidity for Viet Nam. The agreement was higher for Viet Nam and Thailand, compared with Japan and Australia for Turbidity.

These relationships show that in different countries, stakeholders had different perceptions of the impacts of flood inundation on various issues. For some issues, there were high levels of agreement compared to other issues. The low disparity for the Sri Lankan data was probably due to the way the questionnaire was administrated, which reflected more of a collective, rather than individual, opinion of the stakeholders.

Classification of relationships between impact ranking and key issues

Relationships between the impact ranking scores for the effects of high, medium and low magnitudes for all combinations of flood hazard parameters and key issues were grouped into the following four classes (Dutta *et al.*, 2011):

Class 1: High sensitivity and high agreement (or low disparity)

Class 2: High sensitivity and low agreement (or high disparity)

Class 3: Low sensitivity and high agreement (or low disparity)

Class 4: Low sensitivity and low agreement (or high disparity)

The key issues that show high sensitivity to increasing magnitude for a particular hazard parameter and for which there is high agreement among respondents were placed in Class 1. All the key issues in this class show a reasonably strong, monotonic relationship with increasing magnitude of the particular flood hazard parameters and good agreement among stakeholder respondents about these relationships. Key issues in Class 2 appear to be sensitive to the increasing magnitude of the hazard parameters, but the opinions of different stakeholders about these relationships are varied. Class 3 includes key issues that stakeholders agree are not particularly affected by an increase in magnitude of the hazard parameters. The key issues in Class 4 also appear to be less sensitive to the hazard parameters; however, there are more widely varying perceptions among stakeholders about these relationships.

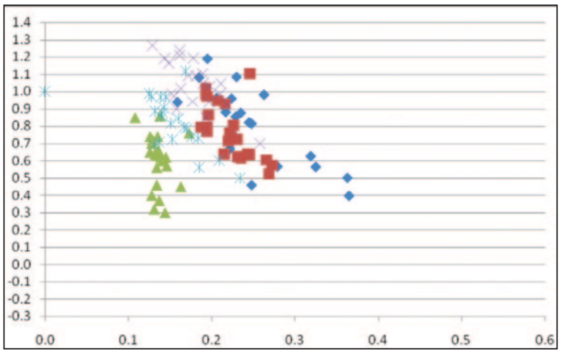
Table 5 shows Class 1 issues for different inundation and water quality parameters for the five countries. It shows that Depth is considered to be highly sensitive to most of the issues and stakeholders across all countries had high agreement. Australia and Japan had similar issues showing high

Impact ranking score	Impact definition
1	No/little impact (0–5% damage)
2	Low impact (5–25% damage)
3	Moderate impact (25–50% damage)
4	High impact (50–75% damage)
5	Extreme impact (75–100% damage)

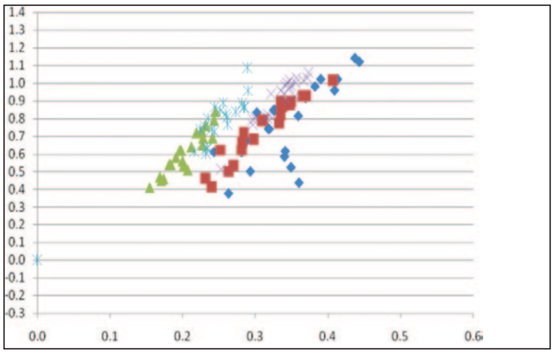
Table 3. Impact ranking scores and their definitions as used in the questionnaire

Country	Australia	Japan	Sri Lanka	Thailand	Viet Nam
Number of responses	33	35	50	34	50

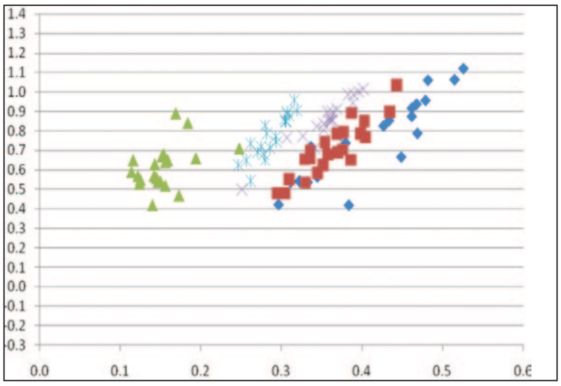
Table 4. Number of responses to questionnaire survey in different countries



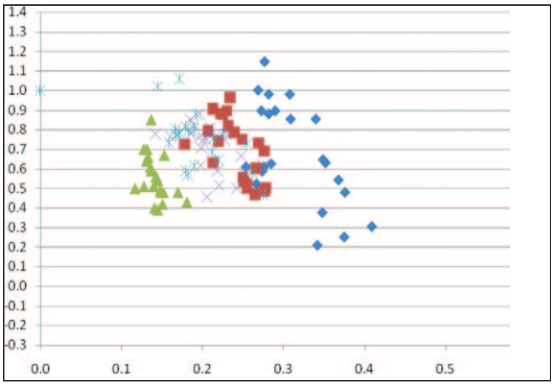
For Depth



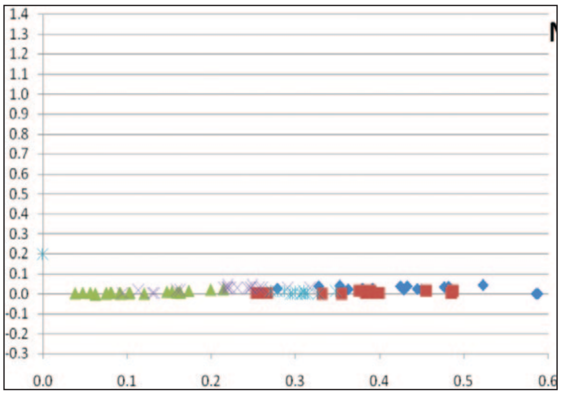
For Duration



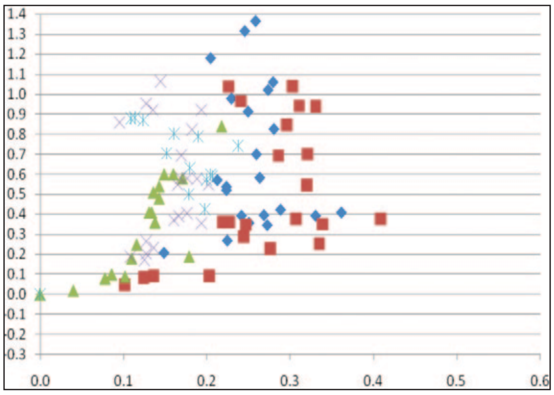
For Velocity



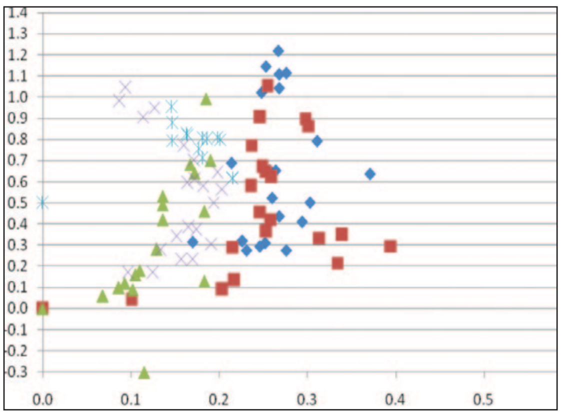
For Frequency



For Nutrient



For Salinity



For Turbidity

Legends:

- Australia
- Japan
- SriLanka
- Thailand
- Vietnam

Figure 2. Scatter plots of Disparity (x-axis) vs. Sensitivity (y-axis) of all 22 issues for 4 inundation and 3 water quality parameters for five countries

sensitivity and agreement. Thailand and Viet Nam shared more similarity in terms of issues identified. Compared with other countries, Viet Nam showed the highest number of issues with high sensitivity and high agreement.

The results show that stakeholders do not prioritize issues and/or hazards for adaptation and mitigation measures similarly across all countries. It is therefore important to take into account the different priorities of stakeholders in different countries.

Pairwise correlations between sensitivities

In order to compare the impact assessments across the five countries, the product-moment correlations between the sensitivity scores across the 22 key issues for each pair of countries and for each of the 7 hazard parameters were calculated (Table 6). A high positive correlation indicates a broadly similar perception across two country panels of the relative rankings of key issues in terms of how dramatically they are impacted by changes in the level of the relevant hazard parameter. Thus, in terms of the impact of increased flood depth on the range of key issues, the relative rankings are fairly consistent across Australia, Japan and Thailand, but more disparate across Sri Lanka and Viet Nam and each of those sites with the first three. It is acknowledged that these patterns may be influenced by the selection of the panels or by the protocols used to obtain their survey responses. Overall, however, it would appear that there are some considerable differences between perceptions at the various country sites of which key issues are most sensitive to changes in levels of the various hazard parameters.

Conclusions

The present paper provides the outcome of a comparative analysis of five case studies conducted in five countries to identify and prioritize flood impact issues through the engagement of stakeholders towards adaptation and mitigation measures in coastal zone areas in the Asia-Pacific region.

It is clear that stakeholders in different countries prioritize flood impact issues differently, although there are similarities between priorities in Australia and Japan, and to a lesser extent Thailand. While differences in methodology may explain a very different response in Sri Lanka, Vietnamese and Sri Lankan stakeholders responded differently in their priorities.

Further research is needed if it is deemed desirable to develop a common methodology to flood vulnerability assessment across multiple coastal sites in different countries. Further research to look into the reasons behind similarities and differences in stakeholder responses in the selected countries would provide insight for the development of common methodologies.

References

Creel, L. 2003. Ripple Effects: Population and Coastal Regions, MEASURE *Communication*, September 2003, Population Reference Bureau, Washington, DC, USA, pp 1–7.

Costanza, R., *et al*. 1997. "The Value of the World's Ecosystem Services and Natural Capital," *Nature* 387 (May 15, 1997): 256–60.

Dutta, D., Wright, W. and Rayment, P. 2011. Synthetic impact response functions for flood vulnerability analysis and adaptation measures in coastal zones under changing climatic conditions: a case study in Gippsland coastal region, Australia. Natural Hazards 59:967–986.

Dutta, D. (Ed.) 2007. Proceedings of the Planning Workshop of the APN Project on Climate Perturbation and Coastal Zone Systems In Asia Pacific Region, Bangkok, Thailand, 27–28 September 2007, Monash University, pp 51.

Engkagul, S. 1993. Flooding features in Bangkok and vicinity: Geographical approach, GeoJournal, Kluwer Academic Publishers, 31(4):1572–9893.

GCB. 2008. Climate Change, Sea Level Rise and Coastal Subsidence along

Table 5. Issues that showed high sensitivity with high agreements for flood inundation and water quality parameters for five countries
Parameters: Dep – Depth; Dur – Duration; Frq – Frequency; Nut – Nutrient; Sal – Salinity; Tur – Turbidity; Vel – Velocity

Issues	Australia	Japan	Sri Lanka	Thailand	Viet Nam
Drainage	Dep	Dep, Frq	Dep, Vel, Frq, Dur, Sal	Dep, Frq	Dep, Dur, Frq
Roads	Dep	Frq, Dep	Dep, Dur, Frq, Vel	Dep, Frq	Dep, Dur, Frq
Railways	Dep, Frq	Frq, Dep	Dur, Dep, Vel, Frq	Dep, Frq	Dep, Vel, Frq, Tur
Ports	Dep, Dur, Frq	Dep, Dur, Frq	Dep, Frq, Dur, Vel	Dep, Frq	Dep, Dur, Frq
Dykes	Dep, Frq	Dep, Frq	Vel, Dur	Dep, Dur, Frq	Dep, Dur, Frq
Coast	Dep, Dur, Frq	Dep, Frq	Dur	Dep, Dur, Frq	Dep, Dur, Vel, Frq
Land-use	Dep	Frq, Dep	Vel, Dep, Dur, Frq	Dep, Frq, Sal, Tur	Dep, Dur, Vel, Frq
Residential buildings	Dep, Frq, Sal	Dep, Frq	Frq, Dur, Dep, Vel	Dep, Frq	Dep, Dur, Frq
Non-residential buildings	Dep Frq, Sal	Dep, Frq, Dur	Dur, Dep, Vel, Frq	Dep, Frq	Dep, Dur, Frq
Potable Water	Sal, Tur, Dep, Dur, Frq	Sal, Tur, Dur, Dep, Frq	Vel, Dur	Sal, Tur, Dep, Frq	Dep, Dur, Vel, Frq, Sal, Tur
Water quality	Sal, Tur, Dep,	Tur, Sal, Frq, Dep	—	Tur, Dep, Sal, Frq	Dep, Dur, Vel, Frq, Sal, Tur
Erosion	Dep	Dep, Frq	Vel, Dur	Dep, Frq	Dep, Dur, Frq, Tur, Sal
Tourism	Frq, Dep, Tur, Sal	Frq, Dep, Tur	Vel	Dep, Frq, Tur, Sal	Dep, Dur, Vel, Frq, Tur
Short term displacement	Dep, Frq, Sal	Dep, Frq	Frq, Dr, Dep, Vel	Dep, Frq, Tur, Sal	Dep, Dur, Vel, Frq, Tur, Sal
Long term displacement	Frq, Dep, Sal, Tur	Frq, Dep	Vel, Dur, Frq, Dep	Dep, Frq, Tur, Sal	Dep, Dur, Vel, Frq, Tur, Sal
Agriculture	Sal, Dep, Frq	Frq, Dep, Tur	Dur, Sal, Tur, Vel, Frq, Dep	Dep, Sal, Frq, Tur	Dep, Dur, Vel, Frq, Tur, Nut
Fisheries	Tur, Sal, Dur	Tur, Frq, Dep	Dep, Frq, Tur, Vel, Sal	Dep, Tur, Sal, Dur, Vel	Dep, Dur, Vel, Frq, Tur, Sal
Fish habitat	Tur, Sal	Dur, Dep, Frq	Dep, Vel, Dur	Tur, Dep, Sal, Frq	Dep, Dur, Vel, Frq, Tur, Sal
Wetland extent	Sal, Tur	Dep, Dur, Tur, Frq	Dep, Dur, Vel, Frq	Dep, Frq, Tur, Sal	Dep, Dur, Vel, Frq, Tur, Sal
Flora diversity	Tur, Sal	Sal, Tur, Dep, Dur	Tur, Dep, Sal, Dur, Frq, Vel	Dep, Sal, Tur, Frq	Dep, Dur, Vel, Frq, Nut
Fauna diversity	Tur, Sal	Sal, Tur, Dep, Dur	Tur, Vel, Dep, Sal, Frq, Dur	Dep, Sal, Tur, Frq	Dep, Dur, Vel, Frq, Tur, Sal
Mangroves	Tur, Dep	Dep, Frq	Tur, Dur, Sal, Dep, Vel	Dep, Dur, Vel	Dep, Dur, Vel, Frq, Tur, Sal

Table 6. Pairwise correlations between sensitivities

Hazard parameters	Countries	Australia	Japan	Sri Lanka	Thailand	Viet Nam
DEPTH	Australia		0.722	0.068	0.761	0.588
	Japan			0.288	0.74	0.545
	Sri Lanka				0.314	0.058
	Thailand					0.448
DURATION	Australia		0.732	0.609	0.67	0.434
	Japan			0.2	0.773	0.262
	Sri Lanka				0.409	0.103
	Thailand					0.224
VELOCITY	Australia		0.539	0.308	0.503	0.4
	Japan			0.6	0.353	0.133
	Sri Lanka				0.255	-0.058
	Thailand					0.238
FREQUENCY	Australia		0.793	0.296	0.558	0.053
	Japan			0.279	0.508	0.338
	Sri Lanka				0.377	0.374
	Thailand					0.223
NUTRIENTS	Australia		-0.096	-0.005	0.087	0.448
	Japan			0.027	-0.038	0.064
	Sri Lanka				0.283	-0.161
	Thailand					-0.636
SALINITY	Australia		0.916	0.428	0.936	0.702
	Japan			0.617	0.935	0.744
	Sri Lanka				0.449	0.308
	Thailand					0.781
TURBIDITY	Australia		0.939	0.464	0.915	0.635
	Japan			0.435	0.95	0.718
	Sri Lanka				0.386	-0.101
	Thailand					0.746

the Gippsland Coast: Implications for geomorphological features, natural values and physical assets, Phase 2 — Gippsland Climate Change Study, Gippsland Coastal Board, Final Report, May 2008.

Herath, S. and Ratnayake, U. 2004. "Monitoring Rainfall Trends to Predict Adverse Impacts — a Case Study from Sri Lanka (1964–1993)," Journal of Global Environmental Change, Vol. 14, Supplement 1, pp 71–79.

IPCC, 2001. The Scientific Basis. Houghton, J.T., Ding, Y., Griggs, D.J., Noguer, M., Van der Linden, P.J., and Xiaosu, D. (Eds.) Cambridge and New York: Cambridge University Press. pp 881.

IPCC, 2007. 4th Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (AR4), United Nations.

Milliman, J.D., Rutkowski, C., and Meybeck M. (1995). River Discharge to the Sea: A Global River Index. LOICZ Reports and Studies: LOICZ Core Project Office, pp 125.

Padma Kumara, N.I., Ratnayake, U. and Edirisinghe A.G.H.J. (2005). "Application of GIS for Landslide Mitigation Work in Sri Lanka," Proceedings, International conference on Monitoring, Prediction and Mitigation of Water-Related Disasters, Kyoto, Japan, pp 47–52.

Ratnayake, U. R. and Herath, G.B.B. 2004. "Recent Changes in Water Cycle and its Effect on Natural disasters and Ecosystems of Sri Lanka," Proceedings, "Preparatory workshop on Sri Lanka national water development report," for UN-WWAP, 29–30 October 2004. Wattala, Sri Lanka.

Sabhasri, S. and Suwarnarat K. 1996. Impact of sea level rise on flood control in Bangkok and vicinity. *In:* Sea-Level Rise and Coastal Subsidence: Causes, Consequences and Strategies [Milliman, J.D. and B.U. Haq (Eds.)]. Kluwer Academic Publishers, Dordrecht, Netherlands, pp 343–355.

Somboon, J.R.P. 1992. Holocene highstand shoreline of the Chao Phraya delta, Thailand. Journal of Southeast Asian Earth Sciences, 7:53–60.

Thammasittirong. 1999. Operational Flood Forecasting for Chao Phraya River Basin, Thesis WM-99-23, AIT, Thailand.

Wilkinson, C. 2000. Status of Coral Reefs of the World: 2000 (Townsville, Australia: Global Coral Reef Monitoring Network).

ARCP2008-07CMY-DUTTA

PROJECT TITLE

Climate Perturbation and Coastal Zone Systems in Asia-Pacific Region: Holistic Approaches and Tools for Vulnerability Assessment and Sustainable Management Strategy

COUNTRIES INVOLVED

Australia, Bangladesh, Japan, Sri Lanka, Thailand, Viet Nam

PROJECT DURATION

2 years

APN FUNDING

US$ 80,000

PROJECT LEADER

Dr. Dushmanta Dutta
Senior Research Scientist
CSIRO Land and Water Adjust Senior Research Fellow
Monash University
CSIRO Land and Water
GPO Box 1666
Canberra ACT 2601, Australia

Tel: +61 2 6246 5859

Email: dushmanta.dutta@monash.edu

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

APN

ARCP2009-12NSY-KARVE

Biochar, Carbon Reduction and Sustainable Soils — Role in Asia and the Pacific?

Priyadarshini Karve[1], Simon Shackley[1], Sarah Carter, Tony Knowles, R. Prabhune, Stephan Haefele[1]
[1]Corresponding Authors
Appropriate Rural Technology Institute (ARTI), Pune, India
Email: simon.shackley@ed.ac.uk; priyadarshini.karve@gmail.com; s.haefele@cgiar.org

ABSTRACT: Biochar is the solid remains of heating biomass in an oxygen-depleted environment (Lehmann and Joseph, 2009). Unlike the carbon found in most organic matter, biochar carbon is chemically altered during the heating process and forms into aromatic carbon ring structures that are very resistant to attack by microorganisms (Lehmann *et al*., 2009). As a consequence, biochar carbon can remain in soil for long periods of time — hundreds to thousands of years — and could be an important method for storing carbon that has been scavenged from the atmosphere during photosynthesis. Biochar can be produced from simple charcoal-making technologies, but unless fugitive emissions and soot are properly controlled, such production methods are likely to produce greenhouse gases such as methane and nitrous oxide and be otherwise unsustainable. Biochar can also be produced from modern technological systems such as pyrolysis and gasification used for generating fuels and/or electricity from biomass, and energy generation is likely to be the main driver for biochar production in the near future.

KEYWORDS: *biochar, carbon storage, rice husk char, BIOCHARM*

Introduction

When combined with bioenergy generation, biochar production can potentially avoid the emission of CO_2 resulting from the use of fossil fuels. Woolf *et al*. (2010) estimate that in a policy context that strongly favours biochar deployment, the annual carbon abatement arising from the biochar option globally by 2050 would be between 1 and 1.8 $GtCy^{-1}$, thus making a potentially important contribution to carbon mitigation and removal. The most important constraint on the quantity of biochar, which can be produced sustainably, is the availability of suitable biomass that does not otherwise have an application (meaning largely crop and woody residues and organic waste streams) and, by extension, the quantity of land that is available for sustainable biomass cultivation (e.g., without incurring an excessive "carbon debt" through direct and indirect land-use change (Fargione *et al*., 2008). Biochar can enhance

Figure 1. Rice Husk Char (RHC) from a gasification unit at an ice factory in Cambodia

Figure 2. ARTI's single barrel kiln for sugarcane and maize cobs in operation

soil "health" and has been demonstrated to promote plant growth and crop productivity in some situations, though much remains to be learnt about the mechanisms which account for these effects (Jeffery *et al*., 2011). Some of the principal mechanisms that can help explain the benefits of biochar are its alkalinity, water holding capacity, cation exchange capacity, nutrient content and physical impacts on soil properties (Sohi *et al*., 2010).

The objectives of the APN-supported BIOCHARM project were to assess the opportunities for biomass-bioenergy-biochar systems in three countries: India, Cambodia and the Philippines. In particular, we evaluated two types of biochar with respect to impact on net carbon equivalent abatement; physio-chemical and structural properties and stability of the char carbon; environmental and health & safety impacts; impacts on crop yield and soil in replicated (and non-replicated) pot and field trials with a range of crop types (rice, maize and vegetables) and other soil amendments. A typical char heap in Cambodia is shown in Figure 1.

Methodology

The two types of biochar used in the project were rice husk char (RHC), which is the by-product from small- to medium-sized (150–300 kW capacity) gasifiers located in rice mills utilizing rice husks as the fuel (Shackley *et al*., 2011); and biochar produced from sugarcane leaf litter and maize cobs using much simpler up-draft gasifier kilns (Figure 2).

In some regions there is a surplus of rice husk relative to demand (and a surplus of rice husk where the husks are used in boilers). Hundreds of kilograms of RHC are produced daily from the gasifiers and very large piles build up (approximately 1000 tonne at one site). Such piles are largely inert, but could generate a pollution risk through leaching or wind/water erosion into the air, water or ingestion by animals, etc. (Shackley *et al.*, 2011). The agricultural waste feedstock such as sugarcane leaf litter and maize cobs (after grain removal) are plentifully available and are not, in most instances, being used for any specific purpose. Examination of RHC char samples were done via 3D imaging (Figure 3a) and Scanning Electron Microscopy (SEM) reveals a highly porous but heterogeneous material (Figure 3b).

Results and Discussion

The carbon and energy balance of the rice husk gasifiers (Figure 4) was calculated and the physio-chemical properties of the

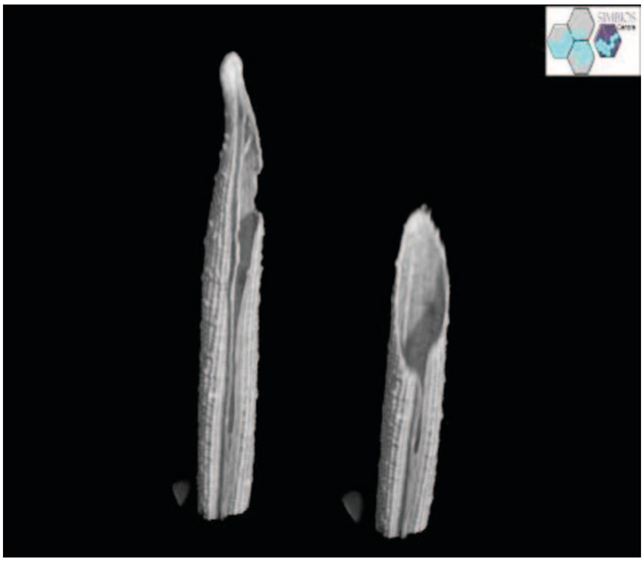


Figure 3a. Three-dimensional image of rice husk char (courtesy of Wilfred Otten, University of Abertay, Dundee)

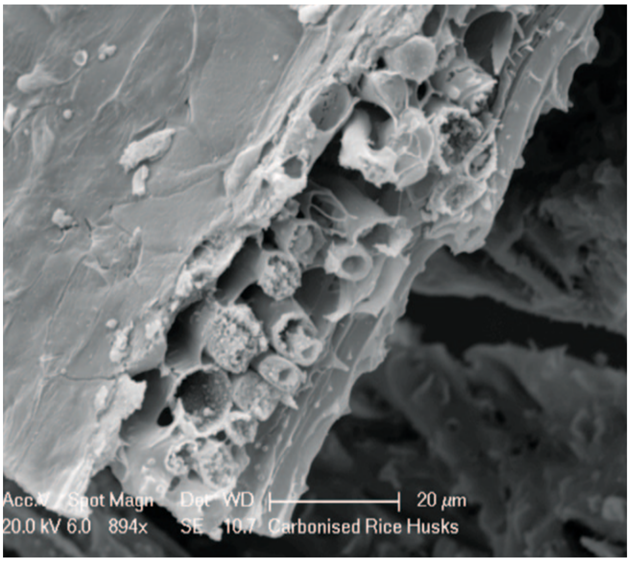


Figure 3b. Scanning electron microscope cross-section of rice husk char (RHC) showing the presence of macro-pores

two biochar samples were examined. The unstable carbon — the component which is expected to be lost through decomposition in the time-scale of hours to several years — was estimated using accelerate ageing laboratory techniques (Masek *et al.*, 2011), so permitting an estimate of carbon that would be stored in the long-term. Simplified life cycle assessment methods were used to measure how much carbon dioxide equivalent (CO_2, N_2O and CH_4) were reduced and removed from the atmosphere across the biomass life-cycle (i.e. from growth to soil incorporation). We found that 0.86 tonne of CO_2 is removed from (or avoided from entering) the atmosphere per tonne of rice husk gasified (Shackley *et al.*, 2011a).

India is the world's second largest rice producer at 132 million tonne (Mt) paddy rice in 2009–10; while the Philippines produced 14 Mt and Cambodia 7 Mt. Assuming 22% of this paddy rice production is rice husk, the potential carbon abatement from use of RHC — assuming that an arbitrary 1/3 of the rice husks could be made available — is approximately 9 Mt CO_2 (India), 1 Mt CO_2 (Philippines) and 0.5 Mt CO_2 (Cambodia). If we compare RHC to some other existing uses of rice husks, such as incorporation into irrigated rice fields, then the greenhouse gas benefit of converting to biochar becomes more significant. This is because, in anaerobic conditions, some of the carbon in rice husks added to soil converts to CH_4, a potent greenhouse gas. Compared to such a baseline, the net carbon equivalent abatement is approximately 4 tonne CO_2 per tonne of rice husk (Shackley *et al.*, 2011a). On an area-basis, the conversion to RHC may reduce greenhouse gas emissions up to five times compared with adding husks to irrigated fields.

The agronomic results provide a mixed picture of the effectiveness of biochar in existing agricultural contexts. Trials growing plants in pots in Cambodia demonstrate that biochar can have a strongly positive effect upon yields (Figure 5). There was a statistically significant (95% confidence level) response to increasing biochar additions for lettuce (harvestable mass, root mass, number of leaves and stem length) and for harvest and stem length in the case of cabbage. The irrigated rice field trials showed a statistically significant increase of 33% in paddy yield with a 41.5 tonne per Ha addition of RHC in the case of one farm, but not in another farm that used the same variety and was located close by (100 m). We cannot currently account for the difference in response, though a compost amendment was also used in

Figure 4. A biomass gasifier in Cambodia generating power from rice husk feedstock

Figure 5. Trials growing plants in pots in Cambodia

the farm where no statistically significant increase was observed. One other study using RHC at a similar rate in rice fields in Southeast Asia showed a statistically significant increase of between 16–35% in poor infertile soils, but no significant increase in better quality soils (Haefele *et al.*, 2011).

A variety of non-replicated exploratory trials with vegetables and irrigated rice also gave positive results with respect to yield. The Indian pot trials did not show such a clear result as those in Cambodia. Three applications stand out as increasing fresh biomass relative to the untreated control: biochar at 20 tonne per Ha; and biochar at 20 tonne per Ha with chemical fertilizer and chemical fertilizer only. Higher biochar applications (40, 60 and 80 tonne per Ha) appear to reduce overall fresh biomass weight compared to the 20 tonne per Ha level and/or synthetic fertilizer applications. The Indian maize field trials using biochar from sugarcane trash and corn cobs did not show any statistically significant yield response. However, there was some evidence (not statistically significant) of a declining yield with biochar additions beyond 20 tonne per Ha. The increase in maize yield for the 20 tonne per Ha biochar application was significant at the 92% confidence level compared to the control. The pH of the agricultural soils where the tests were done may help to explain why the biochar may not have had the same benefits in India as it did in Cambodia. The soil pH in India was 7.4, hence the alkaline biochar would not have had the beneficial effect upon pH as in Cambodia, where the soil pH was 4.8.

Conclusions

The total value of the RHC (carbon abatement plus agronomic benefit) is between $9 per tonne (char carbon only) and $15 per tonne (including also offset emissions from bioenergy) (or $31 per tonne for an avoided anaerobic decomposition baseline) (assuming a carbon price of $5 per tonne CO_2 and an agronomic value of $3 per tonne RHC). Potentially, therefore, RHC can be a valuable addition to farm incomes through improving yields and especially if a carbon value for the RHC could be realized. Because the carbon is fixed during the gasification process, incorporation into the field *per se* does not increase the carbon abatement (excluding indirect effects of the biochar in the soil). Hence, it would be necessary to include the gasification operation within the project boundary in addition to the field incorporation in order to acquire any carbon financing for the biochar. We believe that the results presented here justify further, more detailed, analysis of the benefits, opportunities, costs and impacts of biochar from agri-residues in the Asia-Pacific region.

References

Fargione, J., Hill, J., Tilman, D., Polasky, S., Hawthorne, P. 2008. Land clearing and the biofuel carbon debt. Science 319, 1235–1238.

Haefele, S., Konboon, Y., Wongboon, W., Amarante, S., Maarifat, A., Pfeiffer, E., Knoblauch, C. 2011. Effects and fate of biochar from rice residues in rice–based systems, *Field Crops Research*, 121: 430–441.

Jeffery, S., Verheijen, F., van der Velde, M., Bastos, A. 2011. "A quantitative review of the effects of biochar application to soils on crop productivity using meta-analysis," *Agriculture, Ecosystems and Environment*, 144: 175–187.

Lehmann, J., Czimczik, C., Laird, D., Sohi, S. 2009. "Stability of biochar in soil," in Lehmann & Joseph (Eds.) 2009: 183–205.

Lehmann, J. and Joseph, S. (Eds.) 2009. Biochar for Environmental Management. Earthscan, London.

Masek, O., Brownsort, P., Cross, A., Sohi, S.P. 2011. Influence of production conditions on the yield and environmental stability of biochar. *Fuel* (in Press).

Shackley, S., Carter, S., Knowles, T., Middelink, E., Haefele, S., Sohi, S., Cross, A., Haszeldine, S. 2011. Sustainable gasification-biochar systems? A case-study of rice husk gasification in Cambodia, Part I: Context, chemical properties, environmental and health and safety issues, Energy Policy (in Press).

Shackley, S., Carter, S., Knowles, T., Middelink, E., Haefele, S., Haszeldine, S. 2011. Sustainable gasification-biochar systems? A case-study of rice husk gasification in Cambodia, Part II: Field trial results, carbon abatement, economic assessment and conclusions, Energy Policy (in Press).

Sohi, S., Krull, E., Lopez-Capel, E., Bol. R. 2010. A review of biochar and its use and function in soil, *Advances in Agronomy*, 105: 47–82.

Woolf, D., Amonette, J., Street-Perrott, A., Lehmann, J., Joseph, S. 2010. Sustainable biochar to mitigate global climate change, *Nature Communications*, 1, 56.

Project Report. 2010. Biochar for Carbon Reduction, Sustainable Agriculture and Soil Management (BIOCHARM).

Acknowledgements

The project received additional funding from the UK Biochar Research Centre at the University of Edinburgh and a travel award from Carbon Captured Limited.

ARCP2009-12NSY-KARVE

PROJECT TITLE

Biochar for Carbon Reduction, Sustainable Agriculture and Soil Management (BIOCHARM)

COUNTRIES INVOLVED

Cambodia, India, Philippines

PROJECT DURATION

1 year

APN FUNDING

US$ 40,000

PROJECT LEADER

Dr. Priyadarshini Karve
Appropriate Rural Technology Institute (ARTI)
2nd Floor Maninee Apartments, Survey No. 13, Dhayarigaon
Pune, Maharastra, India

Tel: +91 20 243 90348

Email: priyadarshini.karve@gmail.com

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

ARCP2010-03CMY-MARAMBE

Are Homegarden Ecosystems Resilient to Climatic Change? An Analysis of Adaptation Strategies of Homegardeners in Sri Lanka

Jeevika Weerahewa, Gamini Pushpakumara, Pradeepa Silva, Chathuranga Daulagala,
Ranjith Punyawardena, Sarath Premalal, Giashuddin Miah, Joyashree Roy, Sebak Jana and Buddhi Marambe[1]
[1]Corresponding Author
Faculty of Agriculture, University of Peradeniya, Sri Lanka
Email: bmarambe@pdn.ac.lk

ABSTRACT: Homegarden ecosystems are considered to be resilient to climate change partly due to the use of efficient and effective adaptation strategies by the homegardeners. This study documents the strategies adopted by homegardeners in Sri Lanka and investigates the determinants of the choice of such strategies. Data gathered from household surveys conducted in three selected locations were analyzed to achieve the study objectives. About 52% of the homegardeners in all locations were found to be small-scale farmers (<0.5 ha) engaged in semi-subsistence farming over a long period of time. The majority (85%) of them were educated up to the primary (elementary) level. Among the homegardeners, more than 63% in Keeriyagaswewa, 54% in Pethiyagoda and 90% in Siwalakulama have not made any significant changes to the plant, tree and animal composition of homegardens over the past 20 years. A number of adaptation strategies have been used by the homegardeners enabling them to maintain diversity in the homegarden ecosystem. Changes in planting dates (37%), agronomic practices (39%), use of soil and water conservation measures (41%) and technology (55%) such as the use of new varieties and irrigation equipment, were the most commonly-used adaptation strategies. A considerable variation in the type of adaptation strategies across the households was noted. The results of the probit analysis indicate that the type of employment, age, sex, education level of household head, experience in farming, homegarden size, diversity of homegarden measured by the Shannon Weiner Index (SWI) and perceptions towards climate change, significantly influence the decision to adopt a given strategy. The development programmes to promote adaptation to climate change in homegardens should hence be designed taking the above determinants into consideration.

KEYWORDS: *Homegardens, climate change resilience, adaptation strategies*

Introduction

A "homegarden" is a complex sustainable land use system that combines multiple farming components, such as annual and perennial crops, livestock and occasionally fish, of the homestead and provides environmental services, household needs, and employment and income generation opportunities to the households. Homegardens are considered to be well-adapted agroforestry systems in Sri Lanka that cover about 14% of the total land area of the country, and are known to be dynamic and responsive to the changes occurring in their socio-economic and bio-physical environments. In particular, those homegardens characterized by high species diversity are viewed as being resilient to climate change. Climatic changes are predicted to have adverse effects on food production, to varying degrees, in different ecosystems. One of the reasons attributed to such resilience is the adaptation of coping strategies (Rao *et al.,* 2007; Nhemachena and Hassan, 2007). Despite the above claims, there is a dearth of studies, especially in Sri Lanka, quantifying the extent to which homegardens are resilient to climate change.

The objectives of the present study were to investigate (i) the strategies adapted in homegardens, and (ii) the determinants for the choice of such strategies.

Methodology

Site Selection

Sites for the study were selected based on the characteristics of homegardens (i.e. at least 20 years old, presence of tree crops and annual crops, preferably the presence of domesticated animals, having at least a 3-tiered vertical plant structure), access to homegardens, and availability of climate data from the Department of Meteorology, Sri Lanka. The sites were also selected based on the agro-ecological regions and their sensitivity to changes in climate. Further, uninterrupted nature of the homegardens due to other activities such as access roads, construction/establishment of irrigation reservoirs/schemes were also considered. Accordingly, Keeriyagasweva Village (low country dry zone; n=59), Pethiyagoda Village (mid country wet zone, n=59) and Siwalakulama Village (low country dry zone, n=30) were selected as the sites for the study.

Data Collection

Household surveys were carried out from May to December 2010 in the three selected sites of Sri Lanka. A structured questionnaire was used to obtain the information on general household characteristics, structure and composition of the homegarden, changes made during the past 20 years, perception on temperature and rainfall changes, and information on adaptation strategies. Rainfall and temperature data for the period 1960–2009 were obtained from the Department of Meteorology, Sri Lanka.

Data Analysis

The Shannon-Wiener Index (SWI) was used to measure the diversity of homegardens. Frequency tables and cross tabulations were used to assess the type of adaptation strategies used by homegardeners and a probit model was used to analyze factors that influence decisions to adapt to climate changes following Deressa *et al.* (2010). The dependent variable was treated as one (1) if a certain farmer adopted the strategy and zero (0) otherwise. The independent variables included: SWI, number of individuals employed in farming/off-farming, education level of the household-head (variable=1 for primary, =0 otherwise), household size, sex of the household-head (variable=1 for male, =0 for female), age of the household head (number of years), homegarden size, experience in agriculture, perceived change in temperature (variable=1 for perceived change, =0 otherwise), perceived change in rainfall (variable=1 for perceived change, =0 otherwise) and ownership of animals (variable=1 for owned livestock, =0 otherwise). The variability of rainfall and temperatures were calculated to identify the nature of climate change.

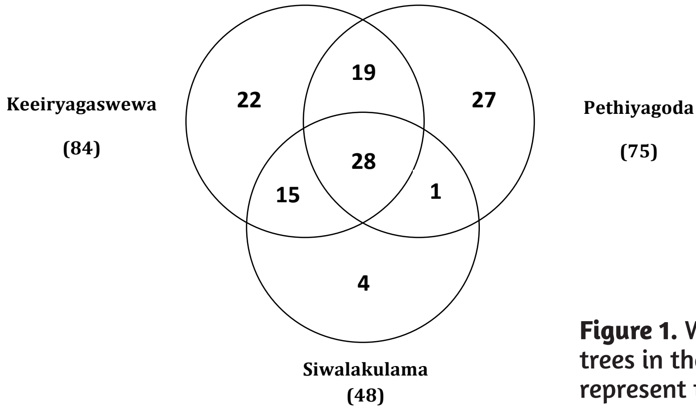


Figure 1. Woody and naturally grown trees in the three study sites (values represent the number of species)

Results of the Analysis and Discussion

General characteristics of the study sites

The analysis of the composition and structure of homegardens revealed that the number of tree species identified in three sites was 116, of which food and timber trees were prominent (Figure 1; Table 1); 28 species were common to all three study sites. Among the domesticated animal species, three livestock species (cattle, goat and buffalo) and poultry were found in homegardens in the two Dry zone sites while no animals were recorded in the Wet zone site at Pethiyagoda (Table 1). The majority of homegardeners, i.e. over 63% in Keeriyagasweva, 54% in Pethiyagoda and 90% in Siwalakulama, indicated that no substantial changes were made to the plant, tree and animal composition of their respective homegardens over the past two decades.

The results of the analysis of household characteristics revealed that the heads of the households were farmers who were educated up to primary level and between 54 and

Table 1. Structure and Composition of Homegardens in Selected villages
Data presented as Mean (range).
* Mean values of the most commonly occurring three species;
KW – Keeriyagasweva Village; PG – Pethiyagoda Village; SK – Siwalakulama Village

Attribute			KW	PG	SK
Number of Homegardens surveyed			59	59	30
Mean Shannon Weiner Index (SWI)			2.133	1.987	1.775
Food Trees	Number of species#		6.43 (5–11)	5.03 (3–8)	4.73 (4–8)
	Number of Trees*				
		Cocos nucifera	4.69	3.62	7.45
		Mangifera indica	3.52	1.46	3.00
		Artocarpus heterophyllus	1.64	2.60	2.42
Timber Trees	Number of species#		3.18 (2–5)	1.98 (0–3)	2.16 (1–2)
	Number of trees*				
		Azadirachta indica	7.40	1.67	4.29
		Tectona grandis	4.10	2.00	3.10
		Berrya cordifolia	5.12	2.60	1.00
Livestock and Poultry	Number of species#		1 (1)	0 (0)	1 (1–2)
	Number of animals*				
		Cattle	8.14	0	3.71
		Poultry	9.0	0	10.0
		Goat	4.0	0	0

58 years of age on average (Table 2). About 52% of the homegardens surveyed, i.e. 46% in Keeriyagasweva, 88% in Pethiyagoda and 23% in Siwalakulama, were less than 0.5 ha. The analysis of climate data indicated that the three sites have experienced increased variability of seasonal rains resulting in more consecutive numbers of dry days with intense droughts and floods. The temperature regime showed an increasing trend in both minimum and maximum temperature (data not presented).

Use of adaptation strategies

The types of adaptation strategies used by the homegardeners in the three locations include changes in planting dates, agronomic practices and technology such as the use of new varieties and irrigation equipment, and use of soil and water conservation measures (Figure 2). Changing technology was the most commonly adapted strategy. During the past 20 years, about 55% of dwellers have changed the technology adopted: 41% have used soils and water conservation measures, while 39% changed their agronomic practices and 37% changed the planting dates of their homegarden crops.

There were differences in the choice of adaptive strategy across sites. In Keeriyagasweva, more than 80% of homegardeners changed planting dates over the past 20 years, while in Siwalakulama, which is also located in the same agro-ecological zone, less than 20% of homegardeners adopted this practice. In both Siwalakulama and Keeriyagasweva, a higher number of dwellers changed their planting dates compared with other adaptive strategies. In Pethiyagoda, soil and water conservation methods were popular compared to other sites and other strategies, where nearly 60% of homegardeners employed soil and water conservation practices in their homegardens.

Determinants of use of adaptation strategies

The results of the probit analysis for surveyed homegardens in the three locations

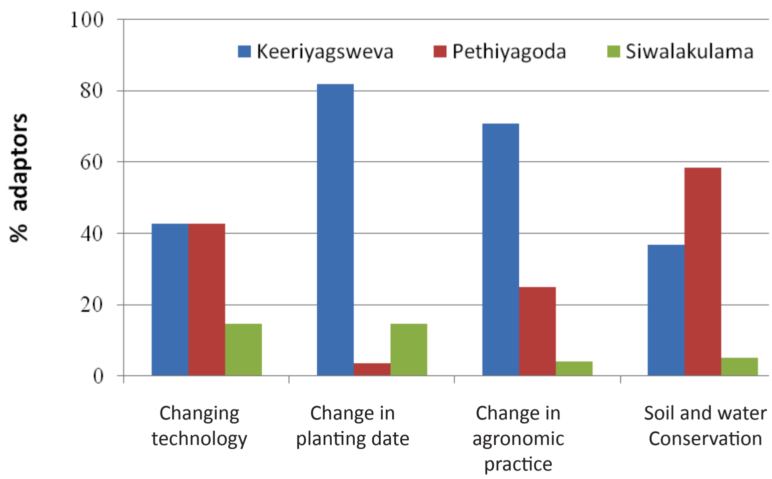
Table 2. Socio-Economic Characteristics of Homegardeners
KW – Keeriyagasweva Village; PG – Pethiyagoda Village; SK – Siwalakulama Village

Attribute		KW	PG	SK
Size of the household	Average	4	4	4
	Range	1–8	1–7	1–5
Age of the household head	Average	55	54	58
	Range	30–83	26–78	30–86
Sex of the household head (% in each category)	Male	86	81	80
	Female	14	19	20
Education level of the household head (% in each category)	No schooling	5.1	1.7	1.3
	Up to primary	84.7	86.4	83.3
	Secondary & above	10.2	11.9	13.3
Occupation of the household head (% in each category)	Housework	0	8	3.3
	Farming	78	28	93.3
	Other	15	50	3.3
	No response	7	14	0
Size of the homegarden (ha)	Average	0.33	0.17	0.4
	Range	0.1–0.6	0.1–0.81	0.04–1.2

Variable	Dependent Variables (Adopted=1; Not adopted=0)				
	Changing planting date	Changing technology	Changing agronomic practice	Soil and water conservation	Any change
Household size		0.12	0.04		-0.05
Employment: Farming=1	0.32**			0.21**	
Employment: Off-farming=1	-0.31**				
Education of the household head	-0.05		-0.93**		-0.61
Shannon Weiner Index (SWI)	0.87**	-0.05		0.23	
Sex of the household head; Male=1		-1.13**	0.39		1.44***
Age of the household head	-0.02**	-0.01	0.001	0.003	0.03**
Experiences in agriculture			0.001		0.02*
Homegarden size	0.42	-0.08	0.82**	-0.30	0.49
Perceived a change in rainfall			-0.64*		-0.36
Perceived a change in temperature		0.72**	0.18	0.38*	0.95**
Ownership of livestock	0.29	-0.01	0.14	0.17	0.18
Natural rate (Constant)	-1.48*	0.84		-1.11*	
Observations	143	143	124	143	124
Pseudo R^2	0.24	0.12	0.13	0.07	0.29

Table 3. Results of the Probit Analysis
*, **, *** statistically significant at the p=0.1, 0.05 and 0.001, respectively

Figure 2. Adaptation strategies reported in the three selected study sites



in Sri Lanka indicated that the number of members in farming and off-farm employment, SWI, as well as age, gender and education level of the household head significantly influenced decision-making on adaptation strategies. It was evident that adaptation has also been influenced by temperature and rainfall change over the past 20 years as perceived by the homegardeners. Interestingly, the specifications that included sites as explanatory variables did not provide satisfactory results indicating that site specific factors do not significantly influence the decision to adopt a strategy (Table 3).

Conclusions

Four main adaptation strategies identified were (i) change in technology; (ii) change in planting date; (iii) change in agronomic practice; and (iv) adopting soil and water conservation strategies. Change in technology was the adaptive strategy most adopted and change in agronomic practices was the least adopted. The decision to adopt new adaptation strategies is significantly influenced by employment; diversity of the homegarden; age, gender, and education level of the household head; awareness of climate change; and homegarden size. Development programmes to promote adaptation to climate change should, therefore, be designed taking the reported determinants into consideration.

RESEARCH HIGHLIGHTS

- Despite the fact that there is evidence that climate change has taken place in the past 20 years, the composition of homegardens in Sri Lanka has not changed substantially. Strategies adapted by homegardeners over the past 2 decades have enabled them to cope with changes in climate.
- Socio-demographic factors of homegardeners and their perception towards climate determine the type of adaptation strategy adopted.
- Homegardeners who have perceived climate change are more prone to adapt to changes using different techniques and technologies.

Acknowledgements

Authors wish to thank the Asia-Pacific Network for Global Change Research (APN) for providing financial assistance to conduct this study (Grant No. ARCP2010-03CMY-Marambe).

References

Deressa, T.T., Hassan, R.M. & Ringler, C. 2010. “Perception of and adaptation to climate change”. Journal of Agricultural Science, Cambridge University Press, pp 1–9.

Nhemachena, C. and Hassan, R. 2007. Micro-level analysis of farmers' adaptation to climate change in Southern Africa. Discussion Paper presented by International Food Policy Research Institute (IFPRI), February 2010.

Rao, K.P.C., Verchot, L. and Laarman, J. 2007. Adaptation to Climate Change through Sustainable Management. Open Access Journal published by International Crops Research Institute For the Semi Arid Tropics (ICRISAT).

ARCP2010-03CMY-MARAMBE

PROJECT TITLE

Vulnerability of Home Garden Systems to Climate Change and its Impacts on Food Security in South Asia

COUNTRIES INVOLVED

Bangladesh, India, Sri Lanka, USA

PROJECT DURATION

2 years

APN FUNDING

US$ 75,000

PROJECT LEADER

Prof. Buddhi Marambe
Faculty of Agriculture
University of Peradeniya
Peradeniya, 20400
Sri Lanka

Tel: +94 81 238 8041

Email: bmarambe@pdn.ac.lk

Website: www.pdn.ac.lk/agri

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

ARCP2010-05CMY-LUCK

The Effects of Climate Change on Potato Production and Potato Late Blight in the Asia-Pacific Region

Luck J[1], Asaduzzaman M, Banerjee S, Bhattacharya I, Coughlan K, Chakraborty A, Debnath GC, De Boer RF, Dutta S, Griffiths W, Hossain D, Huda S, Jagannathan R, Khan S, O'Leary G, Miah, G, Saha A and Spooner-Hart R

[1]Corresponding author

Department Primary Industries and La Trobe University, PMB, 15 Ferntree Gully Delivery Centre, Victoria 3156, Australia

Email: jo.luck@dpi.vic.gov.au

ABSTRACT: The influence of climate change on potato production and the disease, Potato Late Blight, was assessed using two climatically distinct potato growing regions each in India's West Bengal (Nadia and Hooghly) and Bangladesh (Bogra and Munshiganj). Regional climate projections to the year 2050 were obtained for each location using IPCC climate scenario A1B for West Bengal and Bangladesh. Two regional forecasting models indicated an increasing trend (+0.2 to +0.6°C) for maximum and minimum temperatures by 2050. An increasing trend in rainfall was expected for 2050 but no difference in solar radiation was predicted compared to 1981–2010 data. The impact of climate change on potato production in the study areas in India and Bangladesh showed a yield decline of 23–32% by 2050. To assess the effect of climate change on Potato Late Blight, nine published models were tested for accuracy against ten years of West Bengal disease incidence records. The best model was only 25% accurate in predicting Late Blight outbreaks for that time period and, therefore, an alternative approach was developed by adapting the Jhulsacast model and applying fog-based rules. When climate change projections were incorporated, this modified model showed that the onset of Late Blight is likely to be earlier in the growing season for 2031–2040 but severity is likely to be 5–7% less than 1981–2010 records in the intensive potato growing areas of West Bengal. However, in northern Bangladesh, disease severity is predicted to increase by up to 12%, and reduce by 7% in central Bangladesh.

KEYWORDS: *Climate change, Potato Late Blight, food security, plant disease, yield, potato*

Introduction

Climate Change is expected to have significant consequences for agricultural productivity and the incidence and severity of diseases affecting these crops. To examine this more closely, we investigated the impact of climate change on an important disease of potato in the Asia-Pacific Region, Potato Late Blight (PLB). Data from six growing regions, two each from West Bengal, Bangladesh and Australia were analyzed in this study. In the interests of keeping this article brief, the data from Australia is not presented in this paper.

In 2008, India was the 3rd largest producer of potatoes in the world with the state of West Bengal accounting for more than one quarter of the total crop. In 2007, Bangladesh was the 4th largest producer in Asia. A growing concern for West Bengal and Bangladesh, however, is reduced productivity as a result of a lack of arable land, an increasing demand for food and the intensification of climate change and natural disasters. With a government drive to diversify agricultural crops and to improve agricultural output and income, the potato crop is ideal because of its ease of cultivation, high productivity per unit area and diversity of use.

Late blight of potato is caused by *Phytophthora infestans*, and is considered to be the most important disease of potato worldwide. Under favourable climatic conditions, the disease can destroy a potato crop within a few weeks (Figure 1). Late blight is a major disease of potatoes in India (Singh, 1996) and Bangladesh, and is very much a "weather-driven" disease, dependent on two major climatic factors: moisture and temperature.

The objective of the present study was to determine how future climates (projected by the IPCC) will affect the incidence of this disease. In order to identify the indirect effects on the disease, an initial assessment was made of the climate projections for potato growing regions across West Bengal and Bangladesh and its subsequent effect on potato production.

Methodology

Representative locations were selected within West Bengal (Nadia and Hooghly) and Bangladesh (Bogra and Munshiganj) to generate local daily data to run the potato

Figure 1. Bangladesh potato grower amidst a field of potatoes affected by Late Blight (source D. Hossain)

and late blight disease models. These locations were selected based on the presence of potato production and variability in climatic zones. The A1B scenario was used using two global climate models (EH5OM and HadCM3Q) downscaled respectively, by the RegCM3 and PRECIS regional models. We used EH5OM GCMs output in RegCM3 and HadCM3Q output in PRECIS using the A1B scenario. The Infocrop model and DSSAT models were used to predict future potato yields for the selected regions. PLB records collected from BCKV and BARI were used in conjunction with the Jhulsacast model (Singh *et al.*, 2000) to predict disease initiation dates under future climates.

Results

Climate Change Projections

For West Bengal and Bangladesh, both models showed an increasing and significant linear trend of 0.2 to 0.6°C for the maximum temperature and 0.2 to 0.5°C for minimum temperature per decade up to 2050 (Table 1 and Figures 2 and 3). Both the models also showed increasing trends for rainfall output from PRECIS which were higher than those from RegCM3. No difference in solar radiation was predicted compared to the present decade.

Climate change and potato production

Our analysis in West Bengal and Bangladesh concur with Singh, *et al.* (2009) with a trend towards yield decline by 2050 ranging from a 23–28% reduction using PRECIS and 30–32% reduction using RegCM3 at Nadia and Hooghly, respectively (Table 2). At

Table 1. Decade-wide mean projections for West Bengal and Bangladesh for minimum and maximum temperature, solar radiation and rainfall determined from the downscaled Regional Climate Models

Decade	RegCM3				PRECIS			
	TMIN (°C)	TMAX (°C)	SRAD MJ/m²	RAIN (mm)	TMIN (°C)	TMAX (°C)	SRAD MJ/m²	RAIN (mm)
2011–2020	18.8	29.4	18.2	2004	20.1	28.9	16.7	2203
2021–2030	19.0	29.6	18.1	2021	20.5	29.0	16.4	2432
2031–2040	19.5	30.1	18.2	2058	20.9	29.6	16.7	2371
2041–2050	19.9	30.4	18.2	2021	21.4	30.2	16.8	2505

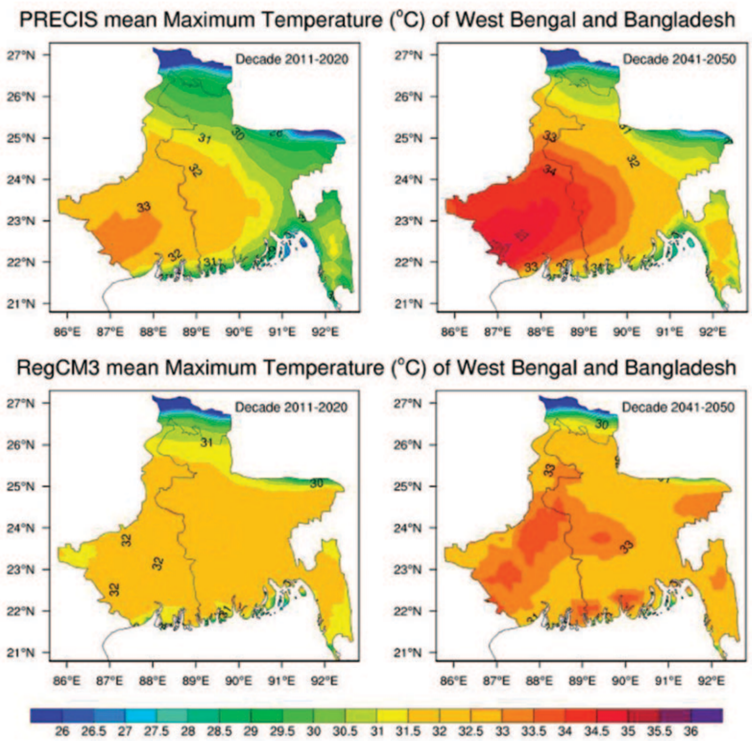


Figure 2. Maximum temperature projections for decades 2011–2020 and 2041–2050

Bogra in Bangladesh the PRECIS regional climate model indicated a lower yield loss (7.2%) compared to the RegCM3 regional climate model (26%). This was compared to Munshiganj which had an 18% yield reduction using PRECIS and a 31% yield reduction using RegCM3.

Climate Change and Potato Late Blight (PLB) Epidemics

To determine if PLB will have a compounding effect on potato losses in future climates, an evaluation of nine published PLB models was undertaken to test which model would be most applicable for the selected potato growing areas. The analysis, based on temperature, rainfall and relative humidity, using 10 year's disease and weather data from BCKV University, revealed that none of the published models worked well under the Gangetic alluvial region of West Bengal conditions. The historical data showed that rain is not a prerequisite for an outbreak of PLB in the Gangetic alluvial region of West Bengal and any model which had a primary component of rainfall was considered unsuitable for predicting late blight in this region. Hence, the majority of popular late blight models were not used in the present study.

Therefore, an alternative approach based on minimum temperature and the onset of morning fog was developed for predicting late blight of potato under the Gangetic alluvial region of West Bengal Jhulsacast (Singh *et al.*, 2000) model. This model has a published accuracy of 62% in India.

Disease initiation was simulated using

RCM	2011–2020		2040–2049		Difference	
	PRECIS	RegCM3	PRECIS	RegCM3	PRECIS	RegCM3
Nadia, West Bengal	18.3	18.4	14.2	12.9	-23%	-30%
Hooghly, West Bengal	16.4	17.5	11.7	11.9	-28%	-32%
Bogra, Bangladesh	21.3	19.2	19.8	14.2	-7.2%	-26%
Munshiganj, Bangladesh	20.3	17.6	16.6	12.2	-18%	-31%

Table 2. Summary of expected mean potato tuber yield (dry weight tonne/ha) for 2011–2020 and 2040–2049, and percentage change between the decades using the DSSAT-Potato crop model and downscaled daily data generated by the PRECIS and RegCM3 regional climate models

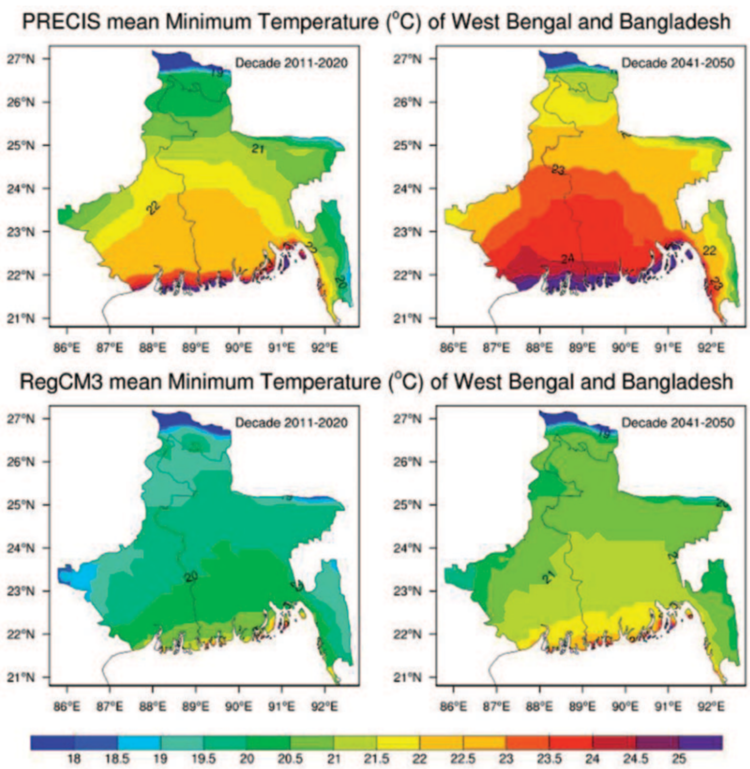


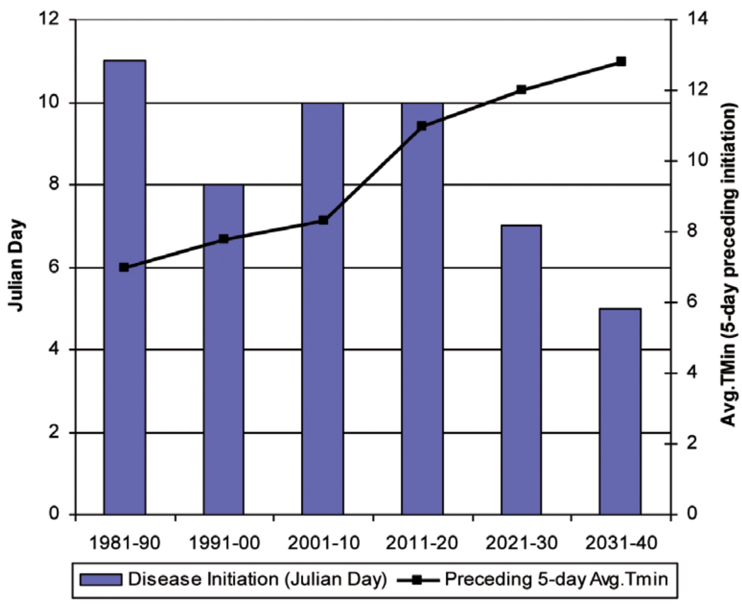
Figure 3. Minimum temperature projections for decades 2011–2020 and 2041–2050

RESEARCH HIGHLIGHTS

- » For West Bengal and Bangladesh potato growing regions, the maximum temperatures will increase by 0.2–0.6 °C and the minimum temperatures will increase by 0.2–0.5 °C per decade up until 2050.
- » Without adaptation, by 2040 potato yields will decline for all potato growing regions examined. Of the four regions studied, the most northern growing region, Bogra, is predicted to sustain the least yield impacts due to the relatively cooler conditions for production.
- » Earlier sowing dates, new planting areas and high temperature-tolerant varieties will need to be considered by growers to adapt to future climate to minimize future yield losses.
- » In the regions examined, the disease, Potato Late Blight, will not significantly increase under future climate scenarios; in some cases it will decrease.
- » The onset of disease is predicted to be early in the growing season in 2040. This will require monitoring of climate conditions and appropriate timing of spray application to minimize the impact of disease.
- » An interesting gap highlighted in this project was the absence of fog data, which is critical for predicting PLB. A routinely collected fog data set would allow the meteorology bureaus to issue fog-warnings for potato growers which could enable pre-emptive fungicide spray application to prevent major losses due to this disease.

the Jhulsacast model for the Chinsurah area for the period 1980 to 2040. Yearly data on average five day temperature preceding disease initiation summarized in decadal interval from 1981–1990 to 2031–2040 were plotted against the decadal average disease initiation dates. Figure 3 shows that the decadal average of 5-day Tmin preceding PLB initiation increased from 7°C (1981–90) to 12.8°C (2031–2040). A clear relationship was demonstrated between the increasing temperature and advancement of PLB initiation. The projected increasing temperatures that occur during the potato growing season will advance PLB initiation by 12 days compared to current temperatures.

Figure 4. The relationship between historical and projected average minimum temperatures (5 days prior to disease initiation) and Late Blight disease initiation



The model indicated that PLB severity is likely to reduce by 5–7% from the 1981–2010 period to the 2031–40 period in the intensive potato growing areas of West Bengal, India. However, in similar intensive growing areas of Bangladesh, disease severity can increase up to 12% and reduce to around 7% in similar intensive growing areas of central Bangladesh. The onset of PLB is likely to be earlier in the growing season in future decades as compared to the present decade (2011–20).

Discussion and Conclusion

Our preliminary results demonstrate that potato yield will decline under future climate scenarios for all potato growing regions examined; Hooghly and Nadia in West Bengal and Bogra and Munshiganj in Bangladesh. Of the four regions studied, the most northern growing region, Bogra, is predicted to sustain the least yield impacts due to the relatively cooler conditions for production. Earlier sowing dates, new planting areas and high temperature tolerant varieties will need to be considered by growers to adapt to minimize future yield losses.

Our analysis of historical PLB incidence in West Bengal and Bangladesh and projected PLB incidence (to 2040) indicate that the disease will not significantly increase under future climates, and in some cases it will decrease. However, the onset of disease is predicted to be early in the growing season in 2040. This will require monitoring of climatic conditions and appropriate timing of spray application to minimize the impact of disease.

An interesting gap highlighted in this project was the absence of fog data, which is critical for predicting PLB. A routinely collected fog data set would allow the meteorology bureaus to issue fog-warnings for potato growers which could enable pre-emptive fungicide spray application to prevent major losses due to this disease.

References

Harrison, J.G. 1992. Effects of the aerial environment on late blight of potato foliage — a review. Plant Pathology 41, pp 384–416.

IPCC, 2007. Climate change 2007: The physical science basis. *In:* S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K. Averyt, M. Tignor, and H. Miller (Eds.) Contribution Of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK. Available from: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html. Accessed March 30, 2011.

FAO, 2008. http://www.potato2008.org

Singh, B.P., Islam, A., Sharma, V.C., Shekhawat, G.S. 2000. JHULSACAST: A computerised forecast of potato late blight in western Uttar Pradesh. *Journal of the Indian Potato Association* 27, No. 1/2, pp 25–34.

Singh, J.P., Lal, S.S. and Pandy, S.K. 2009. Effect of climate change on potato production in India. Central Potato Research Institute. Shimla Newsletter 40, pp 17–18.

Acknowledgements

We gratefully acknowledge the support of the APN for this project as well as co-funding from the Cooperative Research Centre for Plant Biosecurity and the in-kind support from the Department of Primary Industries Victoria and the University of Western Sydney. We thank the "All India Coordinated Research Project on Potato," West Bengal Centre and the "All India Coordinated Research Project on Agro-meteorology," West Bengal Centre for the use of their data. Finally, we dedicate this work to our APN project team member and friend, plant pathologist, Dr. Md. Delowar Hossain who represented the Bangladesh Agriculture Research Institute (BARI), who sadly passed away during this project.

ARCP2010-05CMY-LUCK

PROJECT TITLE

The Effects of Climate Change on Pests and Diseases of Major Food Crops in the Asia-Pacific Region

COUNTRIES INVOLVED

Australia, Bangladesh, India

PROJECT DURATION

2 years

APN FUNDING

US$ 78,240

PROJECT LEADER

Dr. Jo Luck
Principal Research Scientist Microbiology
Department Primary Industries Victoria
PMB 15 Ferntree Gully Delivery Centre
Victoria 3156
Australia

Tel: +61 3 9210 9248

Email: jo.luck@dpi.vic.gov.au

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

ARCP2010-07CMY-BAI

Asian Coastal Ecosystems: An Integrated Database and Information Management System (DIMS) for Assessing Impact of Climate Change and its Appraisal

Ramani Bai V.[1], Mohan S., Raju D. and French J.
[1]Corresponding author
Department of Civil Engineering, University of Nottingham Malaysia Campus
Email: vramanibai@gmail.com

ABSTRACT: The new Database and Information Management System (DIMS) is a web-GIS-based online resource that facilitates the study of climate change impacts, sea-level rise, coastal ecosystems, floods, water quality and other related phenomena in the earth sciences. DIMS consists of two parts: (a) A spatial database of the study area in Asia; namely Malaysia, Singapore and India; and (b) A simple set of software that provides users with basic querying, updating, reporting and data-acquiring capabilities and techniques. DIMS hosts a data inventory on sea level records, temperature, climatic and weather parameters, geologic, ecologic, biologic (both quality and quantity) information and spatial data on the website www.globalclimate-engine.org. The website also hosts new software for flood prediction and water quality. DIMS is designed to be used by two broad groups: regular end-users (e.g., scientists and project leaders) and system administrators. The new DIMS for Climate Change Studies was awarded the Double Gold British Invention of the Year Award at the British Invention Show 2011.

KEYWORDS: *DIMS, database, information management system, climate change*

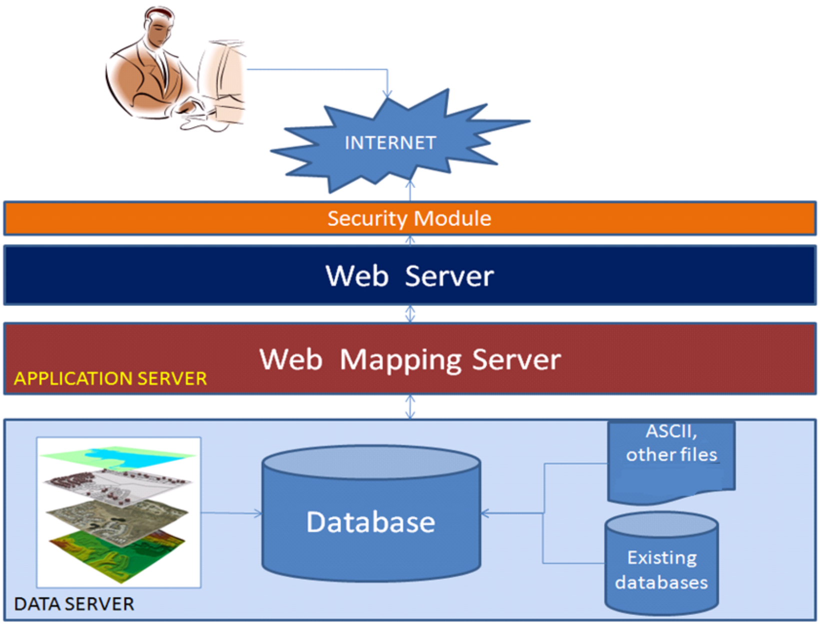


Figure 1. DIMS-GIS System Architecture

Introduction

Climate change poses a serious threat to human security due to increasing disasters in the region. While more research is being conducted on climate change, it is essential to ensure that the data needed to conduct such research is freely and readily accessible to all. Although many global climate models (GCMs) have been developed and provided for worldwide use; access has been limited because of a lack of data. For this reason, the project team of researchers from Malaysia, India, Singapore and England, embarked on developing an Integrated Database and Information Management System (DIMS), as an easily accessible data and information outlet for interested parties in the region.

The main objectives were to: i) Create country-wide compliant metadata to serve as a means of documenting data sets that could be distributed online and searchable; ii) Plan, develop and demonstrate the technology at a regional workshop; and iii) Evaluate DIMS by assessing the impacts of climate change in selected coastal regions in participating countries of India, Malaysia and Singapore.

The primary goal of the project was to develop a comprehensive set of hydrologic, geologic, biologic, and spatial information for onshore and offshore ecosystems through a database driven Internet system (DIMS) for the selected countries in the Asia-Pacific region.

Methodology

The design and implementation of a data-driven website and relational database consisting of climatic, geologic, ecologic, biologic (both quality and quantity) information and spatial data was carried out (Liu 2009; Baker and Michael 2006). For proper development and use of the geodatabase, an accompanying data management plan was developed that addressed important issues such as server configuration, user access, security, workflow, data location, etc. The flow of work in creating the DIMS-GIS is shown in Figure 1. In order to store, manage and analyze all the information available, a relational structure should be chosen (Ramani Bai *et al.*, 2012).

Results and Discussion

Geographic information system (GIS) and remote sensing (RS) technologies are very important tools for planning, management and monitoring natural resources. The DIMS project was pursued with the

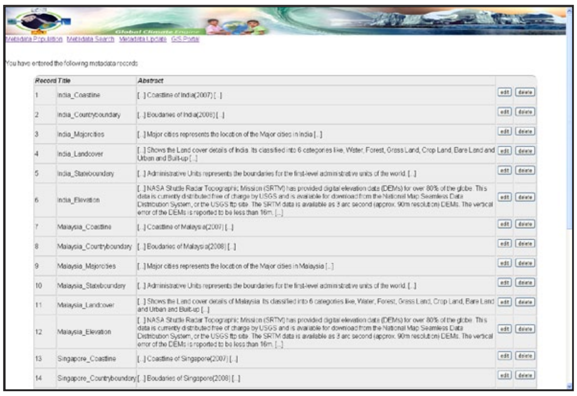


Figure 2. A list of previously entered metadata in the metadata update page (http://dims.globalclimate-engine.org/Metadata_UNM/Edit)

objective of rehabilitating a country's capacity to alleviate the impacts of climate change. DIMS is to be viewed as an opportunity for environmental and science communities to advance in land-use and coastal zone management in light of climate change.

DIMS technology is an important tool for projects charged with managing, improving and preserving a country's climate and its environment, especially in the Asian region. The coastal zone–DIMS concept has generated keen interest that warrants further development. Selected sites from the collaborating countries have been used to evaluate the database (DIMS) created by modelling climate change and coastal mapping. The studies have provided an understanding of climate change, its impact and the sensitiveness of coasts for potential changes in climate. The sample metadata page and the database hosted on the Internet are shown in Figures 2, 3, 4 and 5, respectively (Ramani Bai and Andy Chan, 2010). In conclusion, the use of DIMS in coastal zone management and in climate change studies are both interesting and stimulating.

Conclusions

Climate change and its impact assessment is an inter-disciplinary area that cuts across physics, chemistry, biology, earth sciences, hydrology, agriculture, economics, technology development and many other fields. Therefore, multiple data sets are required even to simulate the current situations by different models in Climate science. Many studies on climate impact assessments utilizing models have been developed in other countries. But there is an urgent need to develop a climate change model for each region as the rainfall and monsoon conditions are entirely different in different countries. Thus there is an immediate need to get data on climate, natural ecosystems, soil, water from different sources, agricultural productivity and socio-economic parameters, amongst others, in order to get a reliable prediction. In this context, it is essential to have accessibility to databases that reflect national and regional concerns. DIMS is paying one such way to scientists, engineers and all interested individuals in climate science and related studies. Efforts

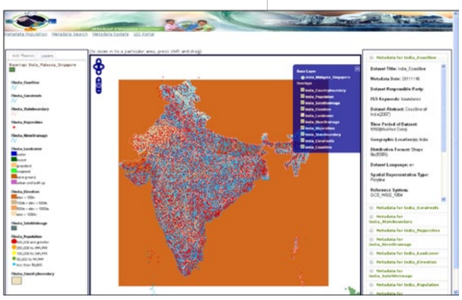


Figure 3. GIS portal for India with metadata

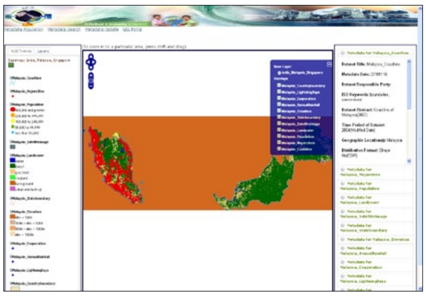


Figure 4. GIS portal for Malaysia

Figure 5. GIS Portal for Singapore

should be taken to establish an effective mechanism for sharing and accessing this data in required formats that can be easily deciphered.

References

Ramani Bai V., Mohan S. and Reza Kabiri. 2012. "Towards a Database for an Information Management System for Climate Change: An Online resource." Climate Change and the Sustainable Management of Water Resources: Climate Change Management, Walter Leal Filho (Eds.) Springer-Verlag, Berlin., 61–67.

Ramani Bai V., and Andy Chan. 2010. "Climate Change and DIMS Technology." Proc., of the year 2010 Asia-Pacific Network for Global Change Research workshop, Kuala Lumpur, 1–466.

Liu, J. 2009. "A GIS-based tool for modeling large-scale crop-water relations." J. Environmental Modeling & Software, 24, 411–422.

Baker Jr., Michael. 2006. Updated GIS Database Design: Geodatabase Model, City of Suffolk, Virginia. Virginia Beach, Virginia.

Acknowledgments

Our Project team is most thankful for the evaluation panel of APN-ARCP who approved this project to allow it to progress to the stage it is today.

ARCP2010-07CMY-BAI

PROJECT TITLE

Asian Coastal Ecosystems: An Integrated Database and Information Management System (DIMS) for Assessing Impact of Climate Change and its Appraisal

PROJECT DURATION

2 years

APN FUNDING

US$ 80,000

PROJECT LEADER

Assoc. Prof. Dr. Ramani Bai V.
School of Civil Engineering
University of Nottingham Malaysia Campus
Jalan Broga, Semenyih,
43500 Selangor, Malaysia

Tel: +60 3 8924 8604

Email: ramani-bai.v@nottingham.edu.my

Website: www.globalclimate-engine.org

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

ARCP2011-04CMY-PAUDEL

Community-Based Forestry and Livelihoods in the Context of Climate Change Adaptation

Birendra Karna[1], M.G. Miah, T.N. Thang, N.S. Paudel
[1]Corresponding author
ForestAction, Nepal. Email: birendrakarna@gmail.com

ABSTRACT: Community-based forest management (CBFM) is so far perceived as the best model for forest management in many developing countries. The contribution of CBFM in livelihoods of the local community is thought to be positive but the emerging contemporary discourse of climate change and its impacts on livelihoods is less recognized in CBFM modalities. In order to make the CBFM modalities more successful, there is a need to assess the linkages between climate change and community-based forest management in relation to climate change. It is crucial to explore adaptation practices that can help rural communities to respond effectively to climate change. The present collaborative research attempts to understand how climate change is affecting forest-dependent communities in one of the world's most vulnerable regions, and the actual and potential adaptation measures that would enable communities and community networks to remain resilient.

KEYWORDS: *community forestry, livelihood, climate change, adaptation*

Introduction

Rural populations dependent on agriculture and forest management ecosystems are particularly vulnerable to both direct and indirect impacts of climate change. Increasing temperatures, erratic rainfall pattern, and rising sea levels are major threats to sustainable livelihoods. The effects of climate change are expected to deepen poverty and adversely affect livelihoods, infrastructure, environmental resources and economic growth as developing countries have a lesser capacity to adapt and are, in effect, more vulnerable. Therefore, adaptation is now acknowledged as necessary for responding effectively and equitably to the impacts of both climate change and climate variability. Although local communities possess relevant indigenous knowledge and experience coping with climate change, this kind of knowledge needs to be documented and disseminated in order to be used effectively. Community forests user groups (CFUGs), who are the main stakeholders in CBFM, are mostly represented by the poor and marginalized sectors of society and are the most vulnerable to climate change-induced hazards (e.g. flash flooding, landslides and drought), which have been more frequent and of higher magnitude in recent years.

Forests are an important resource base for rural livelihoods. The dynamics between the five assets — natural, socio-political, human, physical and financial — that belong to each livelihood determine the management of natural resources and its sustainability. These assets also determine people's ability to respond to the impacts of climate change and to implement activities intended to reduce GHG emissions. Thus, the enhancement of sustainable forest-based livelihoods should therefore form the basis of any adaptation and mitigation effort. Community-based adaptation is perhaps the best and most appropriate option for a country with participation of local communities to conserve, manage and optimize the utilization of natural resources. The inter-dynamics between forest and climate change is incomplete in relation to understanding the socio-cultural aspects of this issue.

Communities in developing countries are heavily dependent on climate sensitive resources like forests, agriculture and fisheries; have lesser capacity to adapt; and are more vulnerable to the effects of climate change (IPCC, 2001; Saleemul, *et al*., 2003; Stern, 2006; Mirza, 2003). The Climate Change Vulnerability Index by Maplecroft's Climate Change Risk Atlas (2011) illustrates a higher risk in poor and developing countries. The index rates 16 countries as at "extreme risk," the 16 mostly represented by developing and poor countries, including all of our project countries: Bangladesh (1), Nepal (4), Viet Nam (13), and Thailand (14). These "extreme risk" countries are already threatened and the extra pressure of climate change impacts places additional socio-economic burden on the nations, mostly affecting the ultra-poor. There is a lack of research to understand the impacts of climate change on livelihoods and design measures to improve adaptive capacity to cope with climate change (Hedger *et al*., 2008).

Yohe and Tol (2002) state that spatial and temporal scale, nature of sector, climatic zone, and socio-economic base of actors, or combination of these factors, play a vital role in designing adaptation measures. Therefore, there is a need to develop policies at the sub-national level rather than at the central level alone for effectively improving the adaptive capacity of communities (Puppim de Oliveira, 2009) and increase the resilience of resource-dependent communities.

With these views, the present study was undertaken covering larger geographic areas (Bangladesh, Nepal, Thailand and Viet Nam) to understand the status of community-based forestry and other livelihood activities and adaptation scenarios in the face of climate change within and across the regions of South Asia (Bangladesh and Nepal) and Southeast Asia (Thailand and Viet Nam).

Methodology

The field-based research was conducted at each project country site. Four case studies from the four countries were conducted and the study used the multiple research approach to meet the research objectives. After the inception workshop in each project country, the research sites were finalized and the International Forestry Resources and Institutions (IFRI) research methodologies together with other social sciences research methods such as interviews, site observations, Participatory Rural Appraisals (PRA) and climate change risk assessment tools, were used extensively to conduct the research. The concerned government departments and literature developed by them were also used as a secondary source to explore their responses to climate-related threats at the national level.

Major activities of this project were centred at IFRI Collaborative Research Centre (CRC) at ForestAction. Based on the agreed research design, the IFRI CRC, based at AIT in Thailand; CORENARM in Viet Nam; Bangabandhu Agricultural University in Bangladesh; and CRC in Nepal, carried out respective country case studies. The research design was developed after the inception workshop organized in Thailand and frequent email communication was the key tool utilized to guide research in each country. Partner countries were engaged in data collection, data coding and data analysis; and are currently in the phase of drafting the report.

Insights

By accomplishing field-level activities and in-house sharing among different partner countries, the present study brought to light the following key insights:

1. Community forests are put at the lowest priority in climate change adaptation strategies. Local people are mostly concerned about agricultural production and livestock grazing activities because these appear to be more directly affected by climate change compared to the resilience of the natural forest. In addition, the already poor and degraded conditions of the allocated community forest results in a lack of interest from the surrounding population as it is not seen as a main source of livelihood.
2. The community by itself is not sufficient to develop an adaptation mechanism. There is a need for continuous technical and economic support to realize efficient adaptation strategies. The best way could be to collect traditional knowledge of the local community and, with infrastructure and technological innovation from an external agency, develop the best, or more appropriate, adaptation strategies.
3. Institutional involvement has been increasing

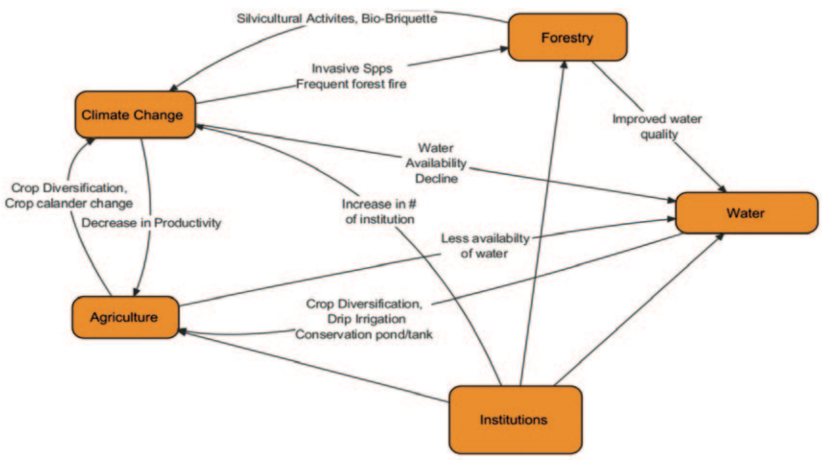


Figure 1. Integrated approach to develop climate change adaptation strategies

with increasing impacts of climate change in sectors such as agriculture, forestry, water, health, etc. Different institutions working on a common agenda for climate change should strengthen and develop an integrated approach to intervention (Figure 1).

4. Changing the orthodox mindset of the community: Due to contemporary developmental issues such as carbon trade (REDD+) and payments for ecosystem services (PES) in the global and regional arenas, the community has also changed their mindset on the conventional use of forest resources. Willingness to adopt market-based mechanisms to get direct economic benefit from CF has started in community forests of Nepal.
5. Most adaptation activities of local people toward climate change are from their own experience or learnt from each other. There are no actual programmes from the government/ local authorities to help/show local people how to adapt to climate change both in their daily lives as well as their production activities. The concern of the government is focussed on coastal areas, where the impacts of climate change are much greater.
6. Diversification of livelihoods and income source based on natural resources are necessary in order to enhance the adaptation capacity of local communities.

FORESTRY AND LIVELIHOOD OF LOCAL PEOPLE OF NATIONAL SAL FOREST —A SITE IN BANGLADESH

The study site is located in the Periphery of the National Sal (Shorea robusta) forest under the Tangail District of Bangladesh where local communities were once completely dependent on the Natural Sal Forest and its natural diversity for their livelihoods. Currently, the dependency on forest and forest products has been drastically reduced. These changes are because of the poor condition of the forestand productivity decrease in natural products. The reasons for this are climate change and anthropogenic activities. Among the anthropogenic activities, deforestation (through illegal forest harvesting) and over-exploitation of the forest are the main culprits. In relation to climatic factors, the most important events are erratic rainfall (such as a delay of the on-set of rain, fewer rainy days, high levels of rainfall within short time), high humidity (long foggy weather), and disease infestation. To protect the remaining forest, the Forestry Department has leased out surrounding land to local people for community forestry/participatory forestry, where both local people and the Forestry Department have some sort of benefit sharing arrangement. Local people have also shifted their livelihood activities like practicing different types of farming (especially agroforestry) in their homestead and surrounding areas and other off-farm activities (small shops, working on other farms as day labourers, etc.), and migrating to other places during the off-season. However, the overall lifestyle of forest dependent people is very poor. The government or concerned authorities should take appropriate measures to rebuild the forest and to create alternative livelihood opportunities for the local people.

Conclusion

In assessing community-based forestry and livelihoods in the context of climate change adaptation scenarios, there are several factors related to climate change vulnerability of households and communities such as: economic conditions, asset and infrastructure development, health and nutrition, diversity in livelihood options and education, and the accessibility of educational programmes. Most of the information related to climate change at the research sites is the perception of local people and there was less accurate measurement of climate variables to measure the effects of climate change on the lives of local people and their production activities. There should be in-depth and continuous research to measure and monitor these factors and observe their actual effects. This would be beneficial in long-term adaptation and mitigation strategies against climate change impacts in the local context.

References

Hedger, M., Greeley, M. and Leavy, J. 2008. Evaluating Climate: Pro-poor Perspective; *IDS Bulletin* 39(4).

IPCC. 2001. Climate change: the scientific Basis — contribution of working Group to third Assessment report of the intergovernmental panel of climate change. Cambridge: Cambridge University Press.

Mirza, MMQ. 2003. The three recent extreme folds in Bangladesh: a hydro-metrological analysis. *Nat Hazards* 28: 35–64.

Puppim de Oliveira, J.A. 2009. The implementation of climate change related policies at the subnational level: an analysis of three countries. *Habitat International* 33: 253–59.

Saleemul, H. *et al.* 2003. Mainstreaming Adaptation to climate change in least developed countries London: International Institute for Environment and Development (IIED).

Stern, N. 2006. The Economics of Climate Change: the Stern Review. UK: Cambridge University Press.

Yohe, G. and Tol, R.S.J. 2002. Indicators for social and economic coping capacity — moving towards a working definition of adaptive capacity; *Global Environmental Change* 12: 25–40.

COMMUNITY INITIATION OF BIO-BRIQUETTE PRODUCTION-LAMATAR, LALITPUR, NEPAL

Communities in Lamatar (project sites) have been managing their forest for a long time. They have started producing the bio-briquette commercially from the invasive species, *Lantana camera*. In the first year (2011) they produced more than 1,000 pieces of bio-briquette worth 20,000 Nrs. This kind of initiative in community forests improves management of unwanted species and raises funds to support their livelihood.

Acknowledgements

We specially thank the community residents for their support in the field. We would also like to thank our project partners and researchers, especially Dr. Dharma R. Uprety and Rajesh Bista, who contributed to this research activity. Likewise, we would like to extend our sincere appreciation to APN for its support.

ARCP2011-04CMY-PAUDEL

PROJECT TITLE

Community Based Forestry and Livelihoods in the Context of Climate Change Adaptation

COUNTRIES INVOLVED

Nepal, Thailand, Viet Nam

PROJECT DURATION

2 years

APN FUNDING

US$ 79,980

PROJECT LEADER

Dr. Naya Sharma Paudel
Executive Coordinator
Environmental Governance Specialist
ForestAction, Nepal

Tel: +977 1 555 0631

Email: naya@forestaction.org

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

ARCP2011-08CMY-HUDA

Food Security and Climate Change: Evaluating the Mismatch between Crop Development and Water Availability

A. K. S. Huda[1], S. P. Wani, X. Mei and V. Sadras
[1]Corresponding Author
School of Natural Sciences, Centre for Plants and the Environment, University of Western Sydney (UWS), Australia.
Email: s.huda@uws.edu.au

KEYWORDS: *climate change, crop phenology, water availability*

Introduction

Plant breeding and crop selection involves optimizing yield for different agro-ecological zones. Soil and climatic parameters are the major matching factors, with temperature, photoperiod and water availability being major climatic factors influencing crop adaption and productivity. Under climate change scenarios, it is proposed that average temperatures will increase while there will be changes in both the amount and distribution of rainfall. Because of these changes, it is probable that mismatches will arise between crop phenology (the growth stages of the crop) and environmental factors, resulting in yield decreases. This will occur through, for example, water or temperature stresses at critical periods of crop yield determination (Huda *et al*., 2011; Mei, 2005; Sadras and Monzon, 2006; Goswami *et al*., 2006 and Wani *et al*., 2008).

A project has been developed with APN ARCP funding to examine mismatches between crop phenology and climate (particularly water availability) arising from recently realized climate trends and proposed climate change. Research collaborators are UWS and South Australian Research and Development Institute (SARDI), International Crops Research Institute for the Semi Arid Tropics (ICRISAT), and Chinese Academy of Agricultural Sciences (CAAS). The project commenced in September 2010 and major coordination activities have been workshops in China, India and Australia to plan and achieve the desired project research outcomes.

Possible mismatches arising from realized warming were the subject of the project planning workshop, held in Beijing in September 2010. The workshop designed case studies in China, India and Australia, and realized a significant input to the project that would be made by young researchers in China and India. Strategies have been developed to enhance capacity building of these researchers during the project, including their involvement in the final project workshop in Australia.

Research approach

Research is focussing on crops of local importance including rice, wheat, sorghum, soybean, groundnut and chickpea at key sites. The Australian research is based on six sites along a north-south transect representing the range of environments for wheat growing in eastern Australia. Rainfall varies from summer dominant in the north (about 23° south) to winter dominant in the south (about 36° south).

In India there are two sites in semi-arid to sub-humid climates (600–1200 mm rainfall per year), coinciding with World Bank projects to rejuvenate tank storage for irrigation, to maximize runoff to tanks during excess rainfall and to improve in-field water management. Sites are at Dharwad in Karnataka state and at Guna in Madhya Pradesh. Dharwad is in the southern part of India and Guna is in the central part. The two regions have different annual rainfall but similar soil type. In Dharwad, annual rainfall is 600–750 mm while in Guna it is 1000–1200 mm, and the soil type is vertisol (heavy cracking clay soil) in both regions. Crops grown at Dharwad are sorghum, soybean, groundnut and chickpea.

In China, research is covering some 72 winter wheat-growing sites on the Huang-Huai-Hai (3H Plain) in Central China, with monitoring of climate and crop growth over the period 1971–present. The growth data of winter wheat involved in this study includes sowing stage, returning green stage, jointing stage, heading stage and maturity.

Methodology is mainly based on the use of cropping systems simulation models to analyze crop growth and yield under existing and predicted climates in the three countries. However, in India, this analysis is complemented by field studies of different water management technologies, while in China climate and phenology data for field monitoring sites is available for the period 1971–present.

Some Preliminary Results

India

Some data is presented for two cropping systems in Dharwad, Karnataka (soybean-chickpea and groundnut-sorghum). As can be seen in Figure 1, yields of different rainy season and post-rainy season crops vary significantly from year to year with, for example, groundnut varying from 0.4–1.1 tonne/ha. Computer simulations were carried out using the DSSATv4.5 model for the present climate (P), and for a number of future scenarios based on climate change predictions. These scenarios were increased average temperature of +1, +2, and +3 °C individually and coupled with a 20% increase and 20% decrease in rainfall.

In Dharwad, groundnut showed no response in days to flowering to increasing

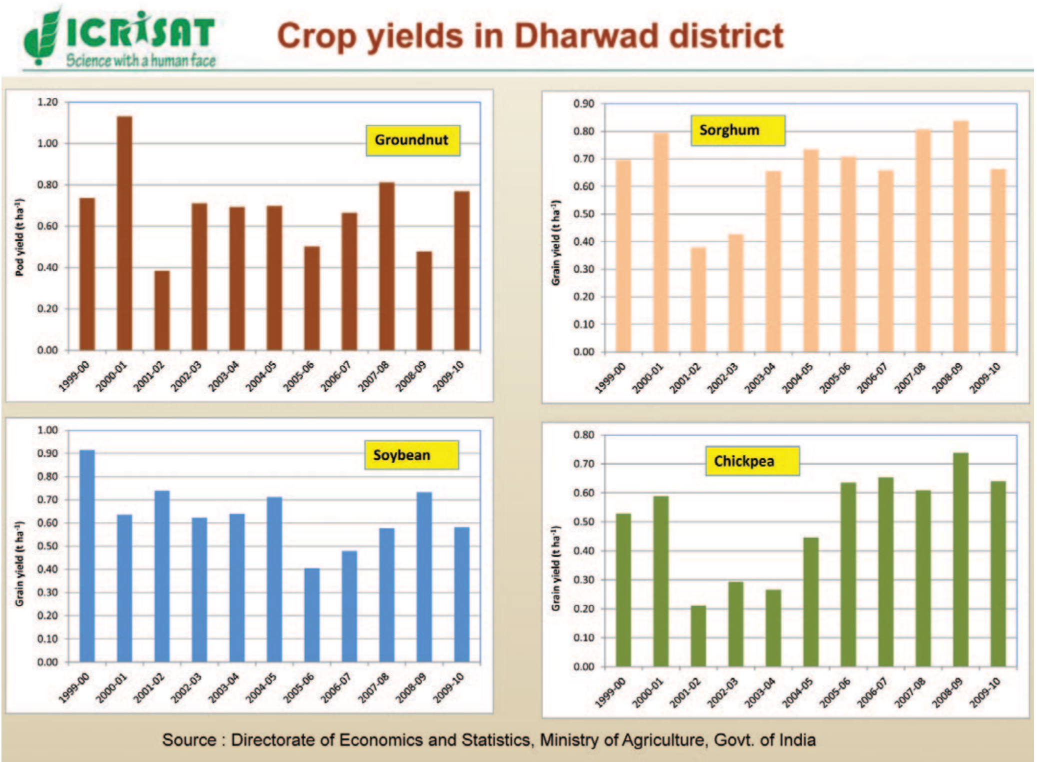


Figure 1. Yields for four crops in the last eleven years at Dharwad, Karnataka

temperature or low rainfall while flowering to maturity duration was reduced from 81 (P) to 78 (P+3) days. Sorghum maturity duration was reduced with warming. Flowering was reduced from 67 days (P) to 57 days (P+3) and flowering to maturity was reduced from 41 days (P) to 35 days (P+3). In both crops, addition and reduction of rainfall did not show any prominent effects on phenology. In the soybean-chickpea system, warming coupled with low rainfall decreased crop duration markedly for soybean by reducing both stages; flowering by 4 days and flowering to maturity by 5 days. In chickpea, warming and rainfall did not show any effect on time to flowering, while warming coupled with low rainfall reduced flowering to maturity from 39 days (P) to 36 days (P+3, -20% RF).

Increased temperature decreased simulated yields of the crops in both cropping systems, and warming coupled with low rainfall increased the reduction. The impact of temperature and rainfall was more pronounced on the soybean-chickpea system and hence, the groundnut-chickpea system is likely to perform better in a changing climate compared with the soybean-chickpea system.

China

The Chinese work to date has concentrated on analysis of a significant data set on realized changes in climate and crop growth over the last 40 years. The max, min and mean air temperature increased by 0.17°C, 0.40°C and 0.26°C per decade, respectively, during the 1961–2010 in the 3H Plain, as can be seen in Figure 2. We can conclude that the rate of increase in minimum temperature is greater than that of maximum temperature. There was no significant change in rainfall over the period.

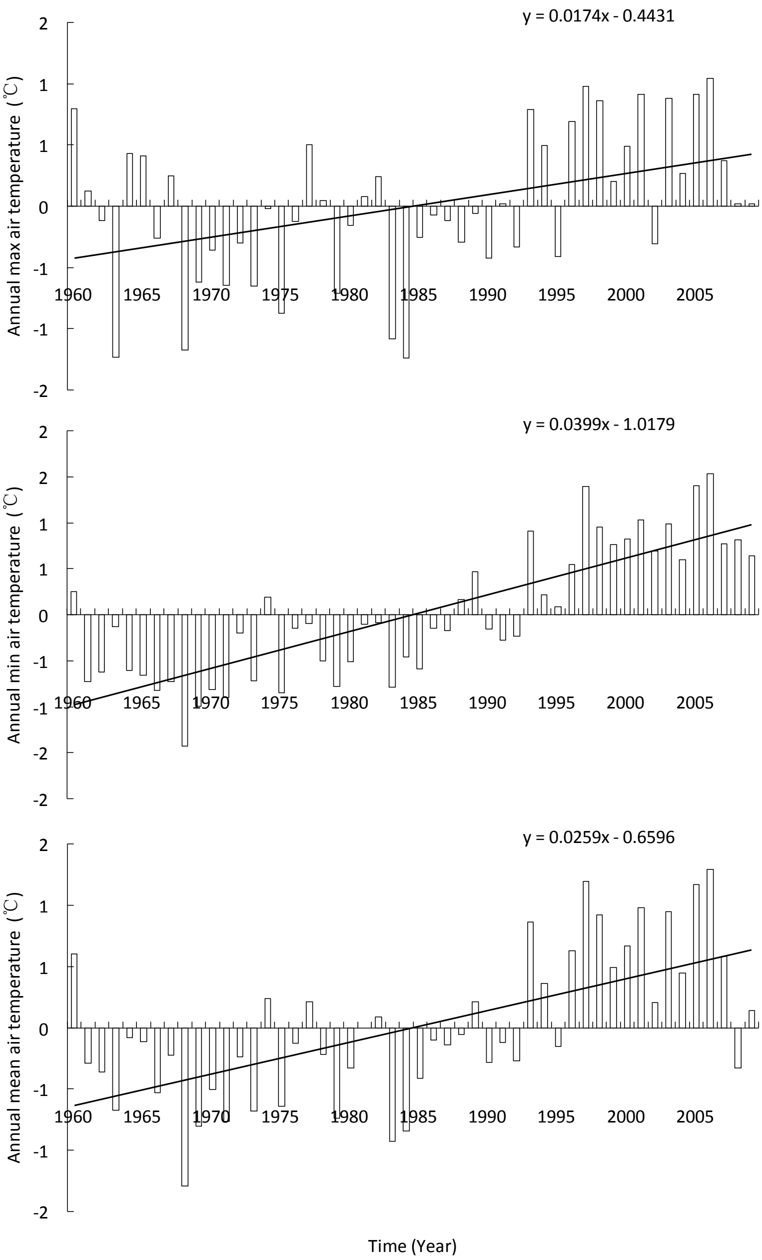
Between the two periods 1971–80 and 2000–2010, rainwater deficit in the period between heading and maturity stages increased by about 15 mm. This phenological stage is important in yield determination, so more attention should be paid to supplementary irrigation in this period, provided that it is available.

Australian Case Study

APN funding was used strategically to link with a larger initiative led by Dr. A. Potgieter (University of Queensland) with the collaboration of colleagues from the Tasmanian Institute of Agriculture Research (H. Meinke), University of Queensland (A. Doherty, G. Hammer, D. Rodriguez) and CSIRO (S. Crimp).

We used OzWheat, a shire scale dynamic stress-index model that accounts for the impacts of rainfall and temperature on wheat yield and a range of climate change projections from CSIRO Cubic Conformal model (CCAM). We modelled five scenarios;

Figure 2. Annual trend in anomaly of max, min and mean air temperature during the period 1961–2010 in 3H Plain in China



a baseline climate (climatology, i.e. 1901–2007), and two emission scenarios, i.e. "low" and "high" CO_2 for two climate projections of 2020 and 2050. These projections did not account for CO_2 effects on crop growth.

The potential benefits from CO_2 fertilization were analyzed using the daily-time step model APSIM in a latitudinal transect in eastern Australia. Locations were Emerald (23°31'25.05" S, 148°9'31.61" E), Dalby (27°11' S, 151°16' E), Moree (29°27' S, 149°50' E), Dubbo (32°11' S, 148°35' E), Wagga Wagga (35°07' S, 147°20' E) and Corowa (35°59' S, 146°23' E). These locations represent a transect of increasing yield potential as driven by the gradients in total radiation, proportion of diffuse radiation, temperature, vapour pressure deficit and rainfall patterns.

Flowering time was advanced by increasing temperature up to 15% relative to the baseline. Under the worst case scenario, in-season crop rainfall was reduced by 12–15% whereas off-season rainfall was reduced by 5–10%. The differential trends for in-season and off-season rain, together with the shifts in phenology, suggest a mismatch between projected climate trends and crop development, which are likely to be relevant for yield.

Irrespective of the emissions scenario, the 2020 projection showed negligible changes in the modelled yield relative to baseline climate, both at the shire or point scale levels. For 2050-high emissions scenario, changes in modelled yield relative to the baseline ranged from negligible (-5%) to +6% in most of Western Australia, and parts of Victoria and Southern New South Wales; and from -5% to -30% in northern New South Wales, Queensland and the drier environments of Victoria, South Australia, and in-land Western Australia (Figure 3).

Carbon dioxide fertilization effects across a North-South transect through eastern Australia cancelled most of the yield reductions associated with increased temperatures and reduced rainfall by 2020, and attenuated the expected yield reductions by 2050.

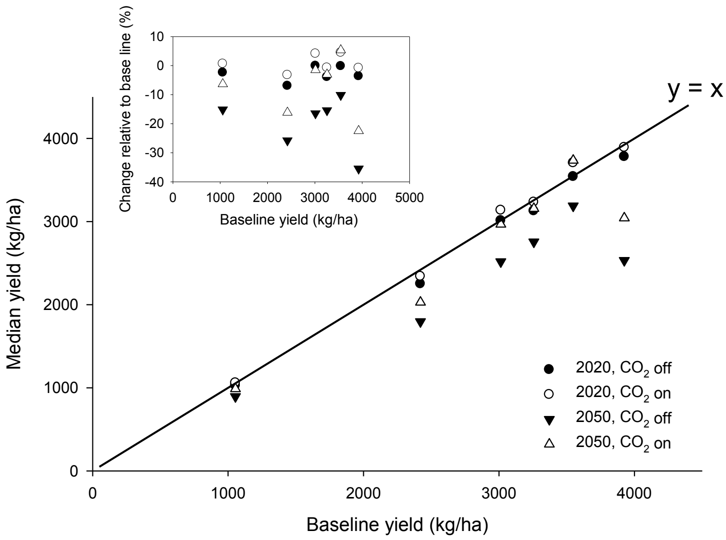


Figure 3. Baseline and median yield data for selected locations and scenarios for Australia

The Hyderabad workshop

The second workshop of the project was held at ICRISAT, Patancheru near Hyderabad, India from 9–13 January, 2012 (Figure 4). Unfortunately, due to visa

Figure 4. Meeting of APN project partners at ICRISAT, Patancheru, India, 9–13 Jan 2012

problems, the Chinese collaborators were not able to attend. However, their paper was provided and they were available electronically during the Workshop. They will also be contributing to the further development of project plans discussed at the workshop. Major outputs of the workshop were paper structures for comparative case studies and strategies to involve young researchers from India and China to complete and present project outputs.

As part of the workshop, we undertook a two-day field trip to the University of Agricultural Sciences, Dharwad and to one of the project field sites some 15 km from the city (Figures 5 to 8). As mentioned earlier, the catchment tank management project is funded by the World Bank. The project has a range of strategies to improve the efficiency of water use, including repair of tanks and other hydrologic structures, and demonstrations of improved agronomic practices.

The strategies are therefore consistent with those required for adaptation to water shortages and excess arising from climate change. Significant rising trends in the frequency and the magnitude of extreme rain events (> 100 mm per day) and a significant decreasing trend in the frequency of moderate events over central India during the monsoon seasons from 1951 to 2000 were observed (Goswami *et al.,* 2006). The seasonal mean rainfall does not show a significant trend, because the contribution from increasing heavy events is offset by decreasing moderate events. This creates threats of waterlogging, but also increased opportunities for off-field storage in village tanks.

Day-to-day decisions regarding new local infrastructure and fair allocation of water are made by a village-based "Tank Users Group". Women's Groups are also associated with the project, and they provide small loans for medical, educational and agricultural purposes.

In addition to these operational strategies, the University of Agricultural Sciences, Dharwad and ICRISAT are collaborating in field research on improved in-field water management. The research is part of the PhD studies being undertaken by two students from the University of Agricultural Sciences, Dharwad. Bed and furrow management systems and crop residue retention have increased profile water storage and soil organic carbon. The students, supported by the Model watershed project funded by the Government of India, are contributing to fulfil the objectives of the current APN project.

Figure 5. Interaction of APN Project team with Women's self-help group, Catchment management project, Dharwad

Planned Project Outputs

Three types of outputs are envisioned:

1. Papers for different countries will present comparative case studies. The papers will address the following questions:

In the past:

- What are the realized long-term climate trends (particularly rainfall and temperature?)
- What observed effects have these trends had on crop phenology or productivity?

And in the future:

- What models/scenarios are being used to predict future climate scenarios?
- Using these predictions, what are the expected temporal shifts in crop phenology under future climate scenarios?
- What are the likely shifts in the pattern of rain and water availability?
- To what extent will climate change contribute to any mismatch between crop phenology and water availability?
- What are the expected consequences of this mismatch for food security?
- What adaptation strategies and policies can be developed to build the resilience of communities and natural resources?

Information on strategies can only be general at this stage, since some proposed strategies will require field testing, which is beyond the scope of this project. Strategies will include use of different crop varieties to avoid water and temperature stress, moving growth of a given crop to another more suitable geographic area, landform treatments, integrated water management, and watershed management to remove excess water during wet periods and store in tanks for later use.

2. Young researchers trained in report preparation and presentation. As part of this strategy the young researchers will carry out literature reviews of past work for India and China under the key words "climate change, crops, India/China". They will also be actively involved in the writing up of country case studies, with local and Australian senior researchers acting as mentors. Finally the young researchers will visit collaborating institutes in Australia and will be involved in the final project workshop.

3. Increased international collaboration and proposals for future collaborative research.

Figures 6 and 7. Group photographs of project team in field at Dharwad

Figure 8. PhD students from an Agricultural University discuss issues with farmer cooperator

References

Goswami, B.N., Venugopal, V., Sengupta, D., Madhusoodanan, M.S. and Prince, K.X. 2006. Increasing trend of extreme rain events over India in a warming environment. *Science* 314: 1442. DOI: 10.1126/science.1132027.

Huda, A.K.S., Sadras, V. Wani, S. and Mei, X. 2011. Food Security and Climate Change in the Asia-Pacific Region: Evaluating Mismatch between Crop Development and Water Availability, International Journal of Bio-resource and Stress Management (IJBSM), 2(2): 137–144.

Mei, X. 2005. Integrated Development of Farming and Animal Husbandry for High-Beneficial Water Conservation in Northern Dryland of China, China Agricultural SciTech Press, 2005.

Sadras, V.O., Monzon, J.P. 2006. Modelled wheat phenology captures rising temperature trends: Shortened time to flowering and maturity in Australia and Argentina. Field Crops Res. 99, 136–146.

Wani, S.P. Joshi, P.K. Ramakrishna, Y.S. Sreedevi, T.K. Singh, P. and Pathak, P. 2008. A New Paradigm in Watershed Management: A Must for Development of Rain-fed Areas for Inclusive Growth. *In:* Comprehensive Assessment of Water Management in Agriculture Series; Rainfed Agriculture: Unlocking the Potential (Wani *et al.*, eds.), ICRISAT, Hyderabad, India.

ARCP2011-08CMY-HUDA

PROJECT TITLE

Food Security and Climate Change in Asia-Pacific Region: Evaluating Mismatch between Crop Development and Water Availability

COUNTRIES INVOLVED

Australia, China, India

PROJECT DURATION

2 years

APN FUNDING

US$ 119,700

PROJECT LEADER

Dr. Samsul Huda
Associate Professor
School of Science and Health
University of Western Sydney
Hawkesbury Campus, M15 Building
Locked Bag 1797 Penrith
NSW 2751, Australia

Tel: +61 245 70 1390

Email: s.huda@uws.edu.au

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

CBA2010-02CMY-TOGTOHYN

Dryland Development Paradigm Application for the Study of the Tuin and Baidrag River Basin Social-Ecological Systems in Mongolia

Chuluun, T.[1], Tserenchunt, B., Altanbagana, M.[1], Davaanyam, S.[1], and Stafford-Smith, M.

[1]Corresponding Authors

Dryland Sustainability Institute, Mongolia, P. O. Box 44/243, Partizan str. 31, Suhbaatar 5, Ulaanbaatar 14250, Mongolia

Email: chuluun@warnercnr.colostate.edu

ABSTRACT: Socio-economic changes and climate change in the last two decades have caused dynamic changes in Mongolia's pastoral systems. To study these dynamics, we applied the Dryland Development Paradigm (Reynolds *et al.*, 2007) as a framework to analyze pastoral social-ecological systems in the Tuin and Baidrag river basins, located in Bayanhongor aimag. Global warming was identified as the most critical slow variable in these drylands. Water resources in the region have already decreased below critical threshold levels, with fewer rivers flowing and lakes drying out. Social-ecological vulnerability has increased more rapidly in the desert steppe region than in other ecological zones in the study area.

KEYWORDS: *Dryland Development Paradigm (DDP), pastoral social-ecological systems, Mongolia*

Introduction

In the past several decades, changes in climate, livestock dynamics and socio-economic factors are interacting in new ways that are altering nomadic land-use systems in Mongolia (Ojima and Chuluun, 2008). In the last seventy years, the annual mean air temperature has increased by 2.14°C in Mongolia (MARCC, 2009) and this warming has intensified in the last two decades. The loss of water points due to global warming (Davaa, 2009) has disrupted traditional nomadic pastoral patterns of seasonal grazing. Increased grazing pressure around the remaining water points has resulted in local overgrazing. These changes have increased the vulnerability of pastoral social-ecological systems. In this paper, we examine the vulnerability of rangelands in river basin areas.

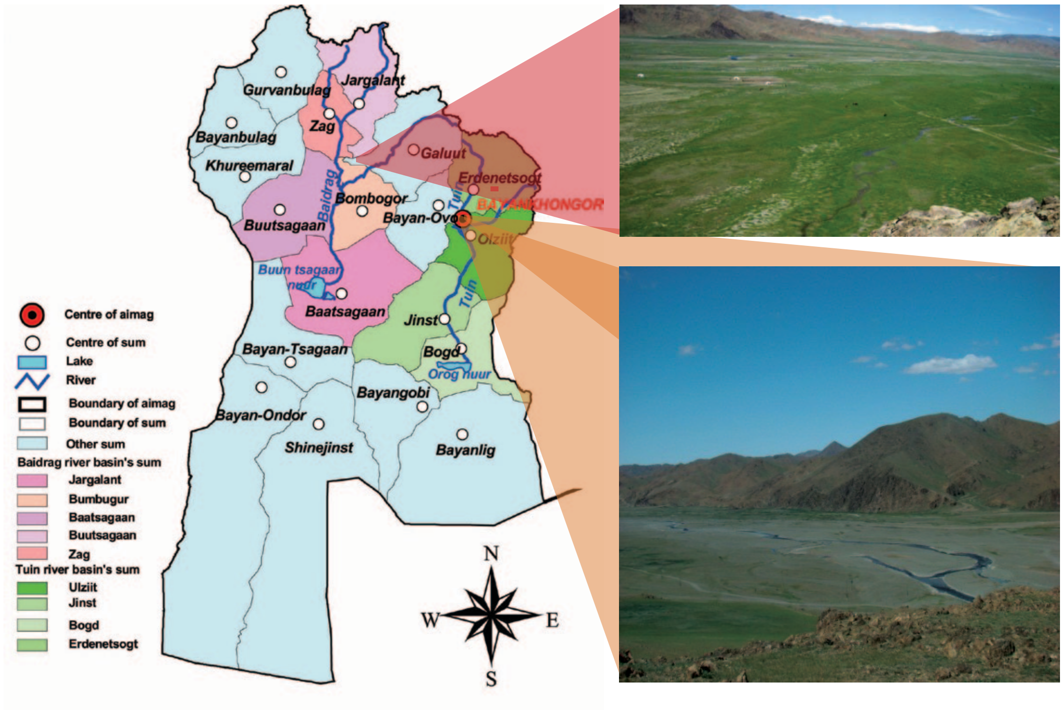


Figure 1. Location of the Tuin and Baidrag river basins in Bayanhongor aimag, Mongolia

Material and methods

Our study areas are pastoral social-ecological systems in the Tuin and Baidrag river basins, located in Bayanhongor aimag province (Figure 1). These two rivers are major rivers located in the south facing slopes of the Khangai Mountains. The Tuin River flows into Lake Orog, and the Baidrag into Lake Boontsagaan. The study area covers different ecological zones: from forest steppe in the high mountains, steppe in the centre, and desert-steppe in the south. These ecological systems were connected not only through natural processes like river flow, but by humans through livestock movements historically (Chuluun and Ojima, 2011).

We used the Dryland Development Paradigm (DDP) (Reynolds *et al.*, 2007) to frame discussions with key stakeholders to understand the main drivers of system dynamics, critical slow variables and thresholds already crossed in pastoral social-ecological systems in our study area. The social survey results were then integrated with socio-economic and climate data analysis. Climate change analysis included warming trends, and drought and *zud* index calculations. Livestock dynamics and composition changes were also included to study land-use and cover change. Social-economic study included the Human Development Index (HDI) and social vulnerability assessments.

The Rangeland Ecosystem Vulnerability Index is a combination of a Drought Index (Natsagdorj and Sarantuya, 2004) and a Rangeland Use Index,

$$\Delta N = \alpha\left(\frac{N - N_o}{N_o}\right)$$

where N is livestock density; and N_0 is the carrying capacity (Mongolian National Atlas, 1990 & 2009); α is a pasture management coefficient, set to 1 in this study (Chuluun *et al.*, 2005).

Results and Discussion

The long-term temperature since 1940 shows a clear warming trend by more than 2^0C in our study area. Intense warming (Figure 2(a)) and the transition to a market economy coincided in the last two decades,

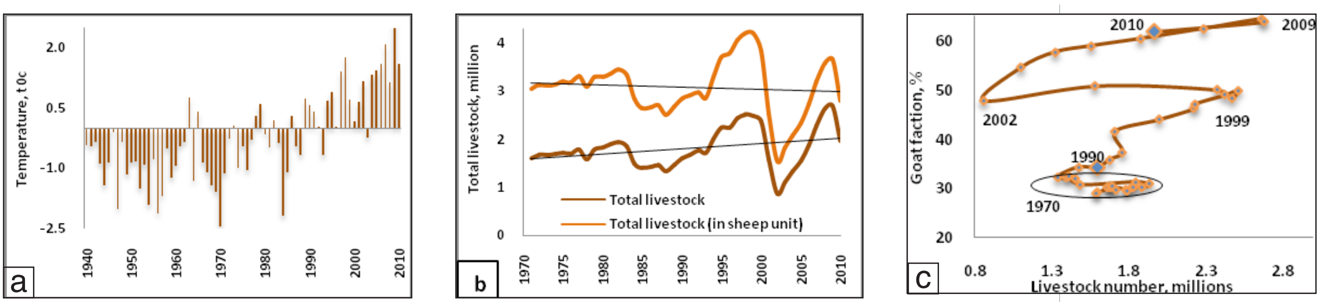


Figure 2. (a) Annual temperature anomaly, (b) livestock dynamics and (c) goat fraction change relative to livestock number in Bayanhongor aimag

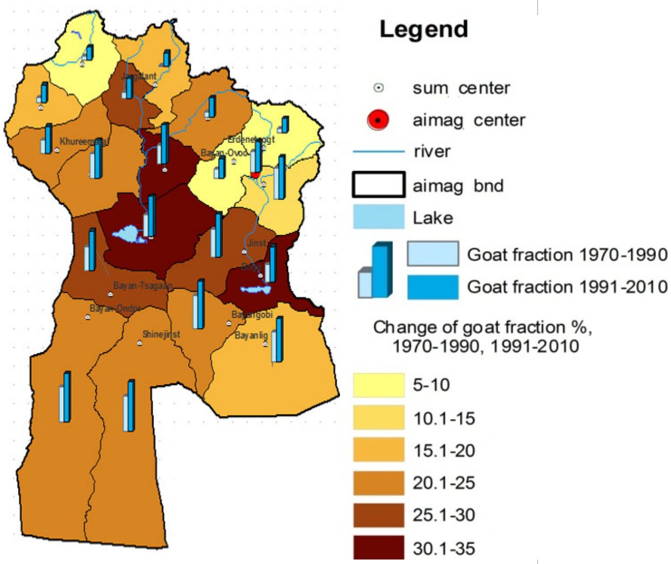


Figure 3. Change of goat fraction in the total livestock

during which livestock numbers also became more dynamic (Figure 2(b)) and livestock numbers increased by about 30% after privatization. Drought summers and *zuds* from 1999–2002 caused huge livestock losses, from which recovery took five to six years. The summer drought in 2009 followed by a *zud* in winter 2010 resulted in more than 300,000 livestock losses in Bayanhongor aimag (Statistical office of Bayanhongor aimag). Thus, both climate and market factors thus play an important role in livestock dynamics. The proportion of goats (goat fraction) in the total livestock numbers was very stable (~30%) during the socialist period (1970–1990), but increased up to 45% by 1999 and 60% by 2010 (Figure 2(c)). The biggest increases in goat fraction occurred in our study areas (Figure 3).

Drought occurs more often in the desert-steppe region compared to the forest steppe and steppe regions (Figure 4). Ecological vulnerability, which accounts for both drought and stocking rate relative

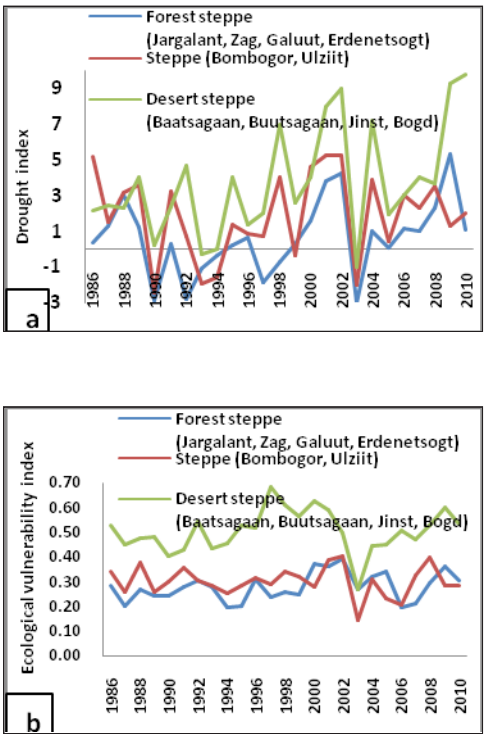


Figure 4. (a) drought and (b) ecological vulnerability assessment in the Tuin and Baidrag river basins by ecosystem type (1986–2010)

Principle	Pastoral social-ecological systems in Mongolia	Key implications for research, management and policy
P1: H-E systems are coupled, dynamic, and co-adapting, so that their structure, function, and interrelationships change over time.	Pastoral social-ecological systems (SESs) became more dynamic with goat number increases (due to income from cashmere) and *zud* impact on livestock loss, which have trade-offs for human or ecosystem well-being; Institutions became weaker compared with socialist period.	ki-1: A comprehensive research is needed for understanding changes in resilience of pastoral systems to climate change and market forcing; ki-2: Management of pastoral social-ecological systems require strategies to cope with global warming; ki-3: "Win-win" policy for both social and ecological resilience is needed;
P2: A limited suite of "slow" variables are critical determinants of H-E system dynamics.	Global warming is reducing forage and water resources overall and seasonally; Overgrazing increased with privatization of livestock.	ki-4: Water resource decrease due to global warming is key slow variable; ki-5: Spring season became bottleneck in short-grass steppe areas both due to drying and overgrazing;
P3: Thresholds in key slow variables define different states of H-E systems, often with different controlling processes; which may change over time.	Water resource decreases have crossed threshold level and are leading to collapse according to a survey. The Orog lake dried out in summer of 2009, but half filled in 2010; 3 out of 25 (as marked on a 1969 map) rivers and streams were flowing in 2009.	ki-6: Continued drying of many streams and lake water reduction indicate crossing of thresholds at different levels. Improved management in the remaining river basins and strengthening of "one-river" pastoral communities along these rivers are key to reduce vulnerability;
P4: Coupled H-E systems are hierarchical, nested, and networked across multiple scales.	Coupled *hot ails* embedded in streams, or small river communities embedded in larger river basin H-E systems are good examples of this.	ki-7: Integrated river basin social-ecological system management plans must be developed, which incorporate not only lower scales of coupled H-E systems, but aimag social-ecological systems;
P5: The maintenance of a body of up-to-date LEK is key to functional co-adaptation of H-E systems.	Local Environmental Knowledge (LEK), both traditional and scientific, is critical for adaptation. Many development projects may be mal-adaptive because of ignorance of traditional informal institutions, or knowledge on rangeland management, and culture.	ki-8: Identified knowledge gaps include: ~ Feedbacks; ~ Monitoring and forecasting of SES; ~ Prime examples of the best SESs based on hybrid scientific and traditional knowledge and innovation; ki-9: Diverse adaptive policies for different ecological-economic zones.

Table 1. Dryland Development Paradigm Application for the Tuin and Baidrag river basin social-ecological systems

to carrying capacity, is greater in the desert-steppe compared to the forest steppe and steppe regions (Figure 5a).

The social vulnerability of districts was calculated based on wealth (livestock number per capita), robustness (livestock loss during *zud* events from 1999–2002 and 2009–2010) and distance to the Bayanhongor aimag centre (Figure 5(b)). Social vulnerability is high when wealth and robustness are low, and distance to the market is long. Districts located in the desert-steppe zone have higher social vulnerability relative to districts located in forest steppe and steppe zones. Vulnerability of social-ecological systems in the desert-steppe zones is higher than in steppe and forest steppe zones (Figure 5c).

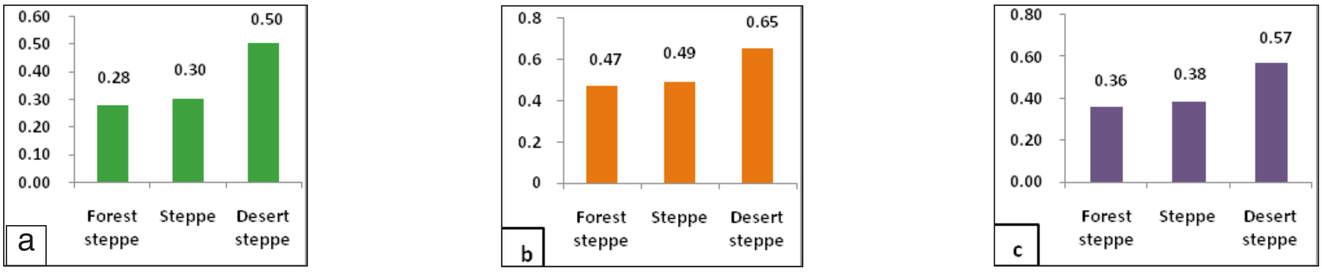


Figure 5. (a) Ecological, (b) social and (c) social-ecological vulnerability assessments in Tuin and Baidrag river basins by ecosystem type (1986–2010) (Forest steppe: Jargalant, Zag, Galuut, Erdenetsogt; Steppe: Bombogor, Ulziit; Desert steppe: Baatsagaan, Buutsagaan, Jinst, Bogd)

The main findings of our research are summarized in Table 1 (Chuluun *et al*. 2011).

Conclusion

Ecological vulnerability (drought, stocking rate relative to carrying capacity) and social vulnerability (livestock number per capita, distance to the market, livestock loss during *zud*) assessment trends showed that social-ecological vulnerability has increased in the desert-steppe region compared to other ecological zones in Mongolia. This indicates that the desert-steppe region is becoming more vulnerable to climate change, land-use change and transition in market economies. In coping with greater socio-ecological vulnerability due to both climate-related disasters and market forces in Mongolia, there is a greater need for adaptive policy regulation and innovative solutions.

These research findings and recommendations were used to develop a Tuin river basin sustainable management plan in collaboration with the Tuin River Basin Consul.

References

Chuluun, T., Altanbagana, M., Sarantuya, G. 2005. Vulnerability and adaptation assessment of the Mongolian pastoral systems to climate and land-use change. Proceedings of the Department of Biology, School of Natural Sciences, Mongolian Education University, 4: 182–189.

Chuluun, T., Ojima, D. 2011. Land in transition: Coping with market forces in managing rangelands in Mongolia. Pages 363–380 *In:* Roger E. Kasperson and Mimi Berberian (Ed.) Integrating Science and Policy: Vulnerability and Resilience in Global Environmental Change, Earthscan, London and Washington, DC.

Chuluun, T., Tserenchunt, B., Altanbagana, M., Stafford-Smith, M. 2011. Applying the Dryland Development Paradigm to pastoral systems in Mongolia. IRC, April 2–8, Rosario, Argentina, 690.

Davaa, G. 2009. Regime, resources, assessment and forecasting of surface water of Mongolia. Report of the Institute of Meteorology and Hydrology, Ulaanbaatar.

Natsagdorj, D., Sarantuya, G. 2004. On the Assessment and Forecasting of Winter Disaster (Atmospheric Caused Dzud) Over Mongolia — Sixth International Workshop Proceedings on Climate Change in Arid and Semi-Arid Regions of Asia, August 25–26, 2004. Ulaanbaatar, Mongolia, pp 72–88.

Ojima, D., Chuluun, T. 2008. Policy Changes in Mongolia: Implications for Land Use and Landscapes. pp 179–193 *In:* Galvin, K.A., Reid, R.S., Behnke, R.H. and Hobbs, N.T. (Eds.) Fragmentation in Semi-arid and Arid Landscapes: Consequences for Human and Natural Systems. Springer, Dordrecht, The Netherlands.

MARCC. 2009. MONGOLIA: Assessment Report on Climate Change. The Ministry of Nature, Environment and Tourism, UNEP and UNDP.

Ulaanbaatar, Mongolia. DDC 551.641 Y-594.

National Atlas of Mongolia. 1990. Mongolian Academy of Sciences. pp 144.

National Atlas of Mongolia. 2009. Institute of Geography, Ulaanbaatar. Published in Republic of Korea.

Statistical Office of Bayankhongor aimag. 2010. Statistical Yearbook-2010.

Reynolds, J.F., Stafford-Smith, M., Lambin, E.F., Turner, B.L. *et al.* 2007. Global Desertification: Building a Science for Dryland Development. Science 316: 847–851.

Acknowledgements

Authors would like to thank L. Mandal, Chair of the Department of Nature, Environment and Tourism, Bayanhongor aimag, Boldbaatar, Chair of the Development Department, the Governor's Office of Bayanhongor aimag, S. Tsend, Governor, Olziit sum J. Tseveen, Governor, Bogd sum, Jargalsaikhan, Governor, Jinst sum, Bayanhongor aimag, G. Enkhbayar, Specialist of the Development Department, the Governor's Office of Bayanhongor aimag, P. Tsolmonbaatar, Vice-Governor, Erdenetsogt sum, Monkhjargal, Environmental inspector, Bombogor sum, Jadambaa & Narantuya, Chair and his spouse of the "Ogoomor Ortomt" herders' community, Erdenetsogt sum, Narmandakh, herders from the Olziit sum, Bayanhongor aimag for their collaboration and participation.

CBA2010-02CMY-TOGTOHYN

PROJECT TITLE

Dryland Development Paradigm (DDP) Application for the Most Vulnerable to Climate and Land-Use Change of Pastoral Systems in the Southern Khangai Mountains of Mongolia (DDPPaS)

COUNTRIES INVOLVED

Mongolia

PROJECT DURATION

2 years

APN FUNDING

US$ 60,000

PROJECT LEADER

Dr. Chuluun Togtohyn
Dryland Sustainability Institute (DSI)
Environmental RS/GIS Laboratory
National University of Mongolia
Central Post Office, P.O. Box 44/243
Partizan street 31
Sukhbaatar district 5
Ulaanbaatar 14250, Mongolia

Tel: +976 11 463089

Email:
chuluun@warnercnr.colostate.edu

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

CBA2010-07NSY-STONE

Web-Based "Discussion-Support" Agricultural-Climate Information for Regional India

Roger C Stone[1], Shirley Reushle, Raji Reddy
[1]Corresponding author
ACSC, University of Southern Queensland, Toowoomba, Australia, 4350.
Email: roger.stone@usq.edu.au

ABSTRACT: An innovative approach to aiding farmer decisions that involve seasonal climate risk has been trialed with farmers in Andhra Pradesh, India. A key concept has been to copy concepts of "discussion-support" approaches, rather than only relying on computerized decision-support approaches. Use of 2nd life/eLearning distance education methods have been trialed with these farmers and advisers with some success. However, it is suggested that vital aspects not necessarily related to core climate and crop science issues, such as farmers' dress and informal interactions within a discussion environment must be appropriately captured in any synthetic video discussion-support if this approach is to gain widespread uptake.

KEYWORDS: *discussion-support, 2nd life avatars, climate risk, farming risk*

Introduction

The World Meteorological Organization (WMO) and others (Hansen, 2002) have identified the immense challenge required in providing climate forecasts and associated risk information for "real-world" farmers in developing countries. Meanwhile, developments have been taking place whereby innovative web-based learning or extension devices such as "2nd life" (utilizing avatars) and "eLearning" (Figure 1) can provide practical outputs that would be relevant to a broader farming community and which may have direct application to farmer decisions (deLucia *et al.*, 2009; Salmon, 2009). In particular, McKeown (2010) points out that the "Maestro eLearning Pyramid" moves the user/farmer from simple, passive reading of some information through to discussions and making a decision — key attributes required of a "discussion-support" system for farmers. Figure 1 provides an illustration of this "eLearning Pyramid" (copyright: Maestro eLearning).

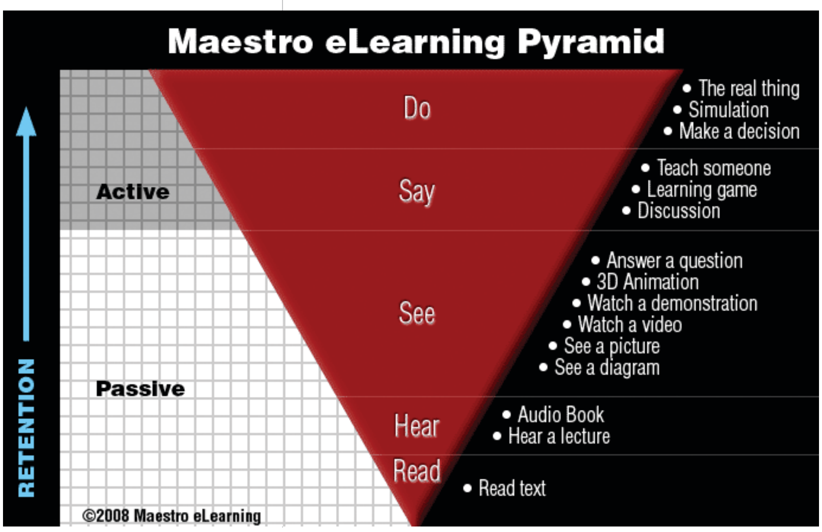
There have been ongoing deliberations regarding the most effective processes needed for connecting climate-cropping systems analyses with "day-to-day" farm management decisions for many years (Hammer, 2000; Keating and McCown, 2001; Meinke *et al.*, 2001; McCown, 2001; Stone and Meinke, 2005). In fact, Nelson *et al.* (2002) demonstrated that the use of participative systems approaches involving crop simulation-aided discussion with advisers and decision-makers is most effective when leading to the development of *discussion-support systems* as a key vehicle for facilitating the "infusion of climate forecasting science" and associated outputs into farming practice. The "FARMSCAPE" project provides a particularly novel approach with the notion and consequent rich imagery of "kitchen table discussions," whereby scientists directly interact with local farmers in the farmers' home or farm worksheds to discuss outputs and management options derived from both recently run crop simulation models and climate forecast outputs (McCown *et al.*, 1998; Carberry, 2001).

This project aimed to bring together the "workshed discussion support" environment, within a regional environment in India but to seek to resolve whether a synthetic farmer discussion environment could be brought together in a similar manner to real life settings using 2nd life/avatar distance education methods. This paper addresses the efficacy of such innovative distance education approaches within a real-farm decision environment in India.

Methodology

A team comprising agronomists, climate scientists and extension specialists was drawn together in order to conduct some initial participative workshops would draw together already cooperative farmers to discuss both their agronomic-climate systems and, importantly, the decisions they faced in the coming season (Figure 2).

Figure 1. Depiction of the eLearning pyramid (courtesy Maestro eLearning)



Aspects of the 2nd life/avatars video, which capturing the fundamentals of the discussions taking place, would be explained to the farmers in order for them to gain ownership of the processes being developed. Based on feedback obtained, the 2nd life videos would then be revised and placed on a dedicated web-server so that farmers from any village in the larger Andhra Pradesh region (which has a total population of ~100 million) could then benefit from both the "real-world" synthetic discussions taking place in the close-to-real-life 2nd life/avatar videos and all future 2nd life/avatar "synthetic" videos, updated monthly, which would then be produced utilizing the latest climate forecast information but without the need to return to the villages for direct interaction.

Results & Discussion

Results of this pilot project are as follows:

- It was possible to provide relevant "real-world" farmer discussion-support and decision information via 2nd life/avatar videos in a "real-world" setting that is pertinent to a farming environment in regional India.
- The discussion-support videos, that utilized 2nd life machima, required the initial active collaboration of/between climate scientists, agronomists, 2nd life/eLearning specialists, software and 2nd life video production specialists to be effective.
- There is a need for initial concerted interaction with farmers in both a village setting and "on-farm" in order to create a sense of trust and understanding among farmers in the target region to obtain appropriate initial feed-back regards to the approach.
- Farmers/users can easily be "put-off" and distracted by what may appear to scientists to be peripheral aspects in the 2nd life/avatar videos that are not directly related to the core science message. For example, not having 2nd life/eLearning avatar figures that depict local farmers looking or behaving exactly as they would in a real-world (Indian village) meeting

scene serves as an immediate distraction from other important aspects of discussion-support deliberations, such as the climate patterns unfolding or the results from pertinent crop simulation models.

- There is a need to provide 2nd life/avatar videos in all relevant languages for a particular region.

There is a need to correctly portray:

- The farmers' sense of humour in "farmer banter" (Figure 3);
- The age of the (synthetic) 2nd life farmers portrayed in the videos; e.g. do not make them appear too young;
- The number of participants in the discussion-support videos; e.g. do not make them too few;
- The types and amount of housing and farm machinery in the background setting needs to be realistic;
- A clear understanding of the farming systems in use in that particular region to be discussed by the "farmers" in the discussion-support videos;
- A clear understanding of the "big issues" that farmers have had over recent years (e.g. drought, excessive rain) in order to establish relevance in creation of the scripts of the discussion-support videos; and
- What capacity farmers may actually have to use climate forecasts.

Figure 2. Participants attending the first farmer and extension specialist discussion workshop that also explained the concept of 2nd life and avatar farmer videos, held in Biranpalli, Andhra Pradesh, September, 2010, with Dr. Sreenivas, ANGRAU

References

Carberry, P.S. 2001. Are science rigour and industry relevance both achievable in participatory action research? *In:* Rowe, B., Donaghy, D., and Mendham, N. (Eds.) Science and Technology: Delivering Results for Agriculture? Proceedings of the 10th Australian Agronomy Conference, January 2001, Hobart, Tasmania.

De Lucia, A., Francese, R., Passero, I., and Tortora, G. 2009. Development and evaluation of a virtual campus on Second Life: The Case of Second DMI. Computers and Education, 52**,** 1, pp 220–233.

Hammer, G.L. 2000. Applying seasonal climate forecasts in agricultural and natural ecosystems — a synthesis *In:* Hammer, G.L., Nicholls, N., and Mitchell, C. (Eds.) Applications of Seasonal Climate Forecasting in Agricultural and Natural Ecosystems — The Australian

Figure 3. Farmer discussion groups attending a village workshop gathering conducted by Dr. Raji Reddy, Dr. Sreenivas (ANGRAU) and Dr. Roger Stone (USQ)

Experience. Kluwer Academic, The Netherlands, pp 453–462.

Hanson, J.W. 2002. Realizing the potential benefits of climate prediction to agriculture: issues, approaches, challenges. Agricultural Systems 74, pp 309–330.

Keating, B.A., and McCown, R.L. 2001. Advances in farming systems analysis and intervention. Agricultural Systems 70, pp 555–579.

Meinke, H., Baethgen, W.E., Carberry, P.S., Donatelli, M., Hammer, G.L., Selvaraju, R., Stockle, C. 2001. Increasing profits and reducing risks in crop production using participative systems simulation approaches. Agricultural Systems 70, pp 493–513.

McCown, R.L., Carberry, P.S., Foale, M.A., Hochman, Z., Coutts, J.A., and Dalgliesh, N.P. 1998. "The FARMSCAPE approach to farming systems research" *In:* Michalk, D.L. and Pratleyt, J.E. (Eds.) Agronomy, growing a greener future? Proceedings of the 9th Australian Agronomy Conference. 20–23 July 1998, Charles Sturt University, Wagga Wagga, NSW, Australia.

McCown, R.L. 2001. Learning to bridge the gap between science-based decision-support and the practice of farming: evolution in paradigms of model-based research and intervention from design to dialogue. Australian Journal of Agricultural Research, 52, pp 549–571.

McKeown, L. 2010. "Overview of the breakthroughs in distance education systems" APN Workshop, ANGRAU, Hyderabad, India, 28 September 2010.

Nelson, R.A., Holzworth, D.P., Hammer, G.L., and Hayman, P.T. 2002. Infusing the use of seasonal climate forecasting into crop management practice in North East Australia using discussion support software. Agricultural Systems 74, pp 393–414.

Salmon, G. 2009. The future for (second) life and learning. British Journal of Educational Technology 40, 3, pp 526–538.

Stone, R.C., and Meinke, H. 2005. Operational seasonal forecasting of crop performance. Philosophical Transactions of the Royal Society B 360, pp 2109–2124.

CBA2010-07NSY-STONE

PROJECT TITLE

Web-based "Discussion-support" Agricultural-Climate Information for Regional India

COUNTRIES INVOLVED

Australia, India

PROJECT DURATION

1 year

APN FUNDING

US$ 35,000

PROJECT LEADER

Prof. Roger C Stone
Director, Australian Centre for Sustainable Catchments
Professor in Climatology and Water Resources
The University of Southern Queensland
West Street, Toowoomba
Queensland Australia, 4350

Tel: +61 746 315415

Email: roger.stone@usq.edu.au

Website: www.usq.edu.au/acsc

ARCP PROJECTS 2

Regional research projects funded under the

Annual Regional Call for Research Proposals (ARCP)

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

ARCP2011-01CMY-WANG

Building Asian Climate Change Scenarios by Multi-Regional Climate Models Ensemble

The present APN project is moving into its 3rd Year and, to date, the project scientists have worked together to achieve the common goals of the project. Each team has made contributions on experimental design (including simulation periods, domain location and size, driving GCMs, etc.), analysis methodology, possibility of collaboration with other multi-model projects, etc. The common framework of the experiment was designed and adopted by all participating climate models. The study focusses on the East Asia Monsoon region, with extra focus on climate change in Southeast Asia and South Asia. Simulations have been carried out using eleven models from nine project groups for both the control climate model, for 1978–2000, and the future climate model, for 2038–2070.

In accordance with the project timeline, the project's second workshop was held at the Conference Centre of the Jika International Hotel, Melbourne, Australia from 26–27 February, 2011. The workshop informed individual teams of the execution and progress of the work that was implemented in the second year, and discussed the future development and activities to fulfill the scope of the project and its objectives.

Thirty-five participants from seven countries attended the workshop, including project scientists from eleven research teams, invited scientists and observers.

The project groups conducted preliminary analysis with the simulation results produced during the first year of the project. Based on the presentations given at the workshop, the following results were obtained:

- Simulation results were validated and inter-compared;
- Analysis related to Asian regional climate studies such as model physical systems, and methods and techniques in downscaling were carried out; and
- Potential project applications were developed, either by directly using Regional Climate Models (RCMs) in related research (ecology, hydrology, etc.), or by applying RCM results in impact assessment studies;

To achieve the scientific goals and produce the expected outcomes of the project, the workshop participants discussed 3 main issues:

1. Next steps in implementing the project objectives, including project data exchange, analysis plan, design of new sensitive runs, scientific publications, etc.;
2. Potential development and application of the project results, which may evolve into a new APN project led by Dr. Yinpeng Li from New Zealand; and
3. Future collaboration with CORDEX in terms of data, information sharing and exchange.

The groups also agreed that the ensemble analysis would be carried out in the light of tasks and sub-regions, and leading teams for detailed analysis and ensemble analysis were set up. The success of the workshop was largely due to the excellent coordination of local host, Dr. John L. McGregor and his team from Aspendale-based CSIRO. The MAIRS (Monsoon Asia Integrated Regional Study) also provided financial and technical support.

Following the workshop, the research groups

Table 1. Integration Status of Project Models

Model	Group Leader	Country	Integration
CCAM	J. McGregor	Australia	completed
NIED-RAMS	K. Dairaku	Japan	completed
RegCM3	X. Gao	China	completed
GRIMs (Regional spectral model)	S. Hong	Republic of Korea	completed
iRCM (IRCP RCM)	Y. Wang	USA	completed
MRI-NHRCM	K. Kurihara	Japan	completed
WRF/ECHAM4	J. Tang	China	completed
SNU/ECHAM4	D. Lee	Republic of Korea	completed
RegCM4/ECHAM4	J. Tang	China	completed
RIEMS	D. Zhao	China	ongoing
WRF	W. Gutowski	USA	ongoing

continued effortlessly to complete project integration and, by the end of 2011, nine out of eleven models had implemented the ECHAM5 downscaling runs with nine models. The results were submitted to build the collaborative Asian climate change projection (Table 1).

In 2012, the following activities will be undertaken:

1. Continue to analyze the ECHAM5 downscaling results completed by individual groups around the related scientific topics;
2. Continue the ensemble analysis and build the Asian climate change scenario with consideration of accompanied uncertainties; and
3. Draft the project reports and a journal paper.

At the time of writing, the next project workshop is scheduled to take place in February 2012, in the Republic of Korea.

ARCP2011-01CMY-WANG

PROJECT TITLE

Building Asian Climate Change Scenarios by Multi-Regional Climate Models Ensemble

COUNTRIES INVOLVED

Australia, China, Japan, Republic of Korea, Thailand, USA

PROJECT DURATION

3 years

APN FUNDING

US$ 118,810

PROJECT LEADER

Dr. Shuyu Wang
Institute of Atmospheric Physics
Chinese Academy of Sciences
Building 40, Huayan Li
Chaoyang District
Beijing 100029, China

Tel: +86 25 8359 2873

Email: wsy@tea.ac.cn

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

ARCP2011-02CMY-KOIKE

River Management System Development in Asia Based on Data Integration and Analysis System (DIAS) under the Global Earth Observation System of Systems (GEOSS)

This project aims to develop an advanced river management system in the Asia Water Cycle Initiative (AWCI) member countries by utilizing DIAS data and data integration capabilities (the AWCI river basin database developed under the GEOSS/AWCI framework and made available through the DIAS system (http://www.editoria.u-tokyo.ac.jp/dias/link/portal/english_index.html).

In the past year, the project has made substantial progress in completing the database, developing methodology and the necessary tools for GCM rainfall bias correction and downscaling (Nyunt *et al*., 2012), and preparation for implementation of the 2nd stage of AWCI. In addition, two events were held: a Training Course on Climate Change Assessment and Adaptation (CCAA) Techniques in Tokyo, March 2011 (Figure 2), and the 8th AWCI ICG meeting in Seoul, October 2011.

Database status

The status of the AWCI database as of October 2011, is shown in Figure 1. All of the 18 countries have submitted their demonstration basin data and 10 countries have already completed the entire task including metadata registration on the DIAS system.

Development of CCAA methods

In order to assess possible impacts of climate change on water resources in AWCI demonstration basins, future climate projections of a set of Global Climate Models (GCMs) is being used. A system for suitable GCM output selection, rainfall bias correction and downscaling using DIAS has also been developed. Details of the methodology are described by Nyunt *et al*. (2012). The bias corrected and downscaled future precipitation data is being used in the Water and Energy Budget Distributed Hydrological Model (WEB-DHM, Wang *et al*., 2009) to simulate possible future water budget and fluctuations in the basins and assess the impacts of climate change.

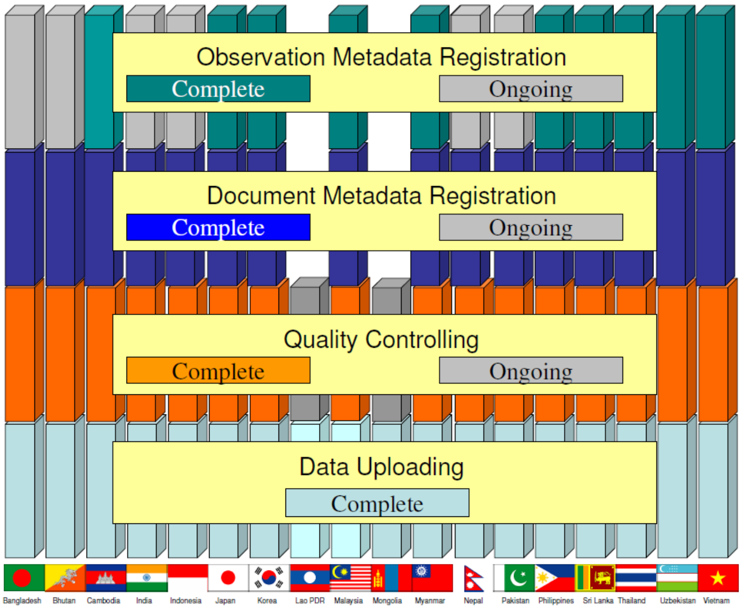


Figure 1. Status of AWCI data submission to DIAS, October 2011

Events

As part of the project activities, a training course for AWCI member country collaborators was organized in Tokyo, Japan, from 11–12 March 2011. The course introduced the aforementioned techniques and tools to conduct a climate change impact assessment study. More than 25 participants from 15 countries took part in the training course, which included three main parts:

1. Climate projection rainfall bias correction method, provided by the University of Tokyo (UT);
2. WEB-DHM application using bias corrected rainfall data and other projection forcings, provided by UT; and
3. Multi-model ensemble hydrologic modelling for climate change assessment, provided by Sejong University, Seoul, Republic of Korea. A brief article on this event was published in the APN Newsletter in September 2011.

In October 2011, the 8th Meeting of the GEOSS AWCI International Coordination Group (ICG) together with the 1st AWCI Climate Change Assessment and Adaptation (CCAA) Workshop were held in Seoul, Republic of Korea (ROK), to review the progress of AWCI activities and also to initiate planning of the next phase of AWCI. More than 50 participants from 17 countries were actively involved in the meeting that was opened by Mr. Jae-Hyun Park of the Korean Ministry of Land, Transport and Maritime Affairs. In his talk, Mr.

Figure 2. Training Course in Tokyo, March 2011.

Figure 3. AWCI event in Seoul, October 2011

Park referred to the 2011 excessive rainfall in ROK and other indicators of a changing climate and emphasized the importance of an integrated approach in addressing water resource issues. He appreciated that AWCI has been successfully promoting such an approach and providing a platform for integrating and merging data with know-how accumulated from participating countries.

The country reports show great progress in the AWCI demonstration projects and good preparedness of individual countries to step into the next phase that envisions further integration and inter-disciplinary collaboration through the GEOSS Water Cycle Integrator (WCI) concept of "work benches." Following this concept, the AWCI community has initiated preparation of a draft implementation plan for the 2nd stage of AWCI to be presented at the 5th GEOSS Asia-Pacific Symposium in Tokyo, April 2012.

Selected publications

Nyunt, C. T., H. Yamamoto, A. Yamamoto, T. Nemoto, M. Kisturegawa, and T. Koike. 2012. Application of Bias Correction and Downscaling Method to Kalu Ganga Basin in Sri Lanka, Annual Journal of Hydraulic Engineering, JSCE, Vol. 56, 2012, February. Accepted.

References

Wang, L., T. Koike, K. Yang, T.J. Jackson, R. Bindlish and D. Yang. 2008. Development of a distributed biosphere hydrological model and its evaluation with the Southern Great Plains Experiments, Journal of Geophysical Research, Vol. 114, 2009, doi: 10.1029/2008JD010800.

ARCP2011-02CMY-KOIKE

PROJECT TITLE

River Management System Development in Asia Based on Data Integration and Analysis System (DIAS) under the Global Earth Observation System of Systems (GEOSS)

COUNTRIES INVOLVED

18 countries in Asia

PROJECT DURATION

2 years

APN FUNDING

US$ 90,000

PROJECT LEADER

Prof. Toshio Koike
Department of Civil Engineering
School of Engineering
The University of Tokyo
Bunkyo-ku, Tokyo 113-8656, Japan

Tel: +81 3 5841 6106

Email:
tkoike@hydra.t.u-tokyo.ac.jp

Website:
http://aqua.t.u-tokyo.ac.jp/REEL/

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

ARCP2011-03CMY-ASANUMA

Intercomparison of Land Surface Process Modelling in Asian Drylands

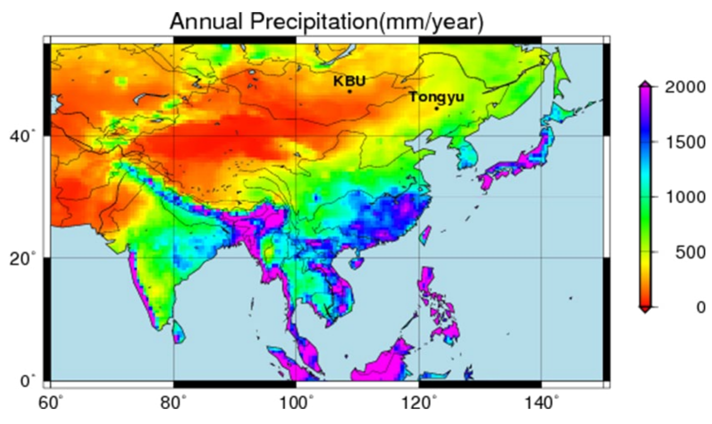
Drylands account for 40% of the Earth's land surface and a similar fraction of the Asian land surface. Characterized by dry climate, low vegetation cover and low nutrients, its ecosystem and the society that depends on drylands are inherently vulnerable to external perturbations such as climate change and land-use change. The present Project — Asian Dryland Model Intercomparison Project (ADMIP), is assessing uncertainties in the prediction of land surface environments with models and improving prediction accuracies. With additional support from the Chinese Academy of Sciences and the Japanese Society for Promotion of Science, this Project is working with 18 registered models run by 16 groups worldwide.

In order to predict the land surface environment of drylands, the project teams utilize Landsurface Models (LSMs) and Terrestrial Ecosystem Models (TEMs). Hence, by addressing the challenges of different process representations and large differences in their predictive capabilities, the project team is carrying out an intercomparison study with a suite of models and data from a selected set of well-documented study sites from the Asian dryland region.

The Project inception meeting was held in Beijing, China during the summer of 2010 and the framework was agreed among the participants. The data working group prepared data for use in the model intercomparison. Two observation sites were identified as target sites: Khelenbayan Ulaan (KBU) in Mongolia and Tongyu in China (Figure 1). From observed data at these stations, input data up to the summer of 2011 for model intercomparison was archived.

A Workshop was held from 13–14 July, 2011, in Lanzhou, where a detailed plan was discussed and agreed upon. In general, through the intercomparison processes of TEMs and LSMs, all participants' models were provided with common atmospheric data (air temperature and humidity) and their computed results (evaporation and vegetation growth) were then intercompared to elucidate relative strengths and weaknesses of each model. Three different stages with different amounts of "knowledge" provided to each model were defined, so that different levels of intercomparison

Figure 1. Precipitation in East Asia and the target stations of the project that will provide the data for the model intercomparison



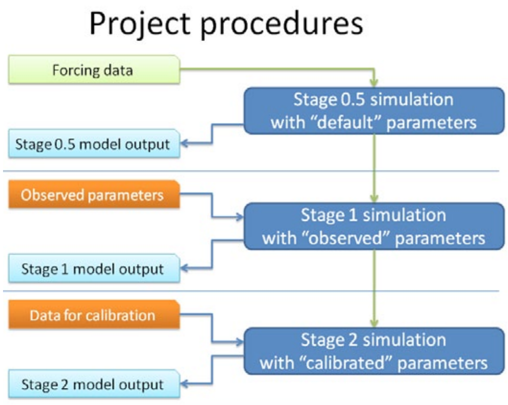
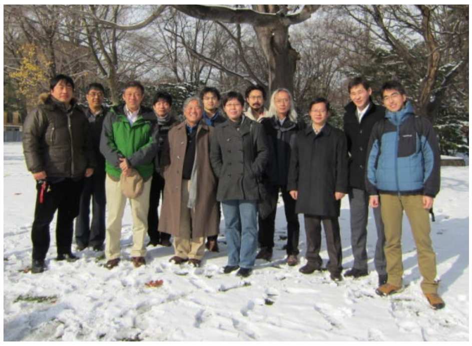


Figure 2. Three intercomparison stages planned in ADMIP

were possible.

The first stage of ADMIP (Figure 2) was the "blind stage," where all models were not given soil and vegetation data, so that the models in their plain, or untrained, status could be intercompared (Stage 0.5). Stage 0.5 will be closed during the winter of 2011–2012, and Stage 1 will follow, where observed characteristics of soil and vegetation will be provided for each model.

From 1–2, December, 2011, a small meeting, mainly with the data working group, was held in Sapporo, Japan. There, the progress of the project was affirmed and some issues, such as data quality, details of Stage 1 and future plans, were discussed.



ARCP2011-03CMY-ASANUMA

PROJECT TITLE

Intercomparison of Landsurface Process Modelling in Asian Drylands

COUNTRIES INVOLVED

Australia, China, Japan, Mongolia, Pakistan, Republic of Korea, USA

PROJECT DURATION

2 years

APN FUNDING

US$ 105,800

PROJECT LEADER

Dr. Jun Asanuma
Terrestrial Environment Research Centre (TERC)
University of Tsukuba
Tsukuba, Japan

Tel: +81 29 853 6704

Email: asanuma@suiri.tsukuba.ac.jp

Website: http://hywr.kuciv.kyoto-u.ac.jp/admip/index.html

ARCP2011-04CMY-PAUDEL

Community-Based Forestry and Livelihoods in the Context of Climate Change Adaptation

Community-based forestry (CF) has received wide attention for its potential role in reducing Emissions from Forest Deforestation and Degradation (REDD) and sustaining rural livelihoods in developing countries throughout the Asia-Pacific region. Recent studies demonstrate that rural populations dependent on agriculture and forest ecosystems are particularly vulnerable to both direct and indirect impacts of climate change. Increasing temperature, erratic rainfall patterns and rising sea levels are major threats to sustainable livelihoods posed by climate change. The effects of climate change are expected to deepen poverty and adversely affect livelihoods, assets, infrastructure, environmental resources and economic growth.

Developing countries have lesser capacity to adapt and are more vulnerable to climate change. Therefore, adaptation is now acknowledged as necessary for responding effectively and equitably to the impacts of both climate change and climate variability. Local communities possess relevant knowledge and experience in coping with climate change. However, this knowledge needs to be documented and disseminated in order to be used effectively. The present research aims to investigate how climate change is affecting forest-dependent communities in one of the world's most vulnerable regions, and the actual and potential adaptation measures that enable households, communities and networks to remain resilient.

Field-based research was conducted at each project country site. Four case studies from four countries were undertaken and the study adpoted a multiple research approach to meet the research objectives. After an inception workshop conducted at each project country site, studies were finalized and the International Forestry Resources and Institutions (IFRI) research methodologies, together with other social science research methods, such as interviews, site observations, Participatory Rural Appraisals (PRA) and climate change risk assessment tools, were used to conduct the research. The concerned government department literature was also used as a secondary source to explore government responses to climate-related threats at the national level.

The major activities of this project, including research administration, were centred at IFRI Collaborative Research Centre (CRC) at ForestAction, Nepal. Based on the agreed research design, the IFRI CRC, based at AIT in Thailand; CORENARM in Viet Nam; Bangabandhu Agricultural University in Bangladesh; and CRC in Nepal, carried out the respective country case studies. The research design was developed after the inception workshop organized in Thailand and frequent email communication was the key tool used to guide the research in each country in order to maintain constancy of the research. The partner countries were engaged in data collection, data coding and data analysis, and are currently in the phase of drafting the report.

A full article of this project is available on page 38 in the Featured Articles section of the present Science Bulletin.

ARCP2011-04CMY-PAUDEL

PROJECT TITLE

Community-Based Forestry and Livelihoods in the Context of Climate Change Adaptation

COUNTRIES INVOLVED

Nepal, Thailand, Viet Nam

PROJECT DURATION

2 years

APN FUNDING

US$ 79,980

PROJECT LEADER

Dr. Naya Sharma Paudel
Executive Coordinator
Environmental Governance Specialist
ForestAction, Nepal

Email: naya@forestaction.org

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

ARCP2011-05CMY-BAE

Climate Change Impact Assessment on Asia-Pacific Water Resources under AWCI/GEOSS

The objectives of the present study are to evaluate the climate change impact assessments on water resources in the Asia-Pacific region in collaboration with the Asian Water Cycle Initiative for the Global Earth Observation System of Systems (AWCI/GEOSS) and to promote capacity building for climate change impact assessment technology. Two basic approaches were undertaken: Analysis of past historical observation data to detect climate change trends in more than 18 countries; and Simulation of climate and water resources under future greenhouse gas emission scenarios. A non-parametric Mann-Kendall's test and regression analysis were used for the former, while Global Climate Model (GCM) output with downscaling schemes and hydrologic models were used for the latter.

In the first year, the data collected underwent quality control before application. Currently, the project focusses on analysis of past historical data of demonstration basins in 12 countries including Bangladesh, Cambodia, India, Japan, Republic of Korea (ROK), Malaysia, Mongolia, Philippines, Sri Lanka, Thailand, Uzbekistan and Viet Nam. In the analysis, we used the Mann-Kendall statistical test and linear regression analysis to analyze past historical data and determine trends in precipitation

Table 1. General description of demonstration basins in 12 countries

No.	Country	Basin name	Area (km^2)	Major issues	Climate regime	Annual Precipitation
1	Bangladesh	Meghna	61021	Floods, Droughts	Humid	
2	Cambodia	Sangker	2961	Floods	Very Humid	
3	India	Seonath	30760	Floods	Humid	
4	Japan	Upper Tone River	3300	Floods	Humid	1500 mm
5	Republic of Korea	Upper Chungju-dam	6662	Floods	Temperate	
6	Malaysia	Langat	2350	Floods, Drought, Water Quality	Very Humid	2470 mm
7	Mongolia	Selbe	303	Floods, Droughts, Water Quality	Semi-arid	
8	Philippines	Pampanga	10540	Floods	Humid	4200 mm
9	Sri Lanka	Kalu Ganga	2720	Floods	Very Humid	3000 mm
10	Thailand	Mae Wang	600	Floods	Humid	
11	Uzbekistan	Chirchik-Okhangaran	20160	Floods	Humid	
12	Viet Nam	Huong	2830	Floods	Very Humid	3000 mm

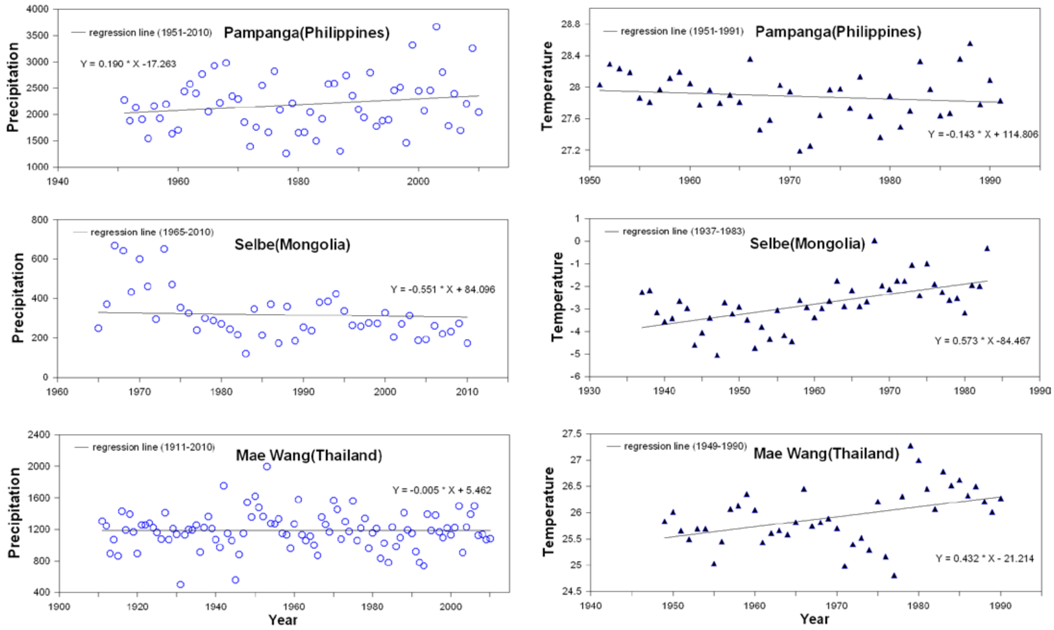


Figure 1. Trends of annual precipitation and temperature in selected demonstration basins of Asian countries

and temperature.

A general description of all 12 demonstration basins is shown in Table 1. These basins are important from the viewpoint of the socio-economic benefit area and hydrological sciences.

For historical climate trends, the results show that most basins have an increasing trend of annual precipitation, including Meghna (Bangladesh), Upper Chungju Dam (ROK), Langat (Malaysia), Pampanga (Philippines), Kalu ganga (Sri Lanka), Chirchik-Okhangaran (Uzbekistan), and Huong (Viet Nam). Three basins have a decreasing trend of precipitation: Sangker (Cambodia), Seonath (India), and Selbe (Mongolia). The basins of the Upper Tone River (Japan) and Mae Wang (Thailand) show no trends in annual precipitation (Figure 1). All basins but one (Pampanga, Philippines) show an increasing trend in annual temperature. The increasing trend in temperature is quite clear in 9 basins, which have an increasing trend at a level of α=0.05.

Figure 2. The 8th AWCI International Coordination Group (ICG) meeting and the 1st Climate Change Assessment and Adaptation (CCAA) Workshop

Table 2. Trends of annual precipitation and temperature for 12 demonstration basins of Asian countries

Notes: b – slope of standardized linear regression analysis; β – slope of Mann-Kendall test; P – probability of obtaining linear regression line or Mann-Kendall statistics. The positive value of b and β show an increasing trend and decreasing trend for negative value

No.	Country	Basin	Variable	Linear regression		Mann-Kendall test	
				b	P	β	P
1	Bangladesh	Meghna	Precipitation	0.285	0.959	7.954	0.902
			Temperature	0.626	1	0.021	1
2	Cambodia	Sangker	Precipitation	-0.101	0.788	-1.423	0.739
			Temperature	0.451	0.994	0.021	0.997
3	India	Seonath	Precipitation	-0.219	0.986	-2.074	0.992
			Temperature	0.367	1	0.006	0.999
4	Japan	Upper Tone River	Precipitation	0.006	0.515	0.342	0.547
			Temperature	0.676	1	0.014	1
5	Republic of Korea	Upper Chungju-dam	Precipitation	0.232	0.92	5.127	0.943
			Temperature	0.437	0.997	0.023	0.992
6	Malaysia	Langat	Precipitation	0.315	0.994	5.968	0.993
			Temperature	0.391	0.994	0.01	0.99
7	Mongolia	Selbe	Precipitation	-0.551	1	-4.191	1
			Temperature	0.573	1	0.042	1
8	Philippines	Pampanga	Precipitation	0.19	0.927	4.66	0.868
			Temperature	-0.143	0.814	-0.006	0.902
9	Sri Lanka	Kalu Ganga	Precipitation	0.195	0.991	2.633	0.997
			Temperature	0.13	0.923	0.001	0.896
10	Thailand	Mae Wang	Precipitation	-0.005	0.521	-0.302	0.663
			Temperature	0.432	0.998	0.017	0.993
11	Uzbekistan	Chirchik-Okhangaran	Precipitation	0.117	0.776	1.371	0.931
			Temperature	0.391	1	0.011	1
12	Viet Nam	Huong	Precipitation	0.417	0.993	40.08	0.997
			Temperature	0.175	0.838	0.012	0.949

The other 3 basins have a greater than 80% probability of following the same trend (Table 2).

As part of the project, the 8th AWCI International Coordination Group (ICG) meeting and the 1st Climate Change Assessment and Adaptation (CCAA) workshop were organized by Sejong University and the University of Tokyo from 6–8 October, 2011. Aside from the review of the AWCI and its working group activities, the ICG meeting focussed on preparing the next step of AWCI.

ARCP2011-05CMY-BAE

PROJECT TITLE

Climate Change Impact Assessment on the Asia-Pacific Water Resources under AWCI/GEOSS

COUNTRIES INVOLVED

Bangladesh, Japan, Mongolia, Pakistan

PROJECT DURATION

2 years

APN FUNDING

US$ 84,000

PROJECT LEADER

Prof. Deg-Hyo Bae
Department of Civil & Environmental Engineering, Sejong University, 98, Gunja-Dong, Gwanjin-Gu, Seoul, 143-747, Republic of Korea

Tel: +82 2 3408 3814

Email: dhbae@sejong.ac.kr

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

APN

ARCP2011-06CMY-LI

Analysis of Urban Land-use Change and its Impact on Food Security in Different Asian Cities of Three Developing Countries using Modified Cellular Automata (CA) Model

Urbanization is understood to be a significant cause of global change; and has led to conflicts between people's needs and sustainable development in the agriculturally important precincts of large Asian cities. Under this background, ecological problems in urban areas are predicted to become more important. Arable land reduction and food shortages will lead to decreased agricultural production, food insecurity and ecological degradation. In the present study, the Cellular Automata (CA) model is being used to assess changes in urban expansion, land use and food security in three core cities of three developing countries and to analyze different urban land use patterns and mechanisms leading to food shortages. The focus of this study is to build and enhance scientific capacity in three cities of China, India and Viet Nam and explore the quantifying urbanization level from the aspect of land use and connecting land-use patterns with urbanization processes. This project is expected to provide an integrated technical report of land-use/land-cover change and the urban landscape pattern for use by farmers, policy-makers and the international community.

Ecological problems in urban areas of Asia have been analyzed and become more significant. Arable land reduction and food shortages are leading to agricultural production decrease, food insecurity and ecological degradation.

To assess changes in urban expansion and land use in terms of agricultural production and food security in three core cities, a CA model was used to analyze different urban land use patterns and mechanisms leading to food shortages. Three cities — Zhangjiagang, Hanoi and Dehradun, in China, Viet Nam and India, respectively were studied and compared using multi-phase remote sensing techniques, land-use maps and socio-economic data for the period 1991–2008.

The project objectives were to:

- Build scientific capacity and enhance international cooperation through building a new strong international research team and training scientists on advanced methods of remote sensing technology and urban landscape pattern analysis using the CA model;
- Collect and observe a series of useful scientific data and information to build a database and ecological models to analyze land-use change and its impacts on food security;
- Provide accurate land-use, ecological, social and economic data and information on urban and peri-urban environments;
- Submit articles to peer-reviewed journals based on the case study; and
- Provide open access to data and disseminate outcomes to scientists and policy-makers.

The results encompassing the above will be reported to the APN at the end of the second year of activities.

ARCP2011-06CMY-LI

PROJECT TITLE

Analysis on Urban Land-use Changes and its Impacts on Food Security in Different Asian Cities of Three Developing Countries using Modified CA Model

COUNTRIES INVOLVED

Australia, China, India, USA, Viet Nam

PROJECT DURATION

2 years

APN FUNDING

US$ 80,000

PROJECT LEADER

Prof. Jianlong Li
The Global Change Research Institute
College of Life Science
Nanjing University, China
22 HanKou Road, Nanjing University
Nanjing City, China, 210093
Tel: +86 25 8359 2715
Email: jlli2008@nju.edu.cn

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

ARCP2011-07CMY-HAN

The Impact of Spatial Parameters on Greenhouse Gas Emissions: A Comparative Study between Cities in China and India

The present project examines the impact of urban spatial parameters on greenhouse gas (GHG) emissions in Xi'an, China, and Bangalore, India. It is hypothesized that household GHG emissions are a function of household attributes and urban spatial parameters. Data was collected through field work consisting of questionnaire surveys and field reconnaissance, and from land-use maps and socio-economic statistics. By analyzing household-level data, this study expects to produce findings that will assist urban planning and management in fast-growing economies. This project will be carried out over two years. In the first year, the research team has worked on data collection. In the second year, the team will analyze and interpret the data, and disseminate the research findings through policy workshops in Bangalore and Beijing.

Progress

By October 2011, 1200 questionnaire surveys were completed and processed in Xi'an, China. The research team in Bangalore completed 800 questionnaires by October 2011. It was planned that by December 2011, about 1200 questionnaires would be collected. The project team held a coordination meeting from 31 October – 2 November 2011 in Xi'an (Figure 1). Researchers from Australia, China and India shared their experiences and discussed their preliminary observations of the data collected from the questionnaires.

Figure 1. Participants in the coordination meeting

Some preliminary findings

Preliminary findings reveal that the team has a robust dataset. Remarkable variations of CO_2 emissions from commuting and household electricity-use illustrate that the dynamics of the dependent variables. Table 1 shows the descriptive statistics of CO_2 emissions from commuting and household electricity consumption in Xi'an. The differences in household CO_2 emissions are clearly shown by the maximum, minimum, and average emission values, measured by kg per household per annum. The co-efficiencies of variation show that CO_2 emissions from commuting varied more widely among the sample households than that from electricity consumption.

Figure 2 shows some spatial variations of CO_2

	Max	Min	Average	Stdev	Co of Var
CO_2 C	28767	0	732	2266	3.09
CO_2 E	14400	32	1489	1360	0.74

Table 1. Descriptive statistics of CO2 emission from commuting and electricity consumption
Note:
CO_2 C – CO_2 emissions from commuting
CO_2 E – CO_2 emissions from household electricity consumption

	Com Dis	Own Car	Wage	Lvl Edu	WK 1–5km
CO_2 C	0.41	0.96	0.90	0.70	0.72
CO_2 E	0.59	0.77	0.71	0.67	0.76

Table 2. Simple correlation coefficients
Note:
CO_2 C – CO_2 emissions from commuting
CO_2 E – CO_2 emissions from household electricity consumption
Com Dis – commuting distance between residence and work by household head
Own Car – sample household car ownership rate
Wage – wage income by household head
Lvl Edu – level of education of household head
WK 1–5 km – availability of jobs in the 1–5 km radius

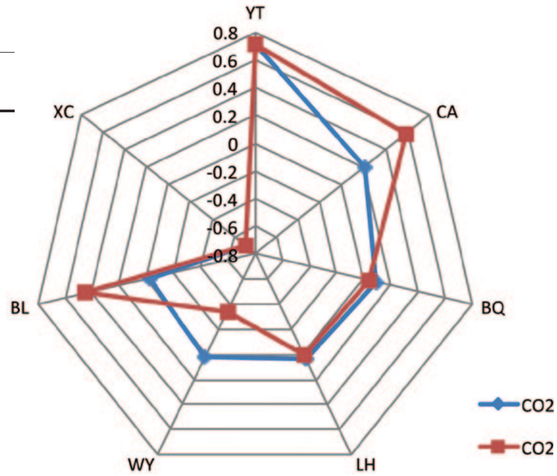


Figure 2. Variations of CO_2 emission by district
CO_2 C – CO_2 emissions from commuting
CO_2 E – CO_2 emissions from household electricity consumption
BL – Beilin; BQ – Baqiao; CA – Changan; LH – Lianhu; WY – Weiyang; XC – Xincheng; YT – Yanta

emissions using aggregate data organized by district. The average CO_2 emissions were standardized and plotted. Three of the seven districts (i.e., Beilin, Weiyang and Lianhu) had average CO_2 emission levels. Baqiao, Changan and Yanta had above average levels, whilst Xincheng had levels below average. In terms of CO_2 emissions from household electricity consumption, Lianhu and Baqiao showed an average level. Beilin, Changan and Yanta were above, while Weiyang and Xincheng were below average emissions.

A simple correlation analysis has already shown that CO_2 emissions are associated with household attributes and the neighbourhood environment. Table 2 reports that CO_2 emissions from both commuting and household electricity consumption is highly correlated with household attributes such as car ownership, income and level of education. The commuting distance between home and workplace, as well as the availability of jobs in the surrounding areas, are also correlated with CO_2 emission levels.

Forthcoming activities

The research team will provide a comparative analysis of the survey results in both Xi'an and Bangalore in greater depth. It is expected that policy suggestions will be derived from both individual and comparative analyses. Two policy workshops will be organized in Bangalore and in Beijing in 2012 to discuss the results.

ARCP2011-07CMY-HAN

PROJECT TITLE

The Impact of Spatial Parameters on Greenhouse Gas Emissions: A Comparative Study between Cities in China and India

COUNTRIES INVOLVED

Australia, China, India

PROJECT DURATION

2 years

APN FUNDING

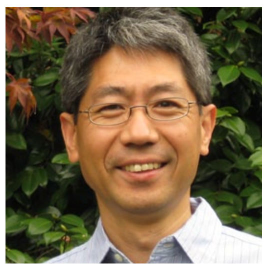
US$ 80,000

PROJECT LEADER

Prof. Sun Sheng Han
Faculty of Architecture
Building and Planning
The University of Melbourne
Australia

Tel: +61 3 8344 7055

Email: sshan@unimelb.edu.au



APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

ARCP2011-08CMY-HUDA

Food Security and Climate Change in the Asia-Pacific Region: Evaluating Mismatch between Crop Development and Water Availability

Phenological development is the single most important attribute of crop adaptation to shifting environments. The present project focusses on crops of local importance including wheat, maize, soybean and chickpea on key sites in India, China and Australia. We address four questions: a) What are the expected temporal shifts in crop phenology under future climates? b) What are the likely shifts in the pattern of rain and water availability? c) To what extent will climate change contribute to any mismatch between crop phenology and water availability? and d) What are the expected consequences of this mismatch for food security? Research outputs will guide appropriate adaptation strategies to build the resilience of communities and natural resources.

An understanding of the impact of climate shifts on key crops under climate change will enable Asia-Pacific-based farmers, community workers and policy agencies to better prepare and adapt to climate change, through changes to existing policy and practices, e.g. the timing of planting, use of new varieties, changes in disease management protocols, alternate planting and shifts in the geographic distribution of crops.

The main activities include:

1. Historical and current climate, crop and management data collection for selected sites in China, India and Australia for scenario studies of target crops,
2. Climate and crop data analysis,
3. Analysis of potential changes to determine if there are any increased risks to crop production and food security in selected locations,
4. A sharing of information and capacity building will occur through workshops, and
5. New project development with funding from possible sources including CGIAR Challenge programme on climate change and food security, AusAID, ADB.

Project methodology will be to: a) Evaluate existing data of phenology, water availability and yield using the cropping systems simulation model APSIM and locally available models and by comparing with current farm practices; b) Use the models to assess practices recommended for projected future climate change scenarios; c) Monitor crop phenology and crop performance to encourage community participation; and d) Develop and evaluate adaptation strategies to minimize risk and maximize opportunities related to the likely impact of climate change variables on current and future practices. In India, there will be a link with the Adarsha Watershed project — an innovative programme of water, soil and

land management enabling farmers to access water and grow crops not just in the rainy season but all year round. In China, activities link with the national key project of mapping agro-climatic resources and adaptation of agriculture to climate change, particularly in water availability. In Australia, activities link with a national project co-funded by GRDC/GWRDC, government and farmers aimed at improving farm water-use efficiency.

Details of activities conducted to date are outlined on page 42 in the Featured Articles section of the present Science Bulletin.

ARCP2011-08CMY-HUDA

PROJECT TITLE

Food Security and Climate Change in Asia-Pacific Region: Evaluating Mismatch between Crop Development and Water Availability

COUNTRIES INVOLVED

Australia, China, India

PROJECT DURATION

2 years

APN FUNDING

US$ 119,700

PROJECT LEADER

Dr. Samsul Huda
Associate Professor
Agroclimatologist/Agronomist and Modeller
School of Science and Health
University of Western Sydney
Hawkesbury Campus, M15 Building
Locked Bag 1797 Penrith
NSW 2751, Australia

Tel: +61 245 70 1390

Email: s.huda@uws.edu.au

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

ARCP2011-09CMY-TOWPRAYOON

Strategic Rice Cultivation for Sustainable Low Carbon Society Development in Southeast Asia

According to the Food and Agriculture Organization (2007), global rice plantations cover 12.5% of total crop plantation areas. The world annual production of rice amounts to 659 million tonne (Mt) and is consumed by 2.81 billion people contributing to 164 billion US dollars of the world economy. Southeast Asia has a major rice plantation area that covers 30% of plantation areas in the world. Maximizing rice yield in this region is essential to increase global food stock. However, the current climate and energy crises strongly influence the production of rice in Southeast Asia.

Strategic rice cultivation practices will enable the region to address both climate change and energy security issues considering rice rotation with energy crops in order to fully utilize rice plantation strategies during the fallow period and, therefore, optimize rice and energy feedstock. The proposed cultivation practices considered in this work aim at reducing GHG emissions while increasing potential long-term soil carbon stock by optimizing land-use change and cultivation practices. The overall goal of the project is to identify strategic rice cultivation practices enabling Southeast Asia to develop towards a sustainable low carbon society while enhancing adaptive capacity in the agricultural sector.

The specific objectives of this project are:

1. To develop sustainable low carbon agriculture in Southeast Asia through improved cultivation practices of rice and energy crops (via crop rotation);
2. To develop long-term field studies to measure, monitor and evaluate the impacts of various cultivation practices on climate change and identify potential adaptive measures and mitigation options; and
3. To enhance regional capacity of scientists and policy-makers in Southeast Asia to contribute to sustainable low carbon development for society.

Activities conducted to date

In order to establish a database of rice cultivation practices in Southeast Asia and identify potential energy crops to be cultivated in rotation with rice during the fallow period, basic information related to rice cultivation practices in Southeast Asia has been collected from several international agencies such as the Food and Agriculture Organization (FAO), International Rice Research Institute (IRRI), and other relevant institutions. In addition to this, an expert meeting on "State-of-the-Art Rice Cultivation Practices in Southeast Asia," was organized by the Joint Graduate School of Energy and Environment (JGSEE), King Mongkut's University of Technology Thonburi in Bangkok from 2–3 March, 2011. The objective of the meeting was to share information with Southeast Asian stakeholders on current practices of rice cultivation in the region, including state-of-the-art rice cultivation practices and methods to adopt more sustainable cultivation practices, including reduced GHG emissions, crop rotation, and enhanced livelihood for farmers.

Experts from Japan and Southeast Asia including Cambodia, Indonesia, Myanmar, Viet Nam and Thailand, contributed to the event and had the opportunity to share their respective country reports on rice cultivation practices, as well as possible mitigation and adaptation options to climate change. The knowledge gathered from this expert meeting was integrated into a report providing information on state-of-the-art rice cultivation practices and the potential for rotation with energy crops in Southeast Asia.

Discussions held during this meeting also contributed to finalizing the design of the questionnaire developed for field surveys in Thailand and Indonesia.

Many important issues of rice cultivation as the basis of our further work have been identified. Rice cultivation in Southeast Asia is mainly classified by ecosystems in upland, lowland and deep water areas. Water resources are mainly from irrigation and rain, and some from underground water. In rainfed areas, rice is cultivated once a year while in irrigated areas, rice can be cultivated for 2–3 cycles/year.

Crop rotation is cultivated mostly in rainfed areas during the fallow period, however water resources are the main problem for crop rotation. The type of crops cultivated during the fallow period are legumes and vegetables. Cambodia plants maize, watermelon and mungbeans when irrigation is available from January to April in rainfed lowland areas. There is no information about the type of crop rotation in Indonesia. Wheat, barley, soybean, potatoes or vegetables are alternative plants grown in rice cultivation areas in Japan. Myanmar plants cotton in irrigated areas from April to July and soybean is planted from April to mid-July in hilly regions. In Thailand, garlic or shallots are grown from January to April and legumes in May to July, while legumes are the alternative in rainfed areas in Northeast Thailand. In terms of mitigation, all experts agree that improvement in soil fertility, water resource management, organic amendment, and SRI are all important priorities.

In order to increase adaptation of rice

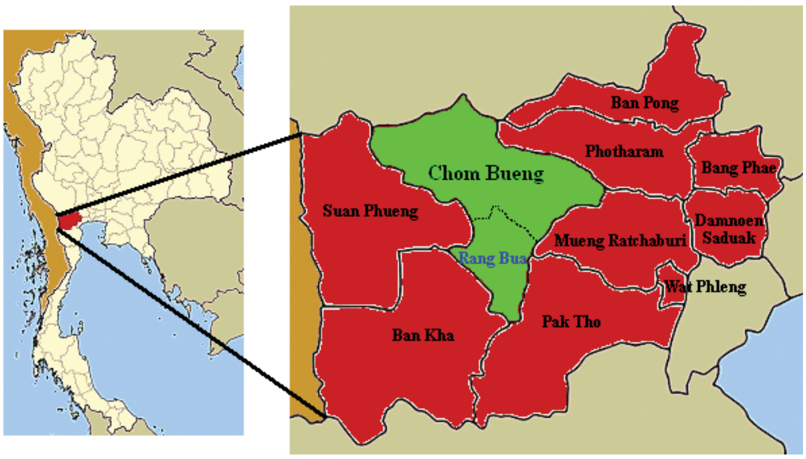


Figure 1. Study site at KMUTT Ratchaburi Campus

Figure 2. Land preparation for crop plantation at KMUTT, Ratchaburi Campus

Figure 3. Crop planting

fields to climate change, experts concluded that issues of both water consumption and water management are priority in maintaining rice yields. Other suggested adaptation strategies include integrated farming and weather forecast planning. However, the main problem for each country is different, which means adaptation strategies will differ from one country to the next, even in the same region. The foremost impact of climate change on rice cultivation and production is water resources (drought and flood), however, other problems include pests, diseases and heat.

Due to extreme weather conditions in Thailand in 2011 with unusually low temperatures in April (short winter period in the middle of summer) and several tropical storms since July resulting in extensive flooding in the north and centre of the country, many of the experimental sites and measurements were affected. Nevertheless, long-term monitoring data related to GHG emissions and soil carbon dynamics are being collected from sites with specific rice cultivation practices and rotation with selected energy crops. It is expected that the data collected will enable the identification of sustainable rice cultivation practices, including rotation with energy crops under well-defined conditions.

ARCP2011-09CMY-TOWPRAYOON

PROJECT TITLE

Strategic Rice Cultivation for Sustainable Low Carbon Society Development in Southeast Asia

COUNTRIES INVOLVED

Indonesia, Japan, Thailand

PROJECT DURATION

2 years

APN FUNDING

US$ 80,000

PROJECT LEADER

Assoc. Prof. Sirintornthep Towprayoon
The Joint Graduate School of Energy and Environment
King Mongkut's University of Technology
126 Prachauthit Rd, Bangmod
Tungkru, Bangkok, Thailand 10140

Tel: +662 470 8309

Email: sirin@jgsee.kmutt.ac.th

Website: www.jgsee.kmutt.ac.th

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

ARCP2011-10CMY-LUTAENKO

Coastal Marine Biodiversity of Viet Nam: Regional and Local Challenges in Coastal Zone Management for Sustainable Development

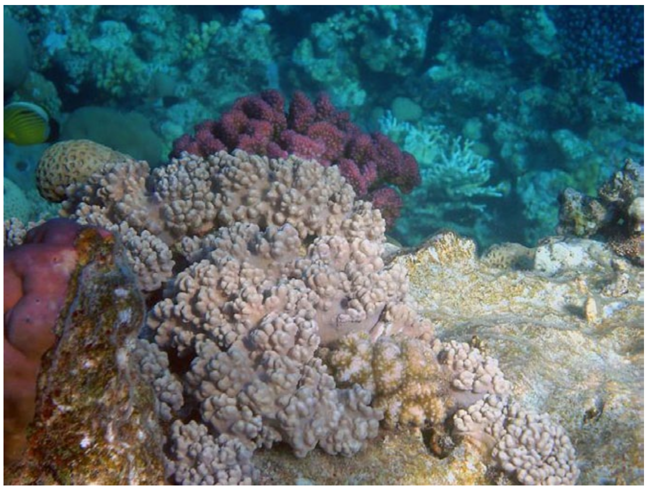
The present project looks at marine biological diversity in coastal zones of the South China Sea with an emphasis on Viet Nam — its modern status, threats, recent and future modifications due to global climate change and human intervention, and methods for conservation.

As part of planned activities, the APN-funded international workshop, ***Coastal Marine Biodiversity and Bio-resources of Viet Nam and Adjacent Areas to the South China Sea,*** was organized by the Vietnamese Research Institute for Aquaculture and the Zhirmunsky Institute of Marine Biology of the Russian Academy of Sciences in Viet Nam from 24–25 November 2011. Over 40 international participants attended the workshop and presented their work on biodiversity, bio-resources, marine biology and conservation aspects of international biota of the South China Sea and neighbouring areas.

During the workshop, there were presentations on diversity and taxonomy of marine turtles, echinoderms-ophiuroids, gastropod and bivalve mollusks, nemertean worms, soft corals, sea anemones, marine algae and fish. Some aspects of management and population dynamics of hard clam *Metertrix lyrata*, shrimp *Metapenaeus ensis*, and fish were discussed. Economic damage to coral reefs and seagrass in Vung Tau Province caused by oil spills and the status of marine turtle populations in Quang Ngai, Binh Dinh and Phu Yen Provinces of Viet Nam are two important examples of human impact on biodiversity and ecosystems that were presented to participants of the workshop.

Dr. Konstantin Lutaenko (Russia) emphasized the importance of international cooperation in biodiversity studies of the South China Sea, which is one of the biodiversity hotspots on Earth and part of the Coral Triangle (Indo-Malayan centre of marine biodiversity). The coastal fringe of the South China Sea is home to about 270 million people that have had some of the fastest developing and most vibrant economies on the globe and, consequently, anthropogenic impacts such as over-exploitation of resources and pollution, are anticipated to be huge. However, our level of progress in understanding regional biodiversity is very low. Dr. Yuri Latypov (Russia) suggested that the Spratly Archipelago coral reefs are very important ecologically, with abundant and undeveloped resources and they can be regarded as a "savings bank" where commercially important invertebrate and fish can be preserved from overfishing. Indeed, there is a proposal to establish a transboundary international maritime reserve zone or park.

Dr. Tan Koh Siang (Singapore) presented data on marine biological invasion in Singapore highlighting Caribbean mussel *Mytilopsis sallei* as an example. Bio-invasions are important but a lesser understood aspect of biodiversity modification. Other presenters from



Viet Nam and Russia dealt with biochemical diversity of marine organisms. The workshop was successful in terms of the variety of topics, researchers and exchange of ideas among Vietnamese and international participants and showed the need for international efforts to understand regional global change and biodiversity-related issues. Two workshops held during the course of the project (Tupas L., Adiningsih E.S., Stevenson L.A., 2011. APN Science Bulletin, Issue 1, pp. 57) summarized biodiversity data and information of Vietnamese and Russian researchers for the final APN-sponsored book on marine biodiversity of Viet Nam. Proceedings of both workshops were published (Dautova and Lutaenko, 2010; Lutaenko, 2011).

During project implementation, new data on coral reefs; macroalgae communities; meiobenthos, intertidal ecosystems; biodiversity of economically important bivalve and gastropod mollusks; and rare groups of animals (sipunculans, nemertines, ophiurans) were collected. These studies are extremely important for the practical purpose of coastal ecosystems management, coral reef restoration and marine farming. The website of the project can be found at: http://www.imb.dvo.ru/misc/vietnam/.

The information obtained and summarized and interpretations of the coastal/ecosystem changes will be useful to develop recommendations for local/national/regional decision-makers and will contribute to the current understanding of tropical ecosystems in the South China Sea, which are the largest in the world.

Publications

Dautova, T.N. 2011. Pathways for dispersal of the octococorals in the East Asia seas — inter-faunal connectivity and centres of biodiversity. Bulletin of the Far Eastern Branch, Russian Academy of Sciences. 2011. N. 4. pp 31–39 [In Russian with English abstract].

Dautova, T.N and K.A. Lutaenko (Eds.) 2010. Proceedings of the International Conference Marine Biodiversity of East Asian Seas: Status, Challenges and Sustainable Development, Nha Trang, Viet Nam, December 6–7, 2010. pp 202.

Dgebuadze, P. Yu., Fedosov, A.E., Kantor Yu.I. 2012. Host specificity of parasitic gastropods of the genus Annulobalcis Habe, 1965 (Gastropoda, Eulimidae) from crinoids in Viet Nam, with descriptions of 4 new species. Zoosystema (in press).

Kantor, Yu.I., Fedosov, A.E., Marin, I.N. 2012. An unusually high abundance and diversity of Terebridae (Gastropoda: Conoidea) in the Bay of Nha Trang, Viet Nam. Zoological Studies (in press).

Lutaenko, K.A. (Ed.). 2011. Proceedings of the Workshop Coastal Marine Biodiversity and Bioresources of Vietnam and Adjacent Areas to the South China Sea, Nha Trang, Viet Nam, November 24–25, 2011. Vladivostok-Nha Trang: Dalnauka, 2011. pp 123.

Pavlyuk, O.N. and Trebukhova, Yu.A. 2011. Intertidal Meiofauna of the Jeju Island, Korea. Ocean Science Journal. V. 46, N. 11. pp 1–11.

ARCP2011-10CMY-LUTAENKO

PROJECT TITLE

Coastal Marine Biodiversity of Viet Nam: Regional and Local Challenges and Coastal Zone Management for Sustainable Development

COUNTRIES INVOLVED

Republic of Korea, Russian Federation, Viet Nam

PROJECT DURATION

2 years

APN FUNDING

US$ 80,000

PROJECT LEADER

Dr. Konstantin Lutaeanko
A.V. Zhirmunsky Institute of Marine Biology
Far East Branch (FEB) of the Russian Academy of Sciences
Palchevsky Street 17, Vladivostok 690059, Russian Federation

Tel.: +7 423 2317 111

E mail: lutaenko@mail.ru

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

APN

ARCP2011-11NMY-PATRA/CANADELL

The Rapidly Changing Greenhouse Gas (GHG) Budget of Asia

Rapid economic growth in many Asian countries has resulted in the increased of energy demand in the region and an increased "global share" of GHG emissions. An understanding of the natural carbon exchange over the land and oceans due to tropical climate variability is required to calculate interannual to interdecadal variations in atmospheric CO_2. An international workshop was organized through financial support from the APN-funded project ARCP2011-11NMY-Patra/Canadell and the Indian Space Research Organization (ISRO) Geosphere-Biosphere Project (GBP) (ATCTM) at the Physical Research Laboratory (PRL), Ahmedabad, India.

The main aim of this 1st APN workshop was to assess resources available among the international research community working on various aspects of earth system science with a focus on South and Southeast Asia. The key issue discussed was the availability of data and models to work towards establishing a GHG budget for the two regions based on synthesis and reconciliation of top-down (atmospheric observations and inverse models) and bottom-up estimates (ground-based flux observations and terrestrial models). These included atmospheric measurements of GHGs, classification of land-cover and soil properties, coastal ocean bio-geochemistry, forest and agriculture inventories, and remote sensing-based estimates. The target GHGs are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).

Figure 1. Asia Greenhouse Gas Budget Workshop, September 2011. About 50 scientists participated from India (38), Japan (3), Indonesia (2), Republic of Korea (2), Sri Lanka (2), Australia (1), France (1), and Philippines (1)

Figure 2. Prabir Patra delivering a keynote speech on "The RECCAP/APN South and Southeast Asian greenhouse gas budgets" at the AsiaFlux workshop "Bridging Ecosystem Science to Services and Stewardship," from 9–11 November 2011, Johor Bahru, Malaysia"

ARCP2011-11NMY-PATRA/CANADELL

PROJECT TITLE

The Rapidly Changing Greenhouse Gas (GHG) Budget of Asia

COUNTRIES INVOLVED

Australia, Bangladesh, China, Indonesia, India, Japan, Singapore, Thailand, The Netherlands, UK, USA

PROJECT DURATION

3 years

APN FUNDING

US$ 150,000

PROJECT LEADERS

Dr. Josep Canadell
Global Carbon Project
CSIRO Marine and Atmospheric Research
GPO Box 3023, Canberra
ACT 2601, Australia

Tel.: +61 2 6246 5631

Email: pep.canadell@csiro.au

Website: www.globalcarbonproject.org

Dr. Prabir K. Patra
Frontier Research Center for Global Change
3173-25 Showa-machi
Kanazawa-ku, Yokohama
Kanagawa 236-0001, Japan

Tel: +81-45-778-5727

Email: prabir@jamstec.go.jp

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

ARCP2011-12NMY-FORTES

Seagrass-Mangrove Ecosystems — Bioshields against Biodiversity Loss & Impacts of Local & Global Change along Indo-Pacific Coasts (The Seagrass-Mangrove Bioshield Project, SMBP)

In the Indo-Pacific region, coastal management vis-à-vis environmental change mitigation and adaptation overly focusses on the control of Malthusian over-fishing in coral reefs. We argue in favour of a growing consensus, which places seagrass-mangrove system conservation as priority; developing a model of its ecosystem health, which is the natural biological protector ("bioshield") in mitigating local and global change along the region's coasts. This model is expected to support decision-making and will be used to build the capacity of stakeholder communities and governments so that they may utilize, more efficiently, ecosystem goods and services while effectively adapting to environmental change.

Phase 1: Science Establishment Phase

1. Sampling. Data collected were tested for:
- i) Seagrass-mangrove production efficiency;
- ii) Mangrove recruitment/mortality;
- iii) Water quality;
- iv) Biodiversity assessment; and
- v) Dugong feeding behaviour and population dynamics.

2. Laboratory analysis. At the time of writing, further analysis was being undertaken at the Marine Science Institute (Philippines) and at the University of Tokyo on:
- i) Water quality; and
- ii) Trophic dynamics.

3. Monitoring. Monitoring was performed quarterly on observable parameters. Monitoring of environmental impacts and ecosystem services was also carried out.

4. Model development. Model development is also underway, particularly focussing on data from the Philippines.

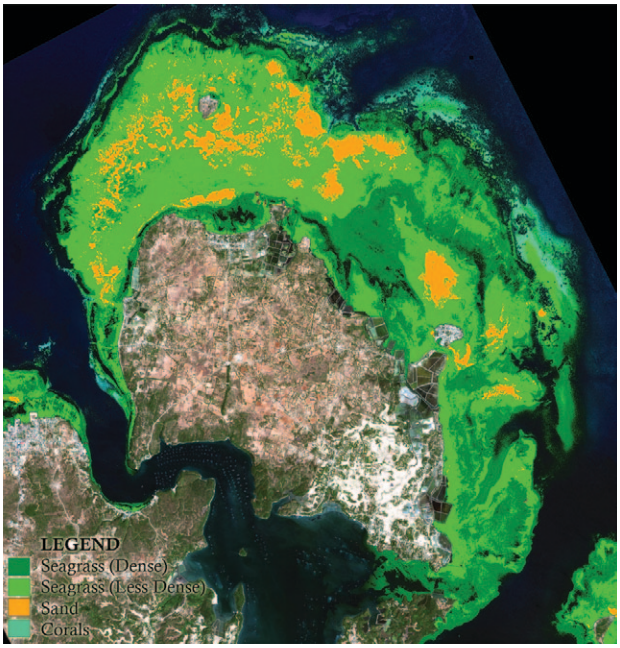


Figure 1. SEAGRASS MAP—Feeds from fish cages along the north bend of the channel (white dots) create a clear gradient in nutrients and chlorophyll-a (eutrophication) along the southeast to northeast stretch of the island of Santiago in Bolinao, Philippines. Here, we established our study stations among the seagrass beds and mangroves (see legend; mangroves are the dark areas along the stretch; the polygons are areas converted into fish ponds and salt pans) (WorldView 2 image of northern Bolinao, Pangasinan, NW Philippines)

Phase 2: Capacity Development Phase

Nature	Title/Place	No./Sectors Represented	Date	Remarks
Focussed Group Discussion	FGD-1/Marine Science Institute (Philippines)	4 project partners	30 Sept – 9 Oct	Finalized data input to models; agreed on finances, future activities
Consultation/ Advocacy	1st Consultation on the SMBP Project (Philippines)	17 participants: Local Gov't Units (7), Education (Secondary Level, 2), Environment (2), Fisheries (2), Resort Association (2), Fishermen's Association (2)	3 Oct	Introduced the project, identified where it can help in coastal development plans, how the latter could help the project; full support from sector obtained
Focussed Group Discussion	FGD-2/Airport Lounge (Philippines)	3 project partners & 4 students	8 Dec	Finalized data input to models; agreed on site activities, finances, future activities.
Consultation/ Advocacy	1stPre-Consultation with the Academe (Philippines)	32 participants/For the Academe only, but with initial consultation with the community local government.	10 Dec	Introduced the project; identified where it could help improve marine science research; the pack test was introduced to a faculty member of the partner college; identified graduate students to work on a project topic for master's thesis; Preliminary consultation made short due to lack of time; full support from sectors obtained
Consultation, Advocacy, & Focussed Group Discussion	1st Stakeholders' Consultation Training Centre, Tourism Complex, Mati, Davao Oriental (Philippines)	38 participants: Local Gov't Unit (8), academe (5), tourism (3), Peoples' Org. (8), NGO (2), environment (3), Fisheries (2), Resort Owners (7)	15 Dec	Introduced the project, identified where we could help each other attain our common objectives; identified graduate students to work on project topics for master's, PhD thesis; full support from sectors obtained

Way forward

At this stage, the data identified for necessary gap-filling studies coupled with data to be collected in the next 2 sampling surveys, the objectives of the project would have been accomplished as planned except for the unfortunate delay due to an adjustment in the schedule of activities and poor weather conditions which hampered the implementation of the activities.

We are very grateful to the local government units, academic institutions, NGOs, NPOs, resort owners and communities in both the Philippines and Indonesia for the unwavering cooperation and support given the teams, especially in the field. This display of support and interest in the project is one major factor, which will ensure smooth implementation, especially for the capacity development phase of the project, in the next two years to come.

ARCP2011-12NMY-FORTES

PROJECT TITLE

Seagrass-Mangrove Ecosystems—Bioshields Against Biodiversity Loss & Impacts of Local & Global Change along Indo-Pacific Coasts (The Seagrass-Mangrove Bioshield Project, SMBP)

COUNTRIES INVOLVED

Australia, India, Indonesia, Japan, Philippines

PROJECT DURATION

3 years

APN FUNDING

US$ 121,750

PROJECT LEADER

Prof. Miguel D. Fortes
Marine Science Institute CS
University of the Philippines

1 Velasquez St., Univ. of the Philippines Campus, Diliman, Quezon City 1101 Philippines

Tel: +63 2 922 3958

Email: migueldfortes@gmail.com

Website: http://www.msi.upd.edu.ph

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

ARCP2011-13NMY-HERATH

Developing Ecosystem-based Adaptation Strategies to Enhance Resilience of Rice Terrace Farming Systems against Climate Change

Rice terraces are an important rice cultivation system, well-suited for mountainous areas. As such, they are practiced widely in parts of the Asia-Pacific region. Mountain rice terraces have multiple benefits. They retain water within their walls and dikes made of compact soil and stone; conserve soil from erosion; create wet fields for intensive rice cultivation; and promote sustainable development of mountain agriculture. For rural areas in general, rice terraces also play a critical role in shaping the landscape, and in soil and water conservation. The special ecological functions of rice terraces, however, are very much dependent on complex water management and are vulnerable to climate and environment change.

Hani rice terraces in China and Ifugao rice terraces in the Philippines are world-renowned sustainable rice terraces that have served local communities for thousands of years. However, climate change is affecting the sustainability of these systems as it brings in a new dimension of continuous change to local water cycles that would be beyond the regulating capacity of current systems. The resilience of the rice terraces to a changing environment has been gradually reduced, especially resilience to extreme weather events. The centuries-established harmony between human activities and nature in both these rice terrace systems will become vulnerable to future environmental change. For example, recent increases in extreme-intensity rainfall have triggered many landslide disasters of steep slopes in Hani terraces. This has caused serious terrace collapse and led to direct threats to livelihoods and the terrace landscape. Future projections show increased intensities of precipitation that will increase the direct runoff volume, coupled with the increased number of non-rainy days, consequently changing the water cycle and reducing available water resources for terraced rice production, especially during the rice planting season.

There is an urgent need to develop ecosystem-based adaptation strategies to enhance resilience of the rice farming system against flood and drought risks, investigate alternative water management schemes in the future to cope with the risk of water cycle change through integration of traditional knowledge and scientific analysis. Moderation of the water cycle change through on-site measures is one such possibility that will be investigated in the present study.

The APN project

In order to address the dual challenges of increasing frequency of high intensity rain that causes floods, as well as an increasing number of non-rainy days that lead to water scarcity in rice terraces in the Monsoon Asian region, Hani rice terraces in China and Ifugao rice terraces in the Philippines have been engaged as study sites to analyze current water cycles and propose ecosystem based adaptation measures. The United Nations University, in partnership with Yunnan Normal University, China, Southwest Forestry University, China, and the University of Philippines, is undertaking a 3-year project that aims to:

- Analyze and evaluate the ingenious and indigenous rice terracing system and technologies of

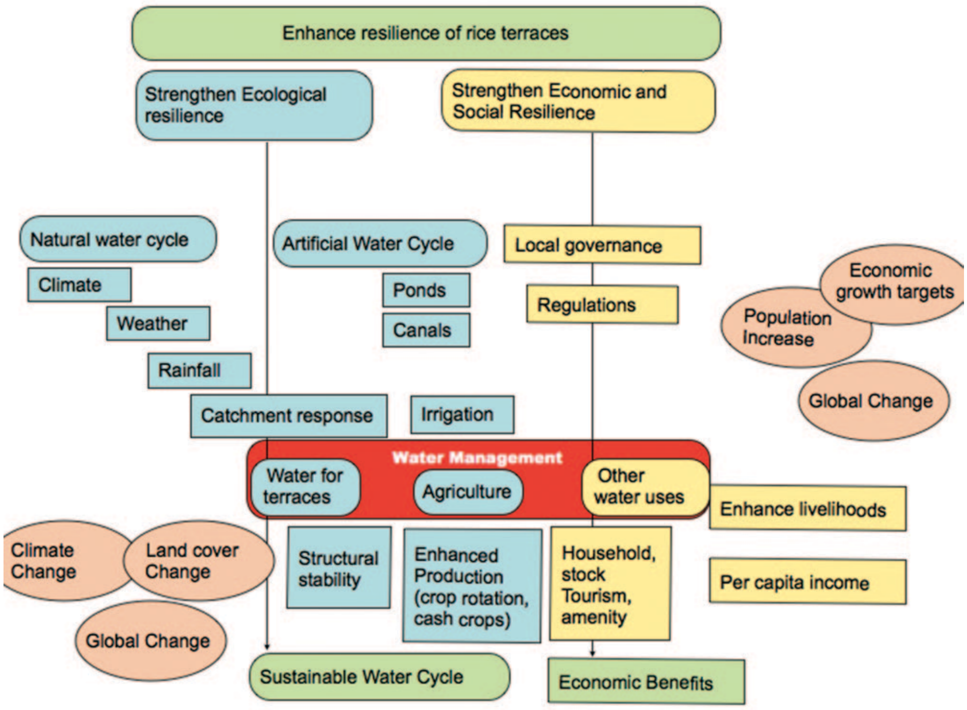


Figure 1. Components to be addressed in the project. The Green boxes are targets. Observations and modelling will be carried out on items in blue boxes. Data and information from secondary sources and interviews will be carried out on items in yellow

the Hani and Ifugao rice terraces, especially their unique water management systems, which have been designed to suit the local ecosystems.

- Develop ecosystem based adaptation measures that will result in generic approaches to strengthen the resilience of traditional rice terrace farming systems in Monsoon Asia, thus reducing flood and drought risk, through case studies in the Hani and Ifugao rice terraces.
- Propose measures to improve the livelihood of residents in the region through enhanced productivity as well as utilizing new business opportunities such as eco-tourism.

At the beginning of this project, the Southwest Forestry University (SWFU) and the United Nations University Institute for Sustainability and Peace (UNU-ISP) organized a workshop on "Ecosystem-based adaptation strategies for enhancing resilience of rice terrace farming systems to climate change," in Kunming, China from 14–17 July 2011. The workshop included 2 days of in-house discussions and 2 days to visit and survey the project study site in Yuanyang County, Yunnan Province, which is located in Southwest China. The objectives of the workshop were to:

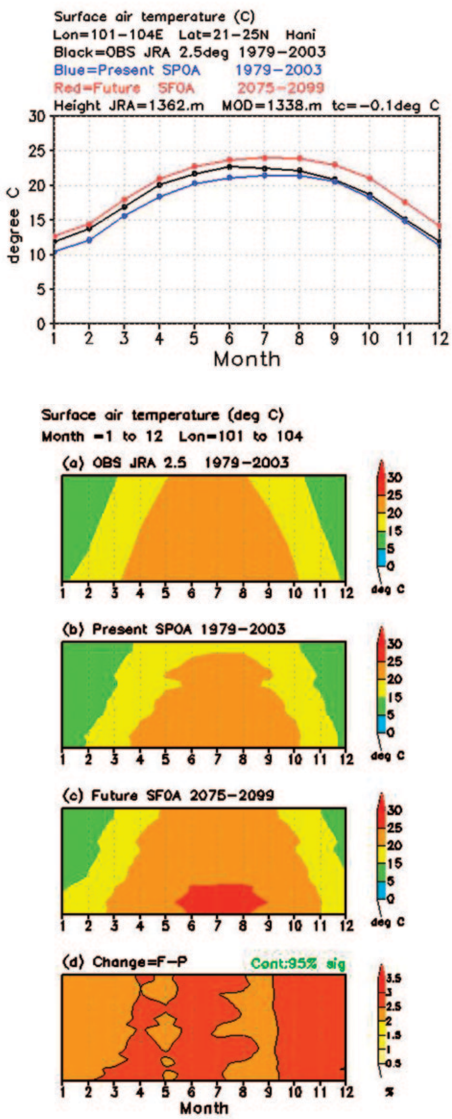


Figure 2. Temperature variation between current and far-future climate scenarios in Hani rice terraces for the IPCC A1B scenario

1. Review the project goals and expected outcomes;
2. Discuss and finalize the project methodology, including the project work plan and responsibilities; and
3. Identify and initiate field studies in the Hani rice terraces.

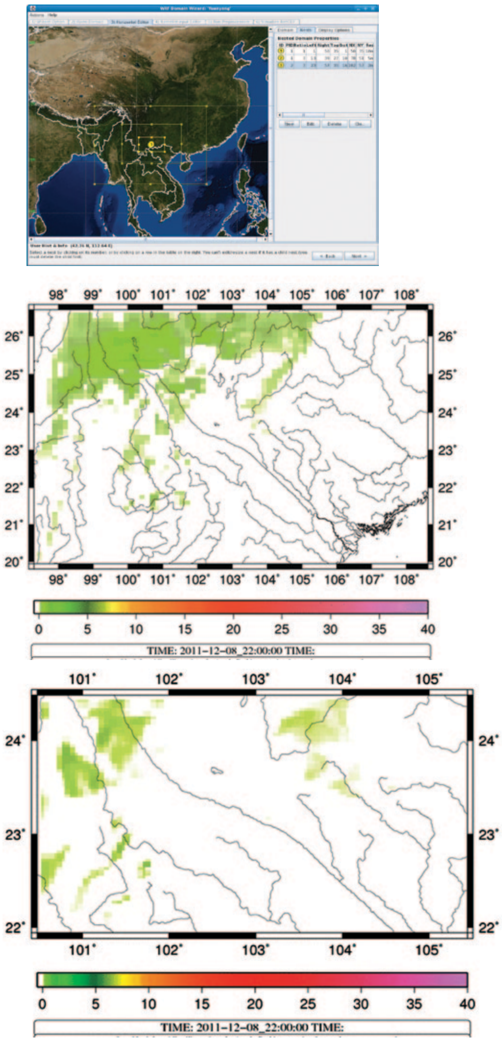


Figure 3. Downscaling domain set up for WRF model for the Hani rice terraces and rainfall control runs for December 2011 for domain 2 (medium resolution) and domain 3 (high resolution)

At the workshop, a three-year research plan and framework for the project were discussed. The framework in the first year will consider links between natural science (hydrological processes, rice production), social and economic systems, and their effects under climate change. The second and third years will focus on designing physical structures such as water collection and infiltration facilities to sustain the ecosystem and enhance livelihoods through the efficient design and governance of water management system. The expanded elements of the project are shown in Figure 1.

The first year work plan entails identifying climate change in the region, its effect on the water cycle and the resulting adverse impacts on the stability of rice terraces. Changes in temperature were investigated by analyzing the Japan Meteorological Research Institute's Atmospheric General Circulation Model (AGMC) which has a horizontal resolution of 20 km. A comparison of the model simulation for temperature change for IPCC AR4 SRES scenario A1B for the MRI time slice experiments covering the Hani rice terrace region for periods of 1979–2003 (current climate) and 2075–2099 (far future) is shown in Figure 2. While the temperatures match with observations shown in Figure 2, it is necessary to carry out bias correction for the rainfall forecasts. In addition, we would like to analyze model uncertainties by comparing the projections downscaled from WRF (NCAR model) with MRI projections. Control runs are now being carried out for the WRF model calibration (Figure 3).

ARCP2011-13NMY-HERATH

PROJECT TITLE

Developing Ecosystem-based Adaptation Strategies to Enhance Resilience of Rice Terrace Farming Systems against Climate Change

COUNTRIES INVOLVED

China, Japan, Philippines

PROJECT DURATION

3 years

APN FUNDING

US$135,000

PROJECT LEADER

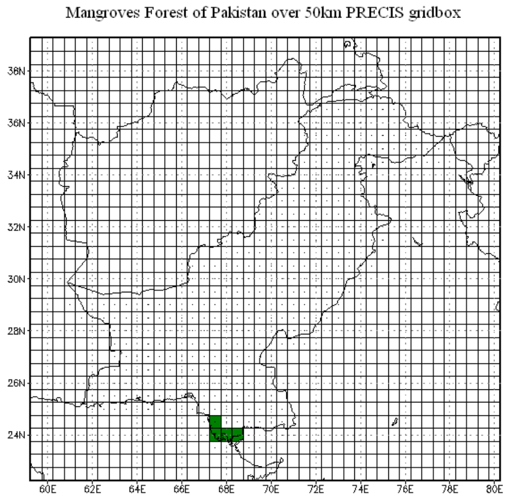
Dr. Anura Srikantha Herath
Institute for Sustainability and Peace
United Nation University
53-70 Jingumae 5-chome, Shibuya-Ku
Tokyo 150-8925, Japan

Tel: +81 3 5467 1290

Email: herath@unu.edu

ARCP2011-14NMY-SALIK

Impact of Climate Change on Mangrove Ecosystems in South Asia



Significant portions of the population along the coasts of South Asia are dependent on different coastal ecosystems. Mangrove forests are an important ecosystem for sustaining biodiversity and livelihoods of its dependent communities. Total mangrove cover in the region has been estimated to be about 10,000 km^2. A number of commercial and non-commercial activities (like cattle grazing, firewood, timber, agriculture, small industries, etc.), are carried out by local communities. Climate change drivers also threat and affect mangrove ecosystems including changes in sea level, hydrology (tidal and fresh water flow within mangroves), high water events, storms, precipitation, temperature, atmospheric CO_2 concentration, ocean circulation patterns, etc. Therefore, a balance is required between resources and utilization under differing climate change scenarios for sustainable development of mangroves and their dependent communities.

The present project seeks to provide science-based information about the impacts of climate change on mangrove ecosystems in South Asia. The impacts of sea level rise, decrease in fresh water flows in the region and other climatic parameters such as temperature fluctuations, precipitation, etc., will be carried out to develop future scenarios of mangrove forests in South Asia. Moreover, the overall vulnerability of mangrove ecosystems will be evaluated by hydrological, climatic, institutional and socio-economic assessments using hydrodynamic modelling, regional climate models, GIS and RS techniques, landscape vegetation models and applying statistical methods.

The present project also intends to raise awareness among local and national-level policy- and decision-makers about the potential impacts of climate change on mangrove ecosystems. This information will enable us to devise policy and intervention plans for mangrove sustainability, development, and conservation by selecting appropriate sites in the region to develop a conceptual institutional framework describing drivers, pressures, responses, trends and impacts on mangrove ecosystems. This will be achieved by involving researchers from participating countries of Pakistan, India, Bangladesh, USA and Sri Lanka who will conduct research on these issues. The outputs are also expected to be helpful for regional and international organizations working in environmental rehabilitation and improvement.

ARCP2011-14NMY-SALIK

PROJECT TITLE

Impact of Climate Change on Mangrove Ecosystems in South Asia

COUNTRIES INVOLVED

Bangladesh, India, Pakistan, Sri Lanka, USA

PROJECT DURATION

2 years

APN FUNDING

US$ 85,000

PROJECT LEADER

Mr. Kashif Majeed Salik
Sustainable Development Policy Institute (SDPI)
8 Main Embassy Road
G-6/3 Islamabad 44000, Pakistan

Tel: +92 51 227 0674

Email: kashif.salik@gmail.com

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

ARCP2011-15NMY-ZHEN

Holistic Assessment of Land-use Change and Impacts on Ecosystem Services of Wetlands

Human society depends on ecosystems and their delivery of goods and services. Changes in the availability of ecological goods and services affect the viability, productivity and stability of the coupled socio-environmental system on which humans rely. Different types of land use and management can maintain or deplete ecosystem services and functions in many different ways. Although most ecosystem services (ES) are still recognized as "public goods," many policy-makers are not informed about the status of ES as they are affected by land-use decisions in many parts of the world. This problem has become severe in wetland ecosystems, where most of the goods and services are provided and used by local people and wild species.

Figures 1 and 2. Dekhar haor (above) in Bangladesh and Boyanghu (below) in China

Wetland ecosystems in Asia play a key role in providing necessary goods and services for humans and wildlife. This project attempts to investigate the impacts of land-use change on ES, including provisioning and regulating services in three commissioned sites of international importance in China, Indonesia and Bangladesh. This project proposes to provide answers, both at the methodological and theoretical levels, that will tackle issues related to the impact of land-use change on ES towards land-use options.

The project team has focussed on reviewing existing land-use practices, land-use change and the main driving forces of both natural and anthropogenic factors at the case study sites. Preliminary results from the Chinese case study have shown that land use in the Poyanghu wetland has gone through significant change. The major causes are due to the government's land-use policy for returning arable land into natural wetlands for ecosystem conservation and an increasing trend in urbanization, which has attracted farmers to cities, leaving farmland abandoned. The Dekhar Haor wetland of Bangladesh

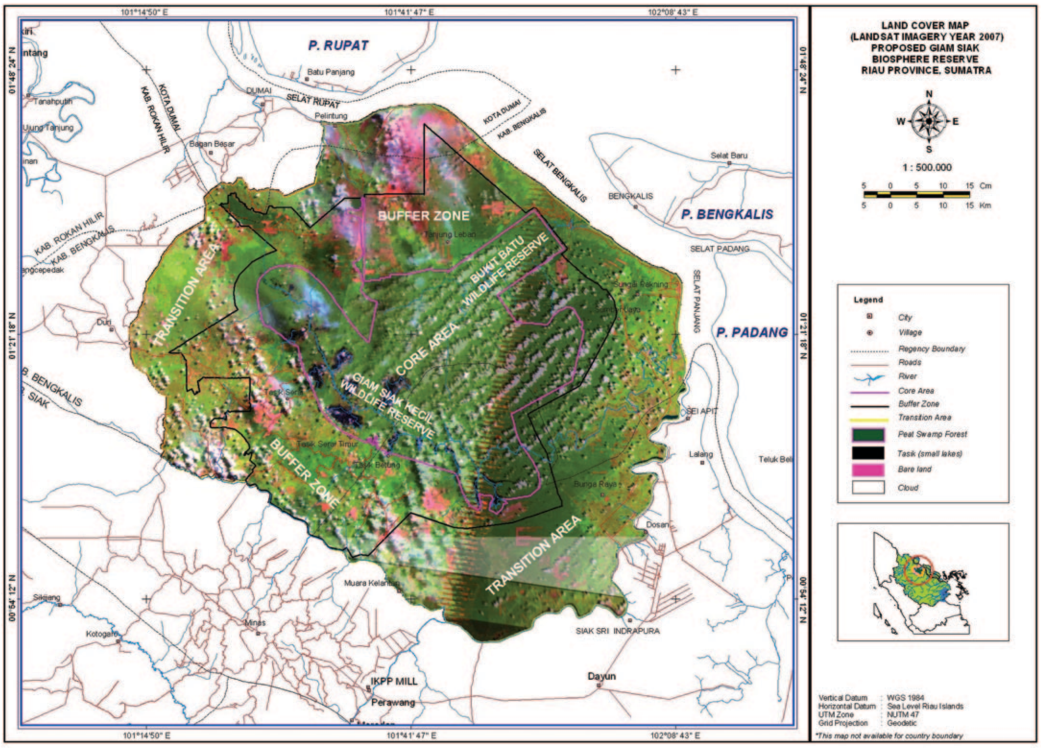


Figure 3. Zonation of Giam Siak Biosphere Reserve in Indonesia

consists of a group of several small freshwater ponds and marshes (beels) in a region of cultivated fields and villages. Local communities are dependent on fishery and agricultural production of the wetland for their livelihood. Fishing and agricultural activities cause a considerable amount of disturbance to waterfowl populations, and over-fishing may be a problem. In Giam Siak Biosphere Reserve of Indonesia, the Peat Swamp Forest (PSF) of Giam Siak Kecil – Bukit Batu (GSK-BB) landscape decreased from 600,000 ha in 1985 to 350,000 ha in 2002. Part of the remaining and contiguous peat swamp forest in the landscape consists of two wildlife reserves (GSK — 84,967 ha and BB — 21,500 ha) and the primary natural production forest that is managed by Sinar Mas Forestry and Partners (aggregate area of 72,255 ha). The initial study indicates that flora and fauna have the potential to be developed as an income source for communities in the surrounding areas.

The project kick-off meeting was held from 29–30 December 2011 in Beijing. The project team integrated the progress of all three sites in terms of land-use change and their driving forces; identified other relevant issues through brainstorming, the impacts of land-use changes on ecosystem changes of the respective sites, data requirements and methods for collection; methodological requirements; and discussed a road map for the following year's activities and implementation plan.

ARCP2011-15NMY-ZHEN

PROJECT TITLE

Holistic Assessment of Land-use Change and Impacts on Ecosystem Services of Wetlands

COUNTRIES INVOLVED

Bangladesh, China, Indonesia, Japan

PROJECT DURATION

2 years

APN FUNDING

US$ 90,000

PROJECT LEADER

Prof. Dr. Lin Zhen
Department of Natural Resources and Environmental Security
Institute of Geographic Science and Natural Resources Research
Chinese Academy of Sciences
11A Datun Road, Chaoyang District
Beijing 100101, China

Tel: +86 10 6488 9276, +86 10 6485 4841

Email: zhenl@igsnrr.ac.cn

Website: http://english.igsnrr.cas.cn

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

ARCP2011-16NMY-IGBP

An International Geosphere-Biosphere Programme Synthesis Theme on Global Environment Change and Sustainable Development: Needs of Least Developed Countries

The present project due to start in 2012 will contribute to IGBP's second major international synthesis of key policy-relevant areas within global environmental change (GEC) research with a view to providing a snapshot of the state of the Earth. The project covers Least Developing Countries (LDCs) in Asia and Small Island Developing States (SIDS) and focusses on human health and the environment, natural disasters and the role of indigenous knowledge systems. The main aims of the project are to:

1. Facilitate integration of local/national-based outputs with relevant outputs from global-based scientific findings on GEC to help address pertinent policy needs in LDCs in Asia and SIDS;
2. Identify new areas of research;
3. Enhance networking between LDCs, APN, and global scientists from IGBP and its partners; and
4. Build capacity in cross-scale fertilization of scientific information among LDCs.

It is expected that the results will be of value to the IPCC 5th assessment process, the UNFCCC LDCs Unit, poverty reduction; and national climate change and disaster management sectors of regional Governments and Universities. The APN project encompasses 5 sub-projects that will address:

1. Barriers to Reducing Climate-Enhanced Disaster Risk In Small Islands (led by Dr. David C. Smith, University Consortium for Small Island States) and four additional sub-projects carried out at the International University of Business Agriculture and Technology (IUBAT), Bangladesh.
2. Droughts In Environmental Change and Sustainability of Asian LDCs (Prof. Alimullah Miyan, IUBAT, Bangladesh)
3. Challenges facing Bangladesh and Myanmar in Nurturing Marine Environment for Sustainable Development (Shohidullah Miah, IUBAT, Bangladesh)
4. Flood in the Context of Environmental Change and Sustainability: Bangladesh and Nepal (Tanvir H. DeWan, IUBAT, Bangladesh); and

Figure 1. Dwelling in rural Jamaica damaged by hurricane Ivan, 2004

Figure 2. Four lead researchers for the APN sub-projects centered in IUBAT: at the Centre is Prof. Alimullah Miyan, IUBAT, Bangladesh who oversees all four projects in addition to his sub-project on drought

5. Coastal Zone Management in Bangladesh (Mohammed Ataur Rahman, IUBAT, Bangladesh).

Barriers to Reducing Climate-Enhanced Disaster Risk in Small Islands: Work in the Pacific has not yet fully begun, but some preliminary work has started within the Caribbean. A survey of physical planners and disaster managers in the Caribbean is ongoing to assess scientific and traditional information on disasters that is gathered and archived; and also assess the format of this information, i.e. whether it is managed in a GIS system (Figure 1). A similar exercise will be carried out in the Pacific.

International University of Business Agriculture and Technology (IUBAT), Bangladesh: The Principal Investigators centered in IUBAT are carrying out preparatory work on projects relating to flood, drought, coastal and marine environment management and full activities will soon be initiated.

Coastal Zone Management in Bangladesh: The huge influx of population in the coastal megacity of Dhaka due to recent climate change disasters has impacted the socio-economic conditions of this enclosed megacity, which is now highly vulnerable. In order to better understand the human and biophysical dynamics, a synthesis will assess results from 25 years of research on changes occurring in the coastal zone from Chittagong to Cox's Bazar along the Bay of Bengal (Figure 3).

To reduce the effects of chemical fertilizers and pesticides, and to conserve nature, the APN Bangladesh Group has placed utmost importance on issues pertaining to organic farming and permaculture and started WWOOF-related (World Wide Opportunities on Organic Farms) activities through volunteering with the aim of learning from farmers' sustainable traditional practices and beliefs.

Contribution to the Planet Under

Figure 3. Erosion and land sliding in Cox's Bazar, Bangladesh

Figure 4. Flood in Dhaka Megacity, Bangladesh

Figure 5. Sal Forest replaced by urbanization; only 50 years ago it was a dense forest, Bangladesh

Pressure Conference, London, March 2012 (http://www.planetunderpressure2012.net): The project facilitator, Dr. Opha Pauline Dube (University of Botswana), and two core researchers, Professor M. Alimullah Miyan (IUBAT, Bangladesh) and Dr. David C. Smith (University Consortium for Small Island States), are co-conveners of the session, "Global Environmental Change and Sustainable Development in Least Developed Countries," at the Planet Under Pressure (PUP) Conference in London, March 2012.

In addition, a number of abstracts by researchers and their students were submitted and accepted either as oral or poster contributions.

Accepted abstracts for different sessions include:

1. Status of data management in managing disaster risk due to natural hazards in Caribbean Small Island Developing States (by Dr. D. C. Smith and others — oral presentation);
2. A model of indicators for the assessment of water resource status (by Iftekharul Islam K., IUBAT); and
3. Vanishing Sal Forests due to Urban Industrial Pressure of Dhaka Megacity (by Dr. Mohammed Ataur Rahman, IUBAT and Mr. Sowmen Rahman, Jahangirnagar University)

ARCP2011-16NMY-IGBP

PROJECT TITLE

An International Geosphere-Biosphere Programme Synthesis Theme on Global Environment Change and Sustainable Development: Needs of Least Developed Countries

COUNTRIES INVOLVED

Bangladesh, India, USA

PROJECT DURATION

2 years

APN FUNDING

US$ 90,000

PROJECT LEADER

IGBP Secretariat — Prof. João M.F. De Morais
International Geosphere-Biosphere Programme (IGBP)
Royal Swedish Academy of Sciences
Box 50005, SE-104 05
Stockholm, Sweden

Tel: +46 8 16 64 48

Email: morais@igbp.kva.se

Website: www.igbp.net

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

APN

ARCP2011-17NMY-MATHUKUMALLI

Tracing Nitrogen and Carbon Biogeochemical Processes in the Inter-tidal Mangrove Ecosystem (Sundarban) of India and Bangladesh: Implications of Global Environmental Change

Global climate change and coastal urbanization have altered the structure and function of mangroves, which are tropical coastal forests that regulate marine biogeochemistry by transporting nutrients and energy along the land-ocean continuum and provide the linkage between man and ecosystems. The Sundarban, the World's largest single-block mangrove in the Gangetic delta of India and Bangladesh, is highly vulnerable to increasing urbanization and climate change. Therefore, an integrated assessment of ecosystem function with nutrient biogeochemical processes and material accretion rates is required to delineate driving forces behind coastal environmental change and help design sustainable management policies to protect mangroves for future generations.

As a part of the present project, concentrations of dissolved nutrients (N, P and SiO_2) data from the five important mangroves (Sundarban, Pichavaram, Coringa, Mangalavanam and Bhitarkanika) in India were collected and the nutrient stoichiometry analyzed to describe the ecological and nutrient status of these inter-tidal mangroves in response to increasing human perturbation (Prasad, 2012).

It appears that the stoichiometric ratios of dissolved nutrients in the mangroves highly deviate from the standard Redfield ratio (Si:N:P = 16:16:1) which are primarily because of the allochthonous nutrients derived from anthropogenic activity. In all mangroves, the Si:N ratios were >1, which indicates that high silica is supplied from terrestrial weathering to mangrove waters. Despite high phosphate loading along with nitrogen from both point and non-point sources to mangrove waters, the N:P ratios demonstrate that phosphorus is a limited nutrient in all mangrove ecosystems.

The long-term nutrient analysis in the Pichavaram mangrove explains that the significant increase in dissolved nutrients since the 1980's is mainly derived from non-point sources that alter the biogeochemical processes in this ecosystem (Prasad *et al.*, 2006). This analysis indicates that the ecological status of the Indian sub-continent mangroves is highly disturbed by anthropogenic impacts. Therefore, an appraisal of the nutrient ratios and sufficiency in mangroves will facilitate the understanding of current environmental conditions of coastal ecosystems, which will further lead to long-term observational research coupled with modelling to develop sustainable management strategies for both conservation and restoration of these mangroves.

References:

Prasad, M.B.K., Ramanathan, A.L., Alongi, D.M. and Kannan, L. 2006. Seasonal variation and decadal trends in concentrations of dissolved inorganic nutrients in the Pichavaram mangrove waters, Southeast India. Bulletin of Marine Sciences 79(2): 287–300.

Prasad, M.B.K. 2012. Nutrient stoichiometry and eutrophication in Indian mangroves. Environmental Earth Sciences doi: 10.1007/s12665-011-1508-8.

ARCP2011-17NMY-MATHUKUMALLI

PROJECT TITLE

Tracing Nitrogen and Carbon Biogeochemical Processes in the Inter-tidal Mangrove Ecosystem (Sundarban) of India and Bangladesh: Implications of Global Environmental Change

COUNTRIES INVOLVED

Bangladesh, China, Indonesia, Japan

PROJECT DURATION

2 years

APN FUNDING

US$ 90,000

PROJECT LEADER

Dr. Bala Krishna Prasad Mathukumalli
Earth System Science Interdisciplinary Centre
University of Maryland
5825 University Research Court, Ste. 4001
College Park, MD 20740, USA

Tel: +1 301 405 1434

Email: mbkp@umd.edu

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

ARCP2011-18NMY-JUNG

Impacts of Global Warming on Coastal and Marine Ecosystems in Northwest Pacific

The highly-productive Northwest Pacific has experienced dramatic changes in oceanographic conditions and ecosystem structure, driven by climatic change and anthropogenic intervention (Figure 1). The project team of natural and socio-economic scientists aims to conduct comparative studies across Northwest Pacific Action Plan (NOWPAP) countries (China, Japan, Republic of Korea and Russia) to evaluate regional differences in response to marine ecosystem changes in the NOWPAP sea area (33–52°N; 121–143°E).

This project aims to provide scientific basis to decision-makers in developing policy strategies that incorporate regional differences in:

1. Marine ecosystems supporting fish stocks; and
2. Vulnerability and adaptation of fishery industries to climate change.

In the first year, we analyzed spatial and temporal variability data in oceanographic conditions for major fish species in the NOWPAP sea area in the last 40 years. In this context, data-sharing between the four countries was a vital component of the project and, in 2011, we conducted retrospective analysis on times-series of climate and oceanographic data that was collected and compiled in the Republic of Korea. We are also expecting data contributions from China, Japan and Russia in due course.

We are developing a new statistical technique (change-point detection) that can detect and predict significant changes from spatially-extensive multivariate times-series data. By applying the "switching model" we were able to define four regimes and their characteristic fish species in Korean waters (Figure 2). We presented the outcomes during the ICES annual science meeting in Gdansk, Poland and the PICES annual meeting in Khabarovsk, Russia in September and October 2011.

We have been developing individually-based models that combine a three-dimensional ocean circulation model and a simple biological model for predicting transport and recruitment of early-life stage fish. A preliminary model was developed for Pacific anchovy

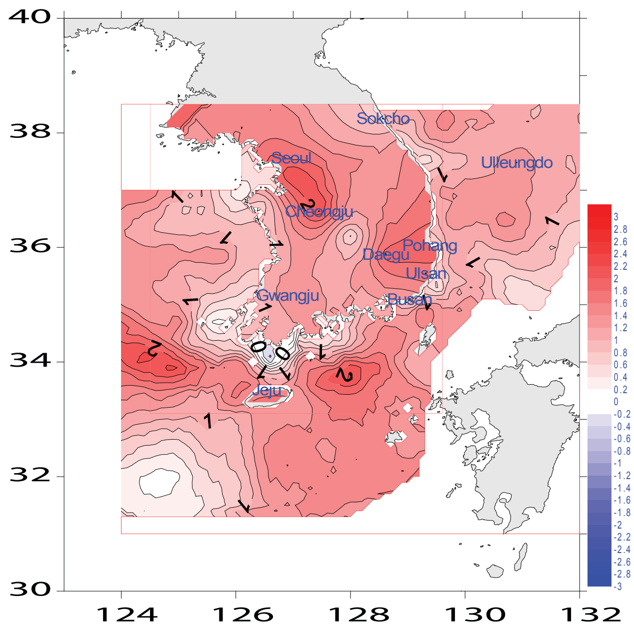


Figure 1. Linear trend of temperature change (°C) in the air and sea surface from 1968 to 2007

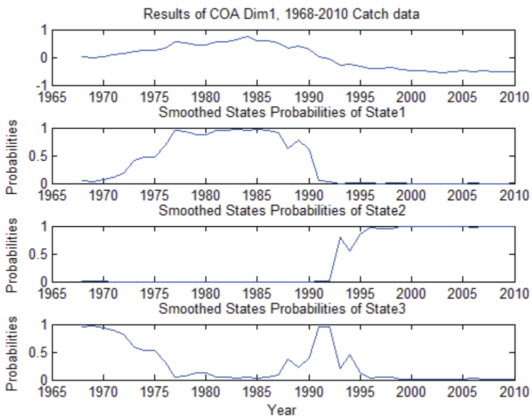


Figure 2. Regime shifts detected by applying a Bayesian Markov switching model to the principle dimension extracted by correspondence analysis to explain variability in fishery species biomass composition from 1968 to 2010 in Korean waters

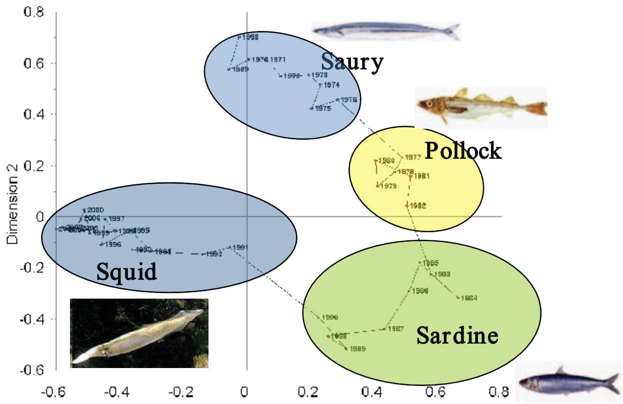


Figure 3. Correspondence analysis of species composition in fishery catch from Korean sea waters from 1968 to 2010. The column variable is year and row variable is fish species. Points of fish species are not shown, but the characteristic species representing the four distinct periods are illustrated

(*Engraulis japonica*) in 2011. In 2012, we plan to develop fishery economic models that can evaluate the risk and vulnerability of fishery sectors to projected changes in marine ecosystems and fishery resources in the NOWPAP area.

The first workshop to discuss progress and results will be held on Jeju Island, Republic of Korea, in February 2012. The workshop will:

1. Discuss the status and availability of data;
2. Discuss what the project team can achieve and barriers that the team need to overcome;
3. Arrange for additional experts to join and contribute to the project; and
4. Plan the second workshop which is expected to be held immediately following the ICES/PICES/IOC Second International Symposium: Effects of Climate Change on the World's Oceans, being held in Yeosu, Republic of Korea, in May 2012.

ARCP2011-18NMY-JUNG

PROJECT TITLE

Impacts of Global Warming on Coastal and Marine Ecosystems in Northwest Pacific

COUNTRIES INVOLVED

China, Japan, Republic of Korea, Russian Federation

PROJECT DURATION

2 years

APN FUNDING

US$ 76,000

PROJECT LEADER

Dr. Sukgeun Jung
School of Marine Biomedical Sciences
Jeju National University
1, Ara 1-dong, 102 Jejudaehakno
Jeju-si, 690-756
Republic of Korea

Tel: +82 64 754 3424

Email: sukgeun.jung@gmail.com

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

ARCP2011-19NSY-KOOTTATEP

Affordable Sanitation as an Adaptive Strategy to Emerging Water-borne Diseases due to Climate Change

Climate change is one of the defining challenges of the century and increasingly recognized as a public health priority. Changing rainfall patterns and temperatures over the coming decades are likely to make sanitation management more complicated. Poor drainage in human settlements increases the risk of exposure to contaminated water and provides a habitat for mosquitoes, leading to increased incidences of water-borne and vector-borne disease. The main health effects of a lack of access to clean water and sanitation are diarrhoea and other diseases caused by biological or chemical contaminants. Most municipalities in Thailand and other developing countries in Southeast Asia are not able to invest in central wastewater collection or treatment systems. Therefore, onsite treatment systems are widely used to partially treat or retain main pollutants (such as organic matter, nutrients). This results in the limited efficiency to remove excreta-related pathogens, causing high incidence of excreta-related disease.

The present study is developing a methodology to assess sustainable sanitation and adaptation strategies for emerging water-borne diseases. The rate of GHG emissions from domestic wastewater and faecal sludge (FS) treatment systems in Thailand will be examined to develop a computer software-based mathematical model. Material Flow Analysis (MFA) will be applied to manage the sanitation planning and to determine the flow of *E. coli* and *Salmonella* within the system. A Quantitative Microbial Risk Assessment (QMRA) will be used to determine the risk of pathogens to public health in relation to exposure to contaminated pathways (Figure 1).

The principal factor in determining methane (CH_4) generation is the amount of degradable organic matter, while nitrous oxide (N_2O) is associated with the degradation of nitrogen components in the wastewater. Primary and secondary data from Thailand, Lao PDR and Viet Nam will be used to develop and calibrate the model, whereas the validation process will determine the accuracy of prediction compared with observed values from the uncontrolled field.

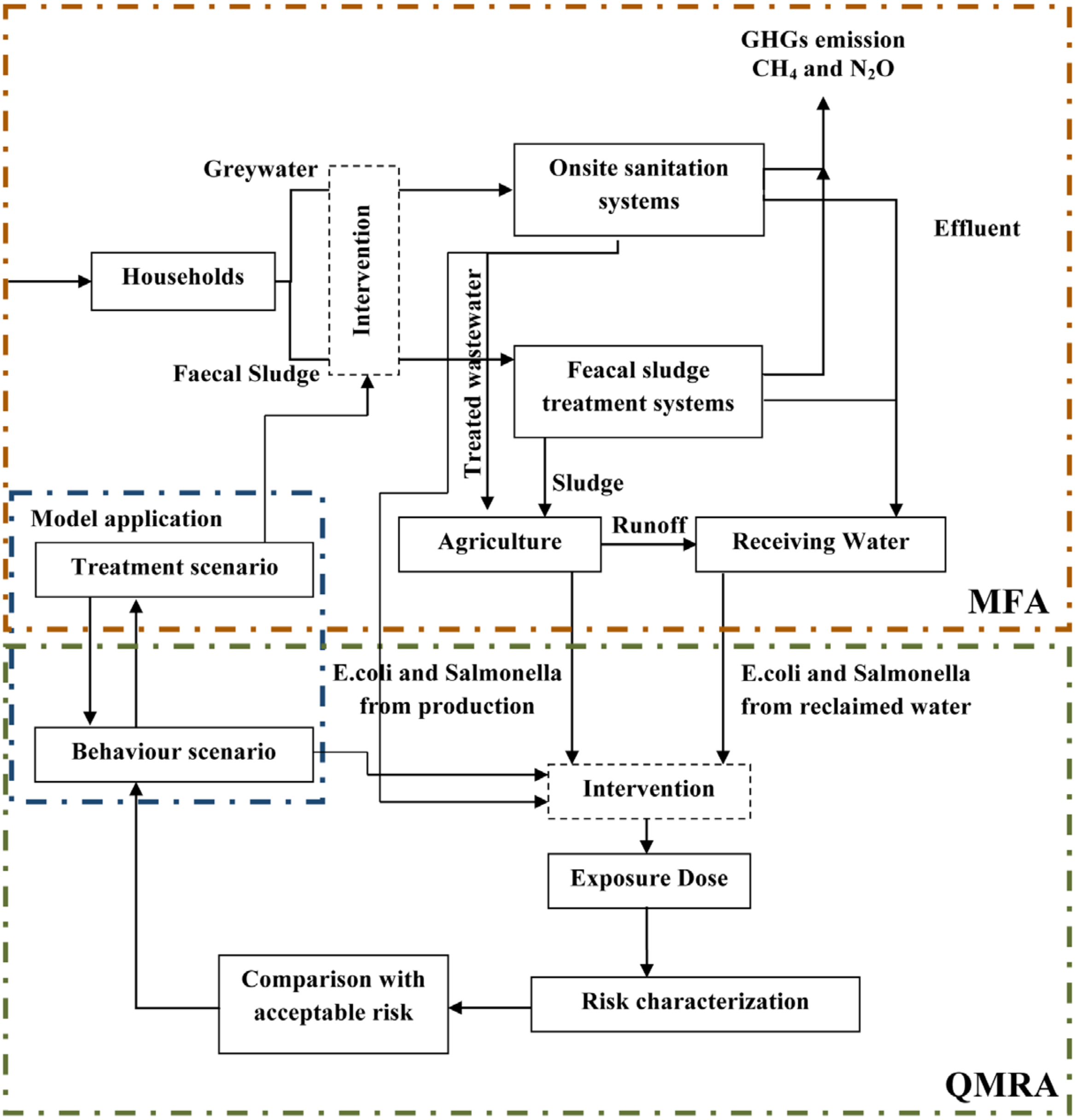


Figure 1. Conceptual model

ARCP2011-19NSY-KOOTTATEP

PROJECT TITLE

Affordable Sanitation as an Adaptive Strategy to Emerging Water-borne Diseases due to Climate Change

COUNTRIES INVOLVED

Lao PDR, Thailand, Viet Nam

PROJECT DURATION

1 year

APN FUNDING

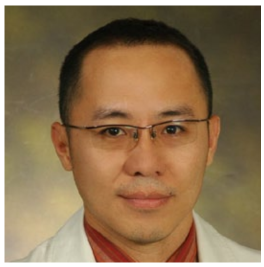
US$ 44,550

PROJECT LEADER

Dr. Thammarat Koottatep
Environmental Engineering and Management
School of Environment, Resources and Development
Asian Institute of Technology, Thailand

Tel: +662 524 6188

Email: thamarat@ait.ac.th



APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

ARCP2011-20NSY-MCEVOY

Assessment of Climate Change Risk and Adaptation Options for Secondary Cities in Southwest Bangladesh and Central Viet Nam

This project aims to develop and test a methodology to assess climate change risks in the context of secondary cities of vulnerable regions in Bangladesh and Viet Nam with a view to providing adaptation guidance. With due cognizance of the substantial body of recently-generated literature, the research is empirically and explicitly context-specific and draws strongly on local knowledge. We intend to promote links between governmental and non-governmental organizations, and facilitate local capacity building as well as regional cross-learning. The project outcomes will be disseminated through partner networks to better inform local and national policy and practice.

Researchers from CCAP visited Viet Nam and Bangladesh in September 2011. Meetings were held with project partners — Southern Institute of Sustainable Development (SISD), Ho Chi Minh City, Viet Nam; and BRAC University, Dhaka, Bangladesh. Other project partners from the Centre for Social Research & Development (CSRD), Viet Nam; and Institute for Water and Flood Management (IWFM), Bangladesh, also attended the meetings. The work plan, financial arrangements and other project issues were discussed in detail and agreements were consolidated. The CCAP lead researcher also had the opportunity for preliminary discussion with BRAC University at the World Reconstruction Conference in Geneva, May 2011. Subsequently in October, financial sub-contracts with the partner organizations were signed through RMIT University's Research & Innovation office.

A literature review has been ongoing over the past four months, particularly on the topics of risk, vulnerability and capacity assessment. In the process, the assertion made in the project proposal regarding the lack of such assessments specific to secondary cities in Asia has been confirmed. Most assessments were found to relate to non-urban contexts and, even in the context of cities, they focussed on the large megacities. A few examples of risk assessments relevant to the concerns of this project include work done in smaller Asian cities by UN-Habitat and the Rockefeller Foundation. Some of this work was referred to for the methodology being developed for this project, however, we found it necessary to tailor a specific risk assessment toolkit relevant to this project. The draft toolkit will be completed in December, 2011 and shared with project partners. It is expected that they will use the toolkit to conduct risk assessments in the case study cities of Satkhira, Bangladesh and Hue, Viet Nam from January to March, 2012. The findings will be shared with partners in all three countries (Australia, Bangladesh and Viet Nam) at a workshop in Hue, in April 2012.

In the interim, the project has been featured as a news item on RMIT University's website, which can be viewed through the link: http://rmit.edu.au/browse/News%20and%20Events%2FNews%2FSocial%20science%2Fby%20title%2FA%2F;ID=48985vbw8d321;STATUS=A.

ARCP2011-20NSY-MCEVOY

PROJECT TITLE

Assessment of Climate Change Risk and Adaptation Options for Secondary Cities in Southwest Bangladesh and Central Viet Nam

COUNTRIES INVOLVED

Australia, Bangladesh, Viet Nam

PROJECT DURATION

1 year

APN FUNDING

US$ 43,000

PROJECT LEADER

Prof. Darryn McEvoy
Climate Change Adaptation Program (CCAP)
Global Cities Research Institute
RMIT University
Melbourne, Victoria, Australia

Tel: +61 3 9925 1943

Email: darryn.mcevoy@rmit.edu.au

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

ARCP2011-21NSY-MANURUNG

Reconstruction of Sea Level Change in Southeast Asia Waters using Combined Tide Gauge and Satellite Altimetry Data

Low lying and densely populated coastal areas with thousands of small islands spread across Southeast Asia are highly prone to sea level rise. Accurate sea level maps in Southeast Asia, where coastal tide gauge data records are too short and sparsely distributed to map sea level trends, is of great importance to scientists and decision-makers in the region interested in past, present and future sea level change. Improving near-coast altimetry processing will extend coastal sea level records and allow accurate mapping of sea level change in the region using existing reconstruction techniques.

Maps of global sea level change affected by global warming were reconstructed by fitting Cyclostationary Empirical Orthogonal Functions (CSEOF), derived from satellite sea level variability, to coastal tide gauge observations (Hamlington *et al*., in press in JGR Oceans). This method is an improved reconstruction technique, compared to methods based on fitting EOFs to global coastal tide gauge data, and provides estimates of the regional distribution of sea levels over the last 60 years. However, further work is necessary to improve the accuracy of satellite altimetry in coastal areas and shallow waters. The CSEOF method, applied to an improved satellite altimeter-data archive calibrated using coastal gauge stations in the region and incorporating additional spatial data, will improve mapping of sea level change in Southeast Asia.

The project will evaulate and improve sea level reconstruction to provide spatial maps of sea level variability and trends in and around Indonesia and Viet Nam using a technique that fits data derived from tide gauges and coastal altimetry to satellite altimeter-derived CSEOF basis functions. This preliminary study will provide a basic foundation that will improve reconstruction using samples from other regions in Southeast Asia based on the development of a land and marine spatial data archive adequate for coastal altimetry. The project will demonstrate multidisciplinary collaboration among scientists from various institutions as well as University and Government institutions in Southeast Asia. This will enhance human capacity development through the exchange of ideas, transfer of technology and upgrading of knowledge and skills. Accurate reconstruction of regional variations in sea level change across the archipelago is of importance to policy-makers and will be accessible to research communities and government to increase their understanding of sea level change from the past to the present using the best available *in situ* and satellite observations.

Preliminary Results

Since project initiation, communications and discussions via email exchange have been used to plan activities and to begin the development of an altimeter data processing toolbox. There are four main results from our preliminary activities that are highlighted in the present report, namely Workshop and Training, site

Figure 1. Director General of Bakosurtanal, Research Members and some participants

survey to the Benoa Tide Gauge Station in Bali, development of a MATLAB-based Coastal Altimetry Processing Toolbox, and the first reconstruction of Southeast Asia sea level change maps using CSEOFs.

An initial meeting was held at the international 5th Coastal Altimetry Workshop (16–18 October, 2011) in San Diego, USA. Researchers met again at workshop, training and kickoff events held from 16–18 November, 2011 in Bogor, Indonesia. The one-day workshop focussed on satellite altimetry, data product types and applications. A lively debate about the potential of satellite altimetry in the region took place and, for most stakeholders, the topic was new and the event provided a useful introduction to satellite altimetry and potential applications in Indonesia.

A site survey to the Benoa Tide Gauge Station in Bali was also useful for calibration and validation of our methodology from the open ocean to the coastal zone to see how far we could improve the satellite altimetry process.

A preliminary reconstructed sea level change map of Southeast Asia was also introduced (Figure 2). The reconstruction uses mainly long term tide gauge data record for reconstructing sea level change and related modes of ocean variability. The basic functions were based on satellite altimetry data. A focus of our research is to improve sea level reconstructions in Southeast Asia by incorporating additional tide gauge data records available in the region in addition to global tide gauge data from the Permanent Service for Mean Sea Level (PSMSL). We also intend to investigate the possibility of using shorter data records in the reconstruction to see which oceanographic signals can be reconstructed. This is a promising research activity that should be completed during our year-long research programme.

Conclusions

A toolbox to process satellite altimetry data products is being developed and should facilitate visualization and analysis of satellite altimetry in coastal areas.

The availability of quality tidal data records in the region should be explored since this will contribute to improving the

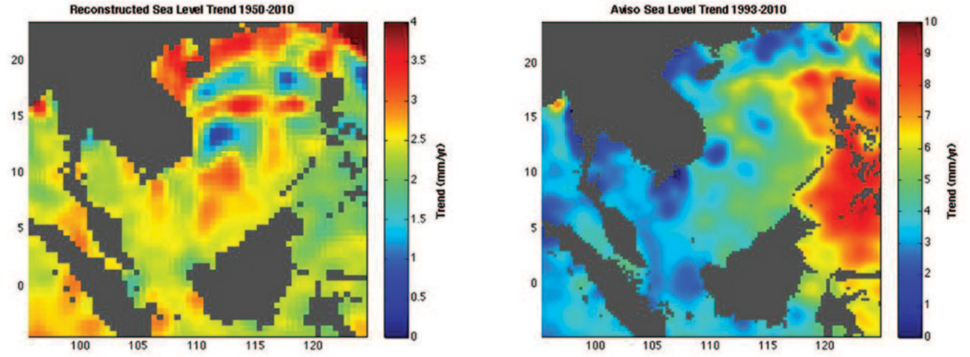


Figure 2. Preliminary reconstructed sea level trend map of Southeast Asia sea level change for 1950–2010 using the global tide gauge database from PSMSL (left) and for 1993–2010 using the AVISO satellite altimeter dataset (right)

resolution and accuracy of reconstructed sea level in Southeast Asia seas. It is expected that the CSEOF sea level reconstruction technique could be adapted to analyze shorter-term data records.

References

Gómez-Enri, J. Vignudelli, S. Quartly, G.D. Gommenginger, C.P. Cipollini, P. Challenor, P.G. Benveniste, J. (2010). Modeling Envisat RA-2 waveforms in the coastal zone: case-study of calm water contamination, IEEE Geoscience and Remote Sensing Letters, Vol. 7, Issue 2, 474-478 10.1109/LGRS.2009.2039193.

Hamlington, B.D. Leben, R.R., Nerem, R.S. Kim, K.-Y., Han, W. (*in press*): Reconstructing sea level using cyclostationary empirical orthogonal functions, J. Geophys. Res.

Vignudelli, S. Kostianoy, A.G. Cipollini, P. Benveniste, 2011. J. Coastal Altimetry, Springer-Verlag Berlin Heidelberg 2011, doi:10.1007/978-3-642-12796-0. pp 565.

ARCP2011-21NSY-MANURUNG

PROJECT TITLE

Reconstruction of Sea Level Change in Southeast Asia Waters using Combined Tide Gauge and Satellite Altimetry Data

COUNTRIES INVOLVED

Indonesia, Viet Nam

PROJECT DURATION

1 year

APN FUNDING

US$ 45,000

PROJECT LEADER

Dr. Parluhutan Manurung
Bakosurtanal, Jl. Raya Jakarta-Bogor Km 46
Cibinong, 16911, Indonesia

Tel: +62 21 8790 7730

Email: parluhutan@bakosurtanal.go.id

ARCP2011-22NSG-LIU

The Impact of Global Warming on Ocean-Atmosphere Feedback Strength in Tropical Indian Ocean

The Indian Ocean Dipole is a significant ocean-atmosphere coupled event over the tropical Indian Ocean. It is largely controlled by internal air-sea feedback mechanisms and strongly modulates Asian climate variability, both locally and remotely. Global warming is the apparent climatic long term trend over the globe, including the Indian Ocean. This project aims to improve the current proposal for the next round of APN's call for proposals that will examine the impact of global warming on the ocean-atmosphere coupled event using multi-model outputs. The outcome will address the following concerns: 1) To what degree does global warming impact the IOD event; and 2) Explain the physical mechanism of how the IOD is influenced by global warming.

According to the project schedule, proponents successfully organized the workshop to improve the proposal on 26 August 2011, in Qingdao, China. Experts in natural climate variability from Thailand, Malaysia and China, joined the workshop to help modify and improve the final proposal for submission to APN in October 2012.

During the workshop, Dr. Lin Liu from China gave a detailed introduction of the project framework. Then, the discussion continued for one and half days until a final agreement was reached. With the help of all participants, the workshop achieved the following outcomes:

1. New collaborators including more scientists from the Asia-Pacific region.
2. Preliminary scientific analysis was conducted. One of the expected outcomes will be to provide useful information for IPCC AR5.
3. Pilot project "Moon Onset Monitoring and Social Economy Impact (MOMSEI)". IOC/WESTPAC agreed to cooperate with the current project to enhance collaboration among Asia-Pacific countries.

Figure 1. Participants of the workshop, including Prof. Wenjie Deng (third from right), APN SPG Member for China

ARCP2011-22NSG-LIU

PROJECT TITLE

The Impact of Global Warming on Ocean-Atmosphere Feedback Strength in Tropical Indian Ocean

PROJECT DURATION

1 year

APN FUNDING

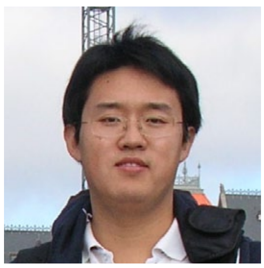
US$12,000

PROJECT LEADER

Dr. Lin Liu
Lab. of Ocean-Atmosphere Interaction and Climate Change
The First Institute of Oceanography
State Oceanic Administration
6 Road Xian-Xia-Ling, High-Tech Park
Qingdao 266061, China

Tel: +86 532 8896 7403

Email: liul@fio.org.cn



CAPaBLE PROJECTS 3

Scientific Capacity Development Projects funded under

the CAPaBLE Programme

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

CBA2011-01CMY-KAWAI

Capacity Building of Biodiversity Research in the Coastal Zones of the Asia-Pacific Region: Phycology Taxonomy Analysis Training using Genetic Markers

In its second year of a 2-year funded APN activity that provided capacity building for young researchers from developing countries in Southeast Asia, the International EMECS Centre organized a training programme for taxonomy identification from 3–13 December 2011 in Kobe, Japan.

Taxonomy is regarded as one of the base elements of biodiversity knowledge and is a prerequisite in establishing certain objective standards in identifying alien species, together with conventional morphological approaches. In this sense, the methodology to identify using genetic markers is recognized as reinforcing the shortcomings of more traditional approaches. Equipping deoxyribonucleic acid (DNA) analysis skills with genetic markers, this training programme has contributed to the knowledge and experience of macroalgal taxonomy among young researchers, providing them with the precise identification skills to distinguish between native and alien seaweed species.

Six trainees from Cambodia, China, Malaysia, Thailand and Viet Nam were divided into three groups for individual technical divisions: Faculty of Science, Kobe University; Faculty of Science, Hokkaido University; and Faculty of Marine Biosciences, Fukui Prefectural University. The training programme enabled trainees to develop skills in taxonomy identification with genetic markers, and thus aiming to contribute to the United Nations Convention on Biological Diversity (UNCBD).

"My overall opinion about this training programme is that it represents a good platform for each participant to gain new knowledge and skills and in my case, put into perspective what we have learnt in theory. I have to admit that the practical training period of five days was rather short and a longer period of time may prove to be a more fruitful experience. Nonetheless, the programme serves as a good opportunity for young researchers like us to expand our network in various countries. I believe that all of us are happy to share the knowledge that we have acquired from the training programme with our fellow colleagues. The techniques we learnt are also useful for identifying marine organisms. Thank you once again to all parties involved in making CAPaBLE 2011 a success! Arigatou gozaimasu!

Sze Wan POONG, Trainee from University of Malaya, Malaysia.

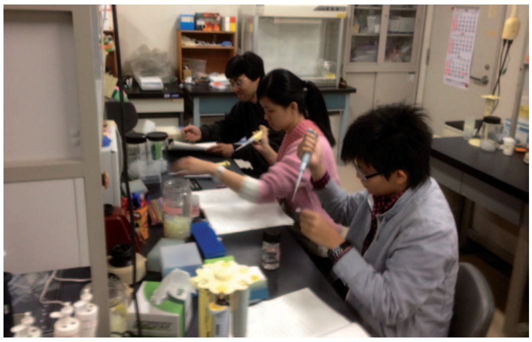
"From the first day till the last day of the CAPaBLE training course here in Kobe University, I am very happy to learn from all Japanese phycologists. This intensive training course enables me to work close with specialists in phycology and molecular biology, and share our experiences not only in academic aspects, but also in general aspects. Academically, I learn how to make an effective phylogenetic tree using various kinds of software, such as Kakusan4, Phylogear and RAxML. I also had lively discussions with my professor and colleagues on how we can build a strong network for algal research in Southeast Asia.

Furthermore, this workshop provided the opportunity for dialogue with other participants. As we are from different communities and cultures, we had so much information to share. We talked about phycological research in our region and building a network in the near future.

Although training schedule was quite limited, I am very confident about using the information I learned here. I believe that all instructors tried their best to train all of us. For the participants new in the field of phycology and genetics, more time may be beneficial.

Given the opportunity to join this activity, I gained more experience in research and can now network with Japanese and Southeast Asian phycologists. Thank you for a good time here in Japan. "Arigatou Gozaimasu."

Narongrit MUANGMAI, trainee from Kasetsart University, Thailand.



CBA2011-01CMY-KAWAI

PROJECT TITLE

Capacity Building of Biodiversity Research in the Coastal Zones of the Asia-Pacific Region: Phycology Taxonomy Analysis Training Using Genetic Marker

COUNTRIES INVOLVED

Australia, China, India, Indonesia, Japan, Republic of Korea, Malaysia, New Zealand, Philippines, Russia, Taiwan

PROJECT DURATION

2 years

APN FUNDING

US$ 60,000

PROJECT LEADER

Prof. Hiroshi Kawai
Kobe University Research Centre for Inland Seas
International Centre for the Environmental Management of Enclosed Coastal Seas (EMECS)
Japan

Tel: +81 78 252 0234

Email: kawai@kobe-u.ac.jp

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

CBA2011-02CMY-KAIHOTSU

Drought Monitoring System Development: Integrating *In-situ* Data, Satellite Data and Numerical Model Output

AWCI (Asian Water Cycle Initiative) of GEOSS collaborates with 18 countries in Asia to share ground observational data to support information exchange, and improve drought monitoring studies in the region. The present project aims to share and improve drought monitoring capability; set up a drought monitoring and research network; and develop early warning systems for drought hazards in the region.

To achieve these goals, the science team has been collecting and processing meteorological and hydrological *in situ* monitoring data and soil moisture/vegetation satellite observation data while building a drought monitoring and research network. During GEOSS-related meetings held in 2011, the project team provided algorithms and methodologies for drought monitoring using data from the *in situ* stations and satellites, and performed numerical analyses. The next meeting that will discuss further progress is scheduled back-to-back with the 5th GOESS Asia-Pacific Symposium being held in Tokyo, Japan in April, 2012.

A training course on analysis techniques for AWCI drought studies was held in January 2012 in Tokyo. Researchers from the collaborating countries learned acquisition and usage techniques of AMSR-E soil moisture products and numerical analysis techniques of drought forecasting, as well as *in situ* method to monitor drought.

The Asia Network Drought Research (ANDR) has been created and presently includes Mongolia, China, Thailand, Viet Nam, Bangladesh and Pakistan. The network is currently under development and expects the other AWCI countries. A few *in situ* stations recording water cycle data have been active in the Mongolian Plateau and Thailand. AMSR-E and MODIS have also been observing soil moisture and vegetation conditions from 2002 to 2011.

A data bank has been active since 2007 and there is a wealth of *in situ* monitoring and satellite observation data. We have been accumulating *in situ* soil moisture data in Mongolia since 2002, China from 2006 to 2009, and daily elements of meteorological data from Viet Nam (2008 and 2009).

Since 2000, there have been frequent severe droughts in Thailand. In 2009 and 2010, droughts in Thailand affected more than 20,000 ha of farmland and heavily impacted villages affecting more than 11,000 people. Figure 1 shows the study area of the AMSR-E soil moisture monitoring in Thailand. Drought monitoring results by AMSR-E in the data bank is shown in Figure 2 for 2003. In this year, Thailand had a severe drought. Remarkable low soil moisture conditions (volumetric soil moisture content less than 6%) during the dry season are

The data bank can be accessed by the APN community and AWCI upon request.

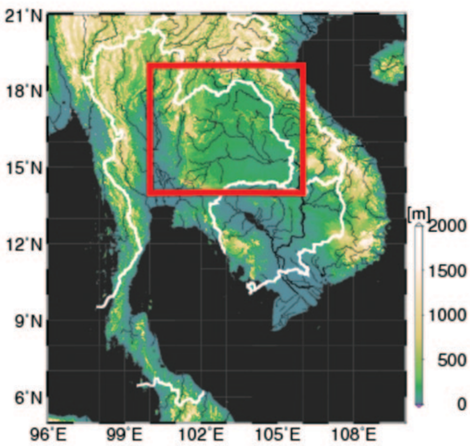


Figure 1. Target area of soil moisture analysis of AMSR-E in Thailand (2003)

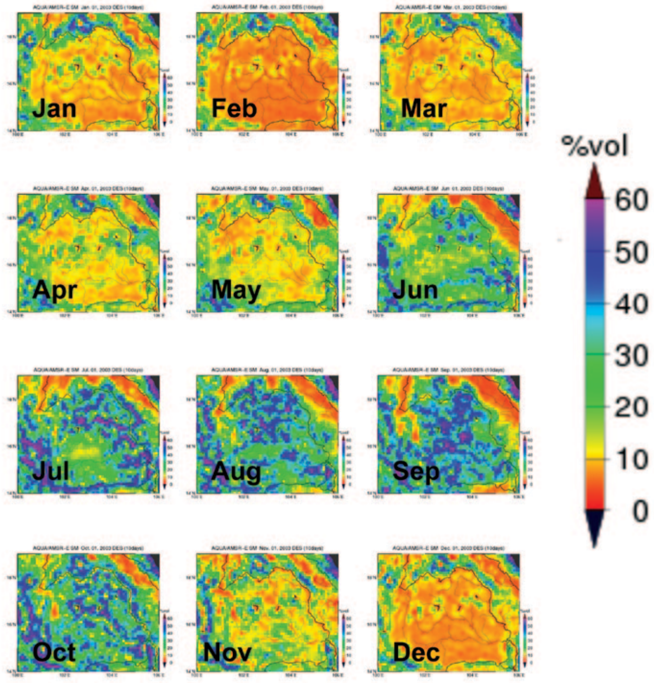


Figure 2. Change of AMSR-E soil moisture averaged over the first 10 days of each month in 2003

also observed. We can see a remarkable change of surface drying and wetting in the drought year in Thailand.

Now, we are attempting to do the following:

- Expand the drought monitoring network and complete the ANDR membership;
- Collect soil moisture and other water cycle data for the data bank;
- Share soil moisture data and other meteorological data of ground- and satellite-based monitoring in the data bank;
- Analyze soil moisture and other data from a drought and climate change perspective;
- Review project demonstrations related to climate change and water quality and improve adaptation activities;
- Obtain numerical drought monitoring outputs and create a trial early warning system; and
- Conduct a training course on drought studies.

CBA2011-02CMY-KAIHOTSU

PROJECT TITLE

Drought Monitoring System Development by Integrating In-situ Data, Satellite Data and Numerical Model Output

COUNTRIES INVOLVED

Bangladesh, China, Japan, Nepal, Pakistan, Philippines, Thailand, Viet Nam

PROJECT DURATION

2 years

APN FUNDING

US$ 80,000

PROJECT LEADER

Prof. Ichirow Kaihotsu
Hiroshima University, Japan

Tel: +81 82 424 6497

Email: kaihotu@hiroshima-u.ac.jp

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

APN

CBA2011-03NSY-WCRP

WCRP Open Science Conference — Climate Research in Service to Society

The World Climate Research Programme (WCRP) held a major international Conference in Denver, Colorado USA, from 24–28 October 2011. This was the first meeting of its kind during the lifetime of WCRP. The goal of the conference was to better identify the scientific challenges and opportunities in understanding the behaviour of the climate system and its interactions with other earth system components.

The main objectives of the conference were to:

- Identify key opportunities and challenges in observations, modelling, analysis and research required to understand and predict responses of the Earth as a system;
- Provide an internationally-based "state of knowledge" for the upcoming fifth assessment report of the IPCC;
- Facilitate cooperation and coordination across WCRP, as well as with other international research programmes, including the World Weather Research Programme (WWRP) and the Earth System Science Partnership (ESSP); and
- Help WCRP and its partners identify and tackle the inevitable climate change challenges facing the planet.

The conference assembled over 1900 participants including 541 graduate students and early career scientists from 86 nations, of which more than 300 scientists were from developing nations. The conference reviewed the latest progress in climate research and contributed to the "big-picture synthesis" of the current state of knowledge on climate variability and change. Particular emphasis was given to the need for science-based climate information at the regional level, key sectors of economies, and climate-related risk management.

Environmental/climate-related issues and concerns that the public and decision-makers are facing are complex and require a trans-disciplinary approach to address them. The conference identified the need for "symbiotic" relationships between providers and users of climate information to ensure that timely, accessible, and easy-to-understand climate information is developed and used effectively. There is also a need for training to develop the next generation of scientists and decision-makers to pursue and promote the use of actionable climate/environmental information.

The outcomes of the Conference will make a measurable scientific contribution to the Fifth Assessment Report (AR5) of the IPCC. The conference showcased the results of the Climate Model Intercomparison Project (CMIP5: http://cmip-pcmdi.llnl.gov/cmip5/) that provides a framework for climate change modelling research for the next five years and the basis for IPCC AR5.

There was also a session on the major historical observational analysis performed by USA, Europe and Japan that will be available to all scientists through WCRP coordinated activities. A major plenary session was also devoted to dialogue and discussion with the co-chairs of the IPCC fifth assessment to discuss how WCRP can continue to contribute to the process in a more effective manner. WCRP will take the recommendations of the OSC to UNFCCC's Subsidiary Body for Scientific and Technological Advice (SBSTA).

The outcomes of the conference will be published in a book containing the major science and technical papers presented during the OSC, together with an overall synthesis of presentations, discussions and recommendations.

CBA2011-03NSY-WCRP

PROJECT TITLE

WCRP Open Science Conference — Climate Research in Service to Society

PROJECT DURATION

1 year

APN FUNDING

US$ 60,000

PROJECT LEADERS

Dr. Ghassem R. Asrar
World Climate Research Programme
World Meteorological Organization
Geneva, Switzerland

Tel: +41 22 730 8246

Email: gasrar@wmo.int

Prof. Guoxiong Wu
LASG Institute of Atmospheric Physics
Chinese Academy of Science
Beijing, China

Tel. +86 10 8299 5266

Email: gxwu@lasg.iap.ac.cn

Website: http://ww.lasg.ac.cn/

CONFERENCE WEBSITE

http://conference2011.wcrp-climate.org/

CBA2011-04NSY-IHDP

IHDP Training Workshops on Asian Development Pathways in the Context of Transitions toward a Green Economy

Against a background of increasing intensity of economic growth, coupled with rapid population increase and unprecedented urbanization processes in developing Asia, IHDP recently organized a Training Workshop on "Asian Development Pathways in the context of transitions towards a "Green Economy". The workshop, which discussed one of the central themes of the human dimensions of Global Environmental Change (GEC), took place from 17–21 October, 2011 in Nanjing, China. At the centre of the event was the question of how to transform the basic economic sectors of Asian countries to be environmentally and economically sustainable.

The Green Economy is a much discussed solution to one of the biggest challenges of our time that is to achieve improvement in human wellbeing while, at the same time, respecting planetary boundaries. The United Nations Environment Programme (UNEP) defines the Green Economy as an economy that improves social equity, while significantly reducing environmental risks and ecological scarcities. A question often neglected, however, is to what extent fundamental societal shifts are a prerequisite for a Green Economy to successfully meet this challenge? Similarly, pathways toward such an economy remain ill-defined.

The Nanjing workshop utilized the "United Nations Conference on Sustainable Development" (UNCSD) to address these issues and provide a context for critical exploration of questions concerning human dimensions — that is, the social and economic dimensions — of a Green Economy. While "Green Economy within the Context of Sustainable Development and Poverty Reduction" is one of the major themes at UNCSD 2012, the concept of Green Economy was criticized by many countries as too vague during the run-up to the Conference. UNCSD 2012 provides an opportunity to combine a critical approach on the issue with a focus on policy-relevant solutions.

The workshop was held over a week and provided ample opportunity for interaction among participants, senior scholars and key policy experts. Each training day began with a series of lectures given by renowned scientists and experts in science-policy interaction. In the afternoons, participants were organized into working groups to address a particular aspect of the Green Economy. While participants came from various professional backgrounds including the scientific, public and private sector, the grant from the APN CAPaBLE Programme enabled young regional researchers in particular to take part. Accordingly, the workshop also made for a great example of regional capacity building with international outreach and integration of local stakeholders into existing international research and policy networks. Moreover, it helped to raise awareness in regard to the science-policy interface by including, on the one hand, the latest scientific findings and new ideas within the policy process and, on the other hand, by confronting participants with the demands of real-world policy-making.

During the workshop, participants identified goals such as equity, inclusiveness and compatibility with other important social and political values, while exploring which transitional pathways towards a Green Economy

are feasible or desirable in the context of rapidly developing Asian economies. They discussed important questions such as:

- Will societies need to alter their perception of economic and personal wellbeing for a Green Economy solution to work?
- If there are tradeoffs between biodiversity, ecosystem services, equity and human rights, what has priority?
- How can societies of varying levels of development integrate scientific expertise and concern on biodiversity and ecosystem services change into decision-making processes responsibly and systematically?

As a result of these investigations, the workshop did not only raise the participants' critical understanding of the human dimensions of GEC but also improved their capacity to conduct research on topics relevant for the development of the Asia-Pacific region. A key aspect of this workshop was to enhance personal networks between individual scientists and policy-makers who sought to locate common ground. Consequently, participants became more receptive to one another's position and ultimately identified mutually beneficial solutions to environmental challenges.

The results of this interaction will be exemplified in the policy-brief to be submitted to APN in 2012 and included in the Rio+20 policy process (via IHDP and its partners).

"The beauty of the workshop to me is the opportunity of working together in a team that has a mix of young professionals and policy-makers across Asia coming in and bridging new ideas and energies and contributing towards seeking new spaces for green economy policies and debates in the region.

Bibek Raj Kandel, Nepal

"The workshop was extremely enriching as it facilitated a multi-dimensional discourse on sustainable development in cognizance of the green economy issue. I appreciate that the workshop covered different perspectives, tools for analysis and disciplinal approaches. It was a great opportunity to also work with delegates in the group sessions, spawning potential research collaboration in the field. Overall, the workshop was organized and handled excellently.

Tina Clemente, Philippines

CBA2011-04NSY-IHDP

PROJECT TITLE

IHDP Training Workshops on Asian Development Pathways in the Context of Transitions toward a Green Economy

PROJECT DURATION

1 year

APN FUNDING

US$ 60,000

PROJECT LEADER

Dr. Anantha Duraiappah
IHDP Secretariat, UN Campus
Hermann-Ehlers-Str. 10, 53113
Bonn, Germany

Tel: +49 228 815 060 1

Email: duraiappah@ihdp.unu.edu

Website: www.ihdp.org

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

CBA2011-05NSY-SCHANG

National Dialogues on Adapting Biodiversity Management to Climate Change

In August 2011, the first of two National Dialogues on Adapting Biodiversity Management to Climate Change was held in Hanoi, Viet Nam, with plans underway to hold the second dialogue in Bhutan in March 2012. The dialogues are part of a larger project focussed on identifying ways to strengthen the legal, regulatory, and institutional systems governing biodiversity to more effectively adapt to climate change. The project seeks to bring together scientists, policy-makers and stakeholders to work together on incorporating adaptive management and the science around biodiversity protection into biodiversity law, policy and management.

Using two key texts — a 130-page resource manual on “Legal and Policy Tools to Adapt Biodiversity Management to Climate Change” and a policy-maker’s guide on “Strategic Options for Adapting Biodiversity Management to Climate Change,” the National Dialogue engaged participants in discussions about climate change impacts and adaptation needs in Viet Nam. It included presentations on climate change impacts on biodiversity, an introduction to the concepts of adaptation and adaptive management, an overview of Viet Nam’s current legal and policy framework governing biodiversity, and a discussion of legal and regulatory options for promoting adaptive resource management.

The workshop was composed of scientists, policy-makers, and officials from Viet Nam’s Ministry of Justice, Ministry of Environment and Natural Resources, Ministry of Agriculture and Rural Development, Hanoi Law University, the Centre for Environment Research, Education and Development, and other governmental and non-governmental organizations. Discussions focussed on the fact that Viet Nam will be preparing several biodiversity-related action plans over the next five years. With amendments also planned for the country’s Law on Biodiversity, there is a valuable opportunity to capitalize on these openings to incorporate climate change adaptation into legal frameworks that govern biodiversity. The workshop participants will continue to discuss these opportunities and brainstorm next steps

in the coming months, through use of a listserv to maintain group dialogue, as well as a matrix to help participants rank and prioritize the different biodiversity adaptation needs that were identified during the discussions, as a precursor to the development of strategies and an action plan for addressing these needs.

The workshop also included five participants from Bhutan's National Environment Commission, the Royal Society for the Protection of Nature, and the Bhutanese Parliament, who discussed their own experiences in climate change adaptation in Bhutan. These participants will help plan the second National Dialogue in March 2012 in Bhutan, which will include a delegation of five Vietnamese participants. The exchange of participants between Bhutan and Viet Nam will strengthen regional cooperation on climate change, adaptation and biodiversity protection.

This project is part of a larger initiative with partner countries in Asia, Africa, and Latin America to build an international network of professionals working to ensure that biodiversity management can adapt to the challenges of a changing climate. This initiative is funded by the MacArthur Foundation.

CBA2011-05NSY-SCHANG

PROJECT TITLE

National Dialogues on Adapting Biodiversity Management to Climate Change

COUNTRIES INVOLVED

Bhutan, Viet Nam, USA

APN FUNDING

US$ 40,000

PROJECT LEADERS

Dr. Scott Schang
Vice President, Climate & Sustainability
Environmental Law Institute (ELI)
Washington DC 20036 USA

Tel: +1 202 939 3865

Email: schang@eli.org

Lisa Goldman
Senior Attorney
Environmental Law Institute
2000 L Street NW, Suite 620
Washington, DC 20036

Tel: +1 202 939 3863

Website: www.eli.org

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

CBA2011-06NSY-LOICZ

Young LOICZ Forum (YLF) 2011 — Enhancing Capacities for Global Change Mitigation in Asia-Pacific Coastal Zones

From 8–15 September, 2011, the Young LOICZ Forum (YLF) — "Enhancing Capacities for Global Change Mitigation in Asia-Pacific Coastal Zones" was organized by LOICZ and its East Asia Office in Yantai, China, with full financial support from the APN. This was also a special event at the LOICZ Open Science Conference (OSC) on "Capacity Building in the Asia-Pacific Region: Coastal Systems, Global Change and Sustainability," from 12–15 September, 2011, in Yantai.

Twenty-six participants, representing young scientists and coastal managers from 21 countries participated in a one-week training workshop on scientific techniques and soft skills, building strategic capacities for sustainable coastal zone management in the Asia-Pacific region. Trainers were drawn from many institutions including the APN, ESSP, IHDP-Taipei, SCOR, SOLAS, SPRINGER, UNU-EHS, UNESCO-IOC and the Yantai local government authorities including the Muping Tourism Bureau, and the Rocheng Oceanic and Fishery Administration.

The design of the YLF took into account the fact that most young scientists and managers, particularly in developing countries, lack opportunities for direct interaction with international institutions, to access research networks and to obtain supervision from leading experts. With lectures, practical exercises, social activities, a field trip, and selected OSC sessions in a cross-disciplinary and multicultural learning environment, the YLF went far beyond traditional scientific training activities, and provided a unique learning opportunity for networking and acquiring transferable and soft skills. The participants had the opportunity to establish links and networks for their future research, to share their interdisciplinary knowledge and to develop a set of skills that are vital for their future careers.

Highlights

As an important component of the YLF, a two-day Proposal Development Training Workshop (PDTW) led by the APN provided an important opportunity for sharing knowledge on proposal development, submission, and the review and selection process. The workshop also increased awareness of the APN among the participants and their capacity to develop competitive proposals not only for APN's annual calls for proposals, but also for other funding agencies.

The most important capacity development outputs

are often the least tangible: The opportunity for participants to expose their own research and experiences to their international peers and the "trickle-down effect" and "global networking" that an event such as the YLF creates and fosters, is a very valuable step in capacity development. The launch of a Young LOICZ Alumni via the recently set-up fan page on Facebook will maintain close substantive ties among the participants themselves, with LOICZ, and between participating institutions. It also provides for the possibility to follow-up with specific surveys and monitor the effectiveness of the YLF in the career development of trainees.

A milestone of the YLF was the award ceremony during the LOICZ OSC dinner, in which four excellent young coastal scientists and managers were honoured for their outstanding performance and contribution to the Forum. For excellence achieved in the Young LOICZ Forum 2011, YLF Awards were presented to Elizabeth Shadwick (CSIRO, Australia), Guangzhe Jin (Hiroshima University, Japan), and Pronab Kumar Halder (Centre for Global Change, Bangladesh).

CBA2011-06NSY-LOICZ

PROJECT TITLE

Young LOICZ Forum (YLF) 2011 — Enhancing Capacities for Global Change Mitigation in Asia-Pacific Coastal Zones

PROJECT DURATION

1 year

APN FUNDING

US$ 30,000

PROJECT LEADER

Dr. Cheng Tang
Yantai Institute of Coastal Zone Research (YIC)
Chinese Academy of Sciences
Yantai, China

Tel: +86 535 210 9021

Email: ctang@yic.ac.cn

Website: http://www.yic.ac.cn

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

CBA2011-07NMY-ABAWI

Building Scientific Capacity in Seasonal Climate Forecasting (SCF) for Improved Risk Management Decisions in a Changing Climate

The Asia-Pacific region is highly vulnerable to the impacts of climate variability and change due to limited institutional capacity. Major limitations to developing effective adaptive capacity to a changing climate in the developing countries of Southeast Asia are: limited national capacity for climate monitoring and forecasting; low levels of awareness among decision-makers to the local and regional impacts of climate variability (e.g. ENSO); and lack of effective policy responses to climate variability and change. This APN-funded project aims to address some of these limitations through targeted training workshops in the use of Seasonal Climate Forecasts (SCF) for leading scientists within meteorological organizations and professionals involved in the agriculture and water sectors. The project also aims to raise awareness of climate variability and change impacts amongst policy-makers, researchers, government agencies and farming communities in Southeast Asia through direct dialogue and seminars. The project is being implemented in partnership with meteorological, hydrological and agricultural agencies in the Philippines, Indonesia and Bangladesh.

Initial in-country visits were conducted in the Philippines, Indonesia and Bangladesh from 10 August to 3 September, 2011 to meet with project collaborators and key government officials, as well as to deliver a series of seminars on climate risk management and the impact of climate variability and change on water, health, energy and agriculture. Over 150 people from various government agencies, universities and the public attended five seminars. From discussions with senior government officials it was apparent that consideration of climate information in planning and decision-making was growing. Attorney Edgar M. Chatto, the Governor of the Bohol Province, said "Climate variability and climate change is a real challenge for our province. We now incorporate climate variability and climate change projections in all aspects of our planning and environmental management issues." Discussion with other senior water managers and agricultural practitioners highlighted the importance of seasonal climate forecasts, particularly in predicting the onset and duration of the monsoon for water allocation, planting and harvesting decisions.

The visit also aimed at training key collaborators from the national meteorological agencies in the use of SCOPIC climate prediction software and obtaining climate datasets for a climate validation study. This study is a key objective of the project and aims to identify climate drivers that have most influence on rainfall patterns including regional extremes. Preliminary analysis of rainfall data using SCOPIC has shown that the El Niño Southern Oscillation (ENSO) has a strong impact on rainfall patterns including the onset date and the duration of monsoon seasons. Results from Indonesia showed that, on average, onset of the monsoon tends to be delayed by up to one month and have a shorter duration in El Niño years compared with La Niña years. Mr. M. A. Matin, the Director General of the Rural Academy Development Agency in Bangladesh, said, "These results, if applicable to rural situations in Bangladesh, could have significant financial benefits through changing of crop varieties at planting times and water

allocation decisions." Further analysis will be conducted during the first regional workshop scheduled from 10–15 January 2012 in Kuala Lumpur, Malaysia, to assess the impact of different climate drivers specific to each country.

In collaboration with the World Meteorological Organization Climate Information and Prediction Services (WMO-CLIPS) programme, several collaborators from Indonesia and the Philippines also attended a two week training workshop on "Operational Climate Prediction for Southeast Asia," in Bogor, Indonesia from 27 September to 7 October 2011, which provided a further opportunity for some of the project team to meet again. This workshop was also attended by meteorological agency staff from Myanmar, Lao PDR, Cambodia, Thailand, Malaysia, Viet Nam and Singapore. The programme included training in SCOPIC as well as the Climate Prediction Tool (CPT), general concepts in climate science, forecast verification, and communication and application of climate forecasts in different sectors. The information generated from this workshop will further enhance the scope of the study being carried out as part of the APN project.

CBA2011-07NMY-ABAWI

PROJECT TITLE

Building Scientific Capacity in Seasonal Climate Forecasting (SCF) for Improved Risk Management Decisions in a Changing Climate

COUNTRIES INVOLVED

Bangladesh, Indonesia, Philippines

PROJECT DURATION

2 years

APN FUNDING

US$ 70,000

PROJECT LEADER

Prof. Yahya Abawi
National Climate Centre
Australian Bureau of Meteorology
Melborune, Australia

Tel: + 61 7 429 550 772

Email: y.abawi@bom.gov.au

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

APN

CBA2011-08NSY-BAKER

Towards Engagement in the United Nations Regular Process for Global Assessment of the Marine Environment: Strengthening Capacity of Developing Countries in the Seas of East Asia

Oceans cover 71% of the Earth's surface and provide multiple economic and social benefits. Despite our obvious dependence on healthy oceans, they are being degraded and continue to be threatened by many factors. The 2002 World Summit on Sustainable Development (WSSD) recommended the establishment of a process to regularly access the state of the marine environment. In 2009, the UN General Assembly endorsed the objectives, scope, and principles of the "Regular Process" and the production of the first integrated global assessment by 2014. It is hoped that the Regular Process will provide information to better understand the status and trends in ecosystem conditions; the vulnerability, resilience and adaptability of these ecosystems; and the goods, services and non-use values they provide to humans.

Prior to the establishment of the Regular Process of Assessment, the UN General Assembly initiated a start up phase — an Assessment of the Assessments (UNEP, IOC-UNESCO, 2009). This was requested by governments in order to provide a foundation for the development of the process. The results of this study illustrated that in the region of the East Asia Seas there are significant gaps in the scope and coverage of existing assessments (Table 1). The report found that there is a wealth of information but this has not been not translated into integrated assessments that provide an overview, especially in

Table 3.1a: **Gap analysis of the coverage of ecosystem properties in regional marine assessments**

	Water Quality	Living Marine Resources	Habitat Characterizations and Impacts	Lower Trophic levels in the Food Web	Protected Species	Social and Economic Conditions
Southern Ocean	some	extensive	some	extensive	extensive	some
Arctic Ocean	extensive	good	some	good	good	good
Baltic Sea	extensive	extensive	good	extensive	extensive	good
Black Sea	some	good	some	some	some	some
East Asian Seas	good	some	good	some	some	some
Eastern African Seas	some	some	some	some	some	some
Mediterranean Sea	extensive	extensive	good	good	good	some
North Central Pacific Ocean	some	extensive	extensive	good	good	good
North East Atlantic Ocean	extensive	extensive	good	extensive	extensive	good
North East Pacific Ocean	extensive	extensive	good	extensive	extensive	good
North West Atlantic Ocean	extensive	extensive	good	extensive	extensive	good
North West Pacific Ocean	good	good	good	some	good	some
Red Sea and Gulf of Aden	some	some	some	some	unknown	some
ROPME/RECOFI Area	good	some	some	some	some	some
South Asian Seas	some	some	some	good	good	some
South East Pacific Ocean	some	good	some	some	unknown	some
Southern Indian Ocean	some	good	good	good	good	good
Southern Pacific Ocean	some	some	good	none	some	some
South West Atlantic Ocean	some	some	some	some	good	good
Western African Seas	some	some	some	some	some	some
Wider Caribbean Region	good	good	good	some	good	good

extensive; good; some; none; unknown

Table 1. Table from the Assessment of the Assessment report showing the comparison between assessments available for the East Asia Seas in relationship to other locations (UNEP, IOC-UNESCO, 2009)

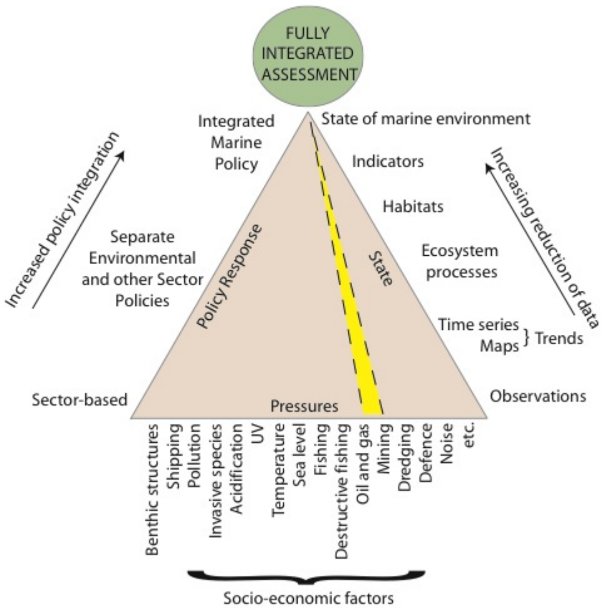


Figure 1. Development of an integrated marine assessment—the relationships between anthropogenic pressures on the marine environment, state, and policy response (Baker and Harris, 2012)

areas such as the link between the state of the marine environment and cross-cutting issues of human health, seafood safety and sustainable fisheries.

The present APN-funded project builds on national and regional efforts (Regional Seas Conventions and Action Plans — COBSEA and NOWPAP) to implement capacity building to improve marine assessments and develop integrated assessments for the region (Figure 1). The first of a planned series of workshops will be held in China in late February 2012 and will focus on outlining reporting requirements, report structure, and timeframe for the first assessment; and strengthening capacity to access and make use of existing scientific data to undertake national assessments and contribute to the global assessment processes.

References

UNEP, IOC-UNESCO. 2009. An Assessment of Assessments, findings of the Group of Experts. Start-up phase of the Regular Process for Global Reporting and Assessment of the State of the Marine Environment including Socio-economic aspects. UNEP and IOC/UNESCO, Malta. (http://www.unga-regular-process.org/index.php?option=com_content&task=view&id=18&Itemid=20).

Baker, E.K., Harris, P.T. 2012. Ch. 2 Habitat Mapping and Marine Management. *In:* Harris, P.T., Baker, E.K. (Eds). Seafloor Geomorphology as Benthic Habitat: GeoHab Atlas of seafloor geomorphic features and benthic habitats. Elsevier, Amsterdam, pp 22–38.

CBA2011-08NSY-BAKER

PROJECT TITLE

Towards Engagement in the United Nations Regular Process for Global Assessment of the Marine Environment: Strengthening Capacity of Developing Countries in the Seas of East Asia

PROJECT DURATION

1 year

APN FUNDING

US$ 40,000

PROJECT LEADER

Dr. Elaine Baker
UNEP GRID-Arendal
The University of Sydney
Australia

Tel: +61 2 9351 3000

Email: elaine.baker@sydney.edu.au

CBA2011-09NSY-ALIGAEN

Climate Change Integrated Education Model: Building Adaptive Capacity for the Next Generation (Malaysia, Indonesia, Philippines, Thailand and Lao PDR)

Due to the worsening condition of the environment, economic productivity and social infrastructure are affected as a result of climate change and other related factors which are directly and indirectly credited to human activities. If the awareness level of these issues remains low and if holistic action cannot be taken appropriately then it is possible to head towards an irreversible direction of environmental disaster. Education is still the most powerful tool to initiate change as well as transform and empower communities (especially youth). As such, this project aims to integrate climate change issues across learning areas to inform and educate today's youth to be responsible in managing their future environment. To achieve this goal, there is a necessity to integrate climate change into the education curriculum. In the present project, utilizing a train-the-trainers approach, the main trainees are secondary school teachers (science, math, english, history and economics) with 2 or 3 curriculum development experts per country per workshop and students directly involved with the teachers.

Project implementation began as scheduled for Thailand and Lao PDR; however for the Philippines, due to internal reshuffling of Officers in the District, the National Office of the Department of Education decided to change the location, resulting in some delay.

To date, three orientation workshops have been conducted:

- **Samut Prakan, Thailand (25–26 August, 2011)**
  - 23-Teachers
  - 4-Officers of the Institute for Promotion of Teaching Science and Technology
  - *(27-Total Number of Participants)*
- **Iloilo, Philippines (2–3 September, 2011)**
  - 28-Teachers
  - 4-School Principals
  - 8-Subject Area Supervisors
  - 1-Assistant Division Superintend (ASDS)
  - *(41-Total Number of Participants)*
- **Vientiane, Lao PDR (29–30 September, 2011)**
  - 20-Teachers
  - 4-Curriculum Officers
  - 3-Officers, Ministry of Education
  - *(27-Total Number of Participants)*

The orientation workshops covered the following topics:

1. Climate change issues as central focus for the "Climate Change Integrated Education Model";
2. Presentation of weather instruments: How to use them and how to integrate them into mainstream learning systems;
3. Concept and framework for Socio-Scientific Issues (SSI): Process and Socio-Scientific Framework;
4. Workshop that implemented the SSI framework to prepare climate change-integrated education projects at school or within a community; and
5. Presentation of outputs: Critiquing, revising and finalizing

As reflected in the work and financial plan of the project, the target number of participants per country was 25, yet we exceeded this figure by 20% for all 3 countries (Thailand, Philippines and Lao PDR) with the same budget.

CBA2011-09NSY-ALIGAEN

PROJECT TITLE

Climate Change Integrated Education Model: Building Adaptive Capacity for the Next Generation (Malaysia, Indonesia, Thailand, Philippines and Lao PDR)

APN FUNDING

US$ 40,000

PROJECT LEADER

Julito C. Aligaen
Southeast Asian Ministers of Education Organization Regional Education Centre for Science and Math (SEAMEO RECSAM), Malaysia

Tel: +60 4 652 2700

Email: juli_aligaen@recsam.edu.my

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

CBA2011-11NSY-TIENHAARA

Workshop on Climate Change Governance in the Asia-Pacific Region: Agency, Accountability and Adaptiveness

Organized by the Climate and Environmental Governance Network (www.cegnet.anu.edu.au) and the Earth System Governance Project (www.earthsystemgovernance.org); the March 2012 workshop is primarily aimed at building the capacity of early career researchers in the Asia-Pacific region to contribute to academic and policy debates about the development of efficient, equitable and accountable governance to respond to climate change. The workshop will also serve as an important networking opportunity and platform to initiate and combine momentum for new research on responses to climate change and earth system governance. It is anticipated that this workshop will lead to further collaborations and future events within the region.

Workshop aims:

- To bring together early career researchers (late-stage PhDs and academics that completed their PhD no more than 5 years ago) from the Asia-Pacific Region to discuss the challenges of climate governance;
- To connect senior researchers and eminent scholars based in Australia with early career researchers in the wider region; and
- To produce an edited volume addressing the key themes of the workshop.

In June 2011 we received confirmation of some additional funding from the College of Asia and Pacific, ANU. This funding will be used to assist Australian-based participants with travel and accommodation costs and will also pay for a fieldtrip to a wind-farm. In August 2011, a call for applications was posted on the APN and Earth System Governance websites and other appropriate forums. Over 80 applications from Australia and the Asia-Pacific region were received. These applications were reviewed by a selection committee and 18 participants have been selected for the workshop, the results of which will be delivered to the APN in due course.

CBA2011-11NSY-TIENHAARA

PROJECT TITLE

Climate Change Governance in the Asia-Pacific Region: Agency, Accountability and Adaptiveness

PROJECT DURATION

1 year

APN FUNDING

US$ 32,000

PROJECT LEADERS

Dr. Kyla Tienhaara
Regulatory Institutions Network
College of Asia & the Pacific
Australian National University, Australia

Email:
Kyla.Tienhaara@anu.edu.au

Mr. Ruben Zondervan
Executive Director
Earth System Governance Project
Lund University
P.O. Box 170
SE-221 00 Lund, Sweden

Tel: +46 46 222 0478

Email:
ipo@earthsystemgovernance.org

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

APN

CBA2011-12NMY-HASSON

Capacity Building in Advanced Remote Sensing (RS) & Geographic Information System (GIS) Techniques for Studying Snow & Ice Dynamics in Hindu Kush-Karakoram-Himalaya (HKH) Region

The Global Change Impact Studies Centre (GCISC), based in Islamabad, Pakistan was fortunate to have been selected as one of the funding recipients under the APN's CAPaBLE programme in 2011. The project entitled "Capacity Building in Advanced Remote Sensing (RS) & Geographic Information System (GIS) Techniques for Studying Snow & Ice Dynamics in Hindu Kush-Karakoram-Himalaya (HKH) Region" is promoting collaboration among relevant institutions in the Himalayan countries of China, Nepal and Pakistan; namely the State Key Laboratory of Cryospheric Sciences, CAREERI- CAS (China), the Institute of Development and Innovation (IDI), Kathmandu, Nepal, Kathmandu University, Kathmandu, Nepal, and National Institutions in Pakistan — the Pakistan Meteorological Department (PMD), Water and Power Development Authority (WAPDA), Pakistan Space and Upper Atmospheric Research Corporation (SUPARCO), Institute of Geographical Information Science (IGIS), National University of Science and Technology (NUST), Department of Meteorology, CIIT Islamabad, and the National Agriculture Research Council (NARC).

The present 2-year project aims to build the capacity of all the above mentioned participating institutions in advanced techniques of RS and GIS to monitor snow coverage and glaciers in the Himalayas and will initiate efforts to promote awareness regarding the need to monitor this crucial water resource with a high degree of accuracy and automation thus paving the way for strong future collaboration among the participating institutions themselves.

The initial accomplishments of the project are as follows:

a) Initialization of a Memorandum of Understanding (MoU) between all participating institutions in Pakistan to carry out collaborative research work that monitors snow and glacier resources in the Himalayas; and share data and relevant expertise to meet the project objectives. The MoU will help support the continuous work needed to expand project activities. At a later stage, efforts will be made to initiate regional MoUs between partners in Pakistan, China and Nepal.
b) Data availability and collection: Data for the first capacity building workshop was identified and collected from Global Land Ice Measurement from Space (GLIMS) Team, University of Nebraska, USA, and online data archives. Data includes ASTER (raw and processed scenes), Landsat (TM, ETM+) scenes, ASTER GDEM V2 (30 m resolution), Topographic Map and a small meteorological

dataset within the Hunza River Basin — a highly glacierized basin in western Karakoram, Pakistan. Study basins in China and Nepal will be finalized in the first inception/training workshop.

c) Capacity Building Workshop: The first two-week Inception/Training workshop was expected to be held from the 21 November to 2 December, 2011. However, unexpected visa delays were encountered and the workshop was postponed until early 2012.

By June 2013, expected outcomes of the project are to:

- Build/Enhance capacity of scientists in advanced RS & GIS techniques and algorithms for regional/country level analysis;
- Identify changes in snow and glacier extents and glacier lakes with respect to existing inventories and causal relations between climate, past glaciations, present glaciations, and future changes;
- Identify/define linkages between glacier melts and downstream meltwater discharge in the HKH Rivers,
- Record information on ice distribution, mass-balance gradients, regional mass-balance trend and landscape factors;
- Strengthen regional scientific linkages amongst scientists in South Asia and China;
- Increase awareness of policy-makers in this field of research and in applying adequate management techniques to ensure the availability of national/regional water resources; and
- Publish a manual, review paper and guidelines on advanced RS & GIS techniques and their application, and provide comparisons with existing conventional techniques.

CBA2011-12NMY-HASSON

PROJECT TITLE

Capacity Building in Advanced Remote Sensing (RS) & Geographic Information System (GIS) Techniques for Studying Snow & Ice Dynamics in Hindu Kush-Karakoram-Himalaya (HKH) Region

PROJECT DURATION

2 years

APN FUNDING

US$ 90,000

PROJECT LEADER

Mr. Shabeh Ul Hasson
Global Change Impact Studies Centre
Islamabad, Pakistan

Email: shabeh.hasson@gcisc.org.pk

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

CBA2011-13NSY-TOLENTINO

Institutionalizing Agroforestry as a Climate Change Adaptation Strategy through Local Capacity and Policy Development in Southeast Asia

The present project promotes collaboration among member countries of the Southeast Asian Network for Agroforestry Education (SEANAFE), namely: Thailand, Indonesia, Malaysia, Lao PDR, Philippines, and Viet Nam. This one-year project is implementing activities that will sustain initial efforts of the agroforestry networks to promote agroforestry as a climate change adaptation strategy and pave the way for institutionalization of agroforestry as a development strategy in Southeast Asia.

The project has three major components:

1. Conduct policy dialogues in agroforestry in Viet Nam, Philippines and Lao PDR: The policy dialogue brought together different agroforestry stakeholders, including implementers of agroforestry-related policies, to deliberate on key issues and policy options towards the institutionalization of agroforestry in the different country networks. In the Philippines, the policy dialogue yielded a draft Executive Order to establish a National Agroforestry Development Programme. The policy brief, an output of the First Phase of this project, served as one of the references for the policy dialogue.
2. Document different climate change adaptation strategies among selected upland farmers in Southeast Asia: This project component is an on-going activity of the four country networks. This project component aims to analyze the perceptions of upland farmers regards climate change, including the effect of climate change on their agroforestry production systems and their coping mechanisms to address climate change impacts.
3. National training on climate change adaptation strategy: This activity aims to teach local agricultural technicians and junior scientists about climate change, including the different mitigation and adaptation strategies so that they can impart information to their respective farmer-clients. Viet Nam and Indonesia will conduct training workshops in December 2011, while the Philippines will conduct a national training workshop in March 2012.

CBA2011-13NSY-TOLENTINO

PROJECT TITLE

Institutionalizing Agroforestry as a Climate Change Adaptation Strategy through Local Capacity and Policy Development in Southeast Asia

COUNTRIES INVOLVED

Indonesia, Lao PDR, Malaysia, Thailand, Philippines, Viet Nam

PROJECT DURATION

1 year

APN FUNDING

US$ 35,000

PROJECT LEADER

Dr. Lutgarda Tolentino
Philippine Agroforestry Education and Research Network
Philippines

Tel: +63 49 536 2657

Email:
secretariat@pafern.org.ph

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

CBA2011-14NSY-NG

Water Safety from Source to Tap — Strategies and Implementation

Climate change leading to extreme drought, floods caused by excessive rainfall, and increasing sea level causing saltwater intrusion, are reducing the reliability of our natural water sources. These, together with an increasing global population, especially in developing countries such as Sri Lanka, are just some of the challenges faced by water supply authorities. As currently practiced in Singapore, a country with limited raw resources, integrating watershed management with energy and water-efficient treatment and reclamation technologies could provide a holistic approach to meeting these challenges and providing safe water through stringent water quality assessment.

There are numerous geographical and climatic similarities between Singapore and Sri Lanka, which are both island countries surrounded by seawater and subjected to hot and arid weather conditions. These are major factors for successful intra-regional technology transfer and possible adaptation of water management strategies including source water quality assessment to ensure safe water delivery. This project aims to achieve an exchange of ideas and translate sustainable strategies on water resource management between the two countries to meet an increasing water demand; and capacity development in terms of scientific knowledge and transfer of technologies for the delivery of safe water.

A four-day workshop was organized in Singapore from 19–22 September, 2011. The event was attended by 21 participants from Singapore: Environmental Engineering Society of Singapore, National University of Singapore, National Environment Agency, Public Utilities Board, Ngee Ann Polytechnic and Analytical

Figure 1. Hands-on training on the water pathogen detection technique

Figure 2. Technical visit to NEWater Visitor Centre

Figure 3. Participants at the 4-day workshop

Laboratories (S) Pte. Ltd.; and from Sri Lanka: National Water Supply and Drainage Board (NWSDB), University of Moratuwa, University of Peradeniya and Institute of Fundamental Studies. The workshop comprised a review on practices in water management, treatment and supply in Singapore and Sri Lanka; training on the development of a water safety plan; hands-on training on emerging contaminants detection and water quality assessment; and technical visits to a water treatment facility and the NEWater Visitor Centre.

The information and capability developed from the workshop in Singapore will be disseminated through in-house training within academia and NWSDB in Sri Lanka. This workshop also provided a preliminary framework to develop a more comprehensive water safety plan using one of the local water treatment plants in Sri Lanka as a pilot case study in the project.

CBA2011-14NSY-NG

PROJECT TITLE

Water Safety from Source to Tap — Strategies and Implementation

PROJECT DURATION

1 year

APN FUNDING

US$ 30,000

PROJECT LEADER

Assoc. Prof. How Yong Ng
Centre for Water Research
Division of Environmental Science and Engineering
National University of Singapore
Singapore

Tel: +65 6516 4777

Email: ceenghy@nus.edu.sg

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

CBA2011-15NSY-WAGAN

Capacity Enhancement of Local Experts from State Universities and Colleges in Assessing Climate Change Vulnerability and Adaptive Capacity of Crop-based Farming Systems in Various Agro-ecological Settings

This project was conceptualized in an attempt to define the role of agricultural systems experts over the global concern on climate change. The project aims to provide a venue where agriculture experts from state universities and colleges, national and international climate change experts, the farming community, and local planners/policy-makers may interact to come up with a community-based vulnerability and adaptation assessment tool to create results that can serve as a basis for developing and prioritizing site-specific and appropriate adaptation measures for agriculture.

Hence, the project will involve a series of activities:

- Interaction and networking among national and international experts that may serve as an avenue for long term and future collaboration;
- Sensitization course designed for local experts from State Universities and Colleges (SUCs);
- Collaborators training-workshop on a vulnerability and assessment tool for specific farming systems;
- Field work on vulnerability and adaptive capacity assessment of crop-based farming systems in selected regions;
- Consultation-workshop on the results of the assessment and finalization of recommendations; and
- Information dissemination.

Initial progress of the project involved a series of project team workshops in August and September, 2011 and an exploratory meeting and interaction with researchers from various institutions in Thailand with projects on climate change in October 2011. The experiences shared are important inputs to the future activities of the project.

Further, a community based vulnerability and adaptation capacity assessment tool called VAST-Agro is being conceptualized and developed at the Agricultural Systems Cluster (ASC) of the University of the Philippines Los Baños (UPLB). This was tested in the field for refinement in November 2011 in one of the municipalities

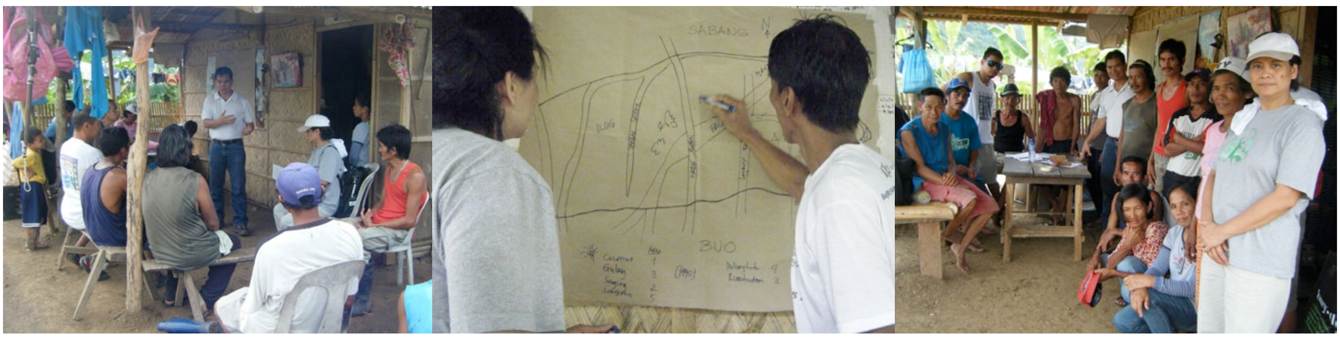


Figure 1. Field test of the VAST-Agro Tool in a farming community

Figure 2. Presentation of VAST-Agro Tool at the launching of the ASC-UPLB Seminar Series

of Laguna province engaged in upland rice and vegetable production. The methodology of data collection and the determination of a vulnerability index for the upland agro-ecosystem using the VAST-agro tool, including some results from the pre-testing done earlier, were presented in a seminar series on climate change adaptation and launched on 8 December, 2011 at ASC, UPLB.

At the time of writing, preparations are underway for a sensitization course on "Adaptation Strategies for Enhancing Resilience to Climate Change of Different Agro-ecosystems," to be held in collaboration with SEARCA, Los Baños, Laguna and the Office of the Dean of the College of Agriculture, UPLB from 16–17 January, 2012. Twelve faculty members/researchers from selected SUCs and other invited representatives of local government agencies will participate in the course. After the sensitization course, a 5-day training workshop (21–26 January, 2012) on the utility of the VAST-Agro Tool for 12 staff from the SUCs follows. The participants are expected to use the tool to assess different crop-based farming systems in their areas of responsibility.

CBA2011-15NSY-WAGAN

PROJECT TITLE

Capacity Enhancement of Local Experts from State Universities and Colleges in Assessing Climate Change Vulnerability and Adaptive Capacity of Crop-based Farming Systems in Various Agro-ecological Settings

COUNTRIES INVOLVED

Indonesia, Philippines, Thailand

PROJECT DURATION

1 year

APN FUNDING

US$ 37,000

PROJECT LEADER

Dr. Amparo M. Wagan
FSSRI-Agricultural Systems Cluster
College of Agriculture, UPLB
Philippines

Tel: +63 49 536 2459

Email: amwagan@uplb.edu.ph

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

CBA2011-16NSY-LI

Demonstration Study on Advancing Global Change Research Approaches Based on Interagency Collaboration and Data Infrastructure of GENESI and GeoBrain

The potential cost reductions for data searching, accessing and processing in Global Change Research (GCR) can greatly benefit scientists. New GCR approaches have been made possible as a result of the evolution of data infrastructure under the GEOSS framework. Following the last APN project in 2009 on the introduction of such new data facilities and processes in Mongolia, the present activity will focus on live demonstrations and study approaches from the rebuilding of some typical GCR study cases (lake-ice changing in China Tibet, flood monitoring in Southeast Asia).

This project will focus on live demonstrations and study approaches using some typical GCR case studies, such as long-term lake ice-cover changes in the Tibetan area and fast flood tracking in Southeast Asia. The inter-agency collaboration data infrastructure of GENESI-DEC (Ground European Network for Earth Science Interoperations, Digital Earth Communities) and GeoBrain will be used to provide scientific data.

The proposed technology transfer project will cover several activities:

- One training workshop for the two case study teams and other scientists, decision-makers and young professional students, will be held in Beijing in 2012. Team members from both GENESI-DEC and GeoBrain will give lectures and hands-on training to local experts and help them to modify their research methods, including access to internationally available data and computing resources.
- A second meeting is planned in Thailand to clarify the implementation plan to improve the two case studies. Technical support teams from GENESI-DEC and GeoBrain will be invited to visit two institutes (in China Tibet and Thailand) in 2012 to assist in the implementation of new data management methods.

As part of the work conducted to date, we coordinated with ESA to monitor recent flooding events (2011) in Thailand via Earth Observations. Major flooding occurred during the monsoon season in Thailand and the event was monitored by CEODE, China and ESA. Optical and ASAR were used together to monitor the flood area. The flood algorithms and automatic collaborative computing platform was used to monitor the flood inundation area for flood mitigation in Thailand. The monitoring data was sent to a Thai agency for flood mitigation (Figure 1).

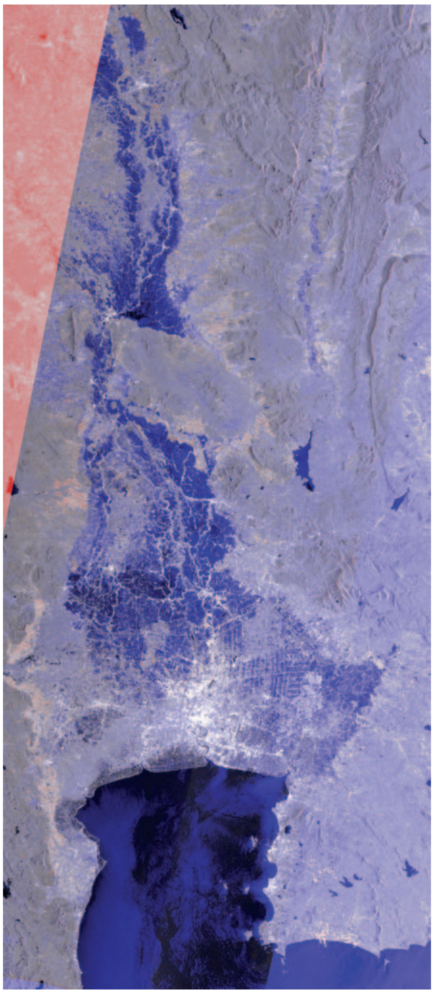


Figure 1. 2011 Thailand Flood monitoring results from ASAR data by ESA

CBA2011-16NSY-LI

PROJECT TITLE

Demonstration Study on Advancing Global Change Research Approaches Based on Interagency Collaboration and Data Infrastructure of GENESI and GeoBrain

PROJECT DURATION

1 year

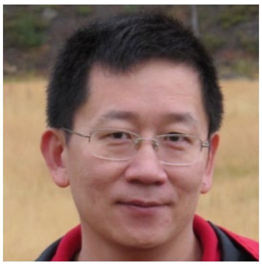
APN FUNDING

US$ 40,000

PROJECT LEADER

Prof. Guoqing Li
The Centre for Earth Observation and Digital Earth
Beijing, China

Email: gqli@ceode.ac.cn



APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

APN

CBA2011-16NSG-DEVY

Scoping Workshop to Develop an APN Proposal on "Building Partnerships for Developing a South Asian Canopy Science Research Programme"

Forest canopies are the interface between forests and the atmosphere. Many important forest–atmosphere interactions such as photosynthesis, respiration, carbon flux, and water and nutrient cycling mainly take place in this region. On a global level, we need to know how plant–atmosphere interactions are likely to be affected by a changing global process. Changes in plant–atmosphere interactions can have cascading effects on animals, which interact with plants as well as with the atmosphere. In recent times, such issues have gained momentum especially in the present context of global climate change. Canopy science provides important inter-disciplinary and large-scale research possibilities such as canopy–atmosphere interactions, structural and functional aspects of canopy on biodiversity, plant animal interaction, etc. Forest canopy research can also provide input to many global-level processes, such as climate change. However, there are few sites with intense studies and good infrastructure in the Asia region (Malaysia, Japan and Australia) and there is an urgent need to replicate these models in other regions to understand processes related to global change.

With the seed grant from APN, a workshop for building the capacity and facilitating exchange of knowledge from established sites to develop a programme in parts of South Asia is scheduled tentatively for August 2012. As a precursor to the workshop, we have identified researchers who have been working on various issues related to the canopy in the region and have compiled a semi-technical report. The report will enable us to identify major gaps in this important discipline and also areas that are under-represented geographically. We have identified 23 researchers who have contributed to the report on a range of topics, which include methods, biodiversity, canopy processes and functions, and ecosystem services and goods. In the following months, we hope to develop a research proposal that will address the gaps and be presented at the workshop for further input.

CBA2011-16NSG-DEVY

PROJECT TITLE

Building Partnerships for Developing a South Asian Canopy Science Research Programme

PROJECT DURATION

1 year

APN FUNDING

US$ 15,000 (Seed Grant for Proposal Development)

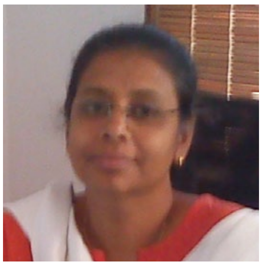
PROJECT LEADER

Dr. M. Soubadra Devy
Suri Sehgal Centre for Biodiversity and Conservation
Ashoka Trust for Research in Ecology and the Environment (ATREE), India

Tel: +91 80 2363 5555

Email: soubadra@atree.org

Website: www.atree.org/soubadra



APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

CBA2011-18NSY-PENALBA

Awareness Raising and Capacity Building on Alternative Water Management for Communal Irrigators' Associations in the Philippines

The Philippines incurs severe crop losses caused by water stress from drought and typhoon-induced flooding. Much of these losses could be avoided if effective water management practices were in place. Uptake of alternative adaptation measures to cope with irrigation-related problems depends on the knowledge and capability not only of individual farmers, but also of the irrigators' associations. Thus, this project aims to improve farmers' awareness and skills on alternative water management technology, climate forecast application, rice production systems, and social mobilization.

The project covers five Irrigators' Associations (IA) that operate Communal Irrigation Systems (CIS) in two provinces in central Philippines, which are highly vulnerable to extreme climate events. A CIS is a small-scale system which irrigates less than 1,000 hectares of land. The five IAs were selected based on a situational analysis of their individual rice production and water management practices, social mobilization schemes, farmers' knowledge on alternative technologies, experiences during extreme weather events, and other problems ranging from operational to institutional and policy issues.

Awareness raising and capacity building seminars that engaged the expertise of water management technologists and agronomists were conducted to bridge the gap between science-based water management techniques and farmers' practices. Seminar topics included: 1) Rice production and water use; 2) Water-saving technologies such as alternate wetting and drying, and aerobic rice; 3) Effective water management under different environmental conditions; and 4) Assessing the feasibility of alternative water sources.

The project plans to further develop the IAs' capability in assessing the vulnerability of their irrigation systems and utilizing the results in their water management and institutional development planning. These are the next target activities of the project.

Figure 1. Dr. Sta Cruz discussing the relation between leaf area and evapotranspiration during an awareness raising and capacity building seminar

Figure 2. A group picture with the members of Ilayang Binahaan, Pagbilao, Quezon

"I was surprised that the project team will actually come back and fulfill their promise that they will share with us new knowledge on alternative water management and go out of their way to seek assistance from other government offices to address our problems with dam siltation and dredging. Let us take advantage of their presence. Let us apply the knowledge that we have gained from this seminar and work together to improve the management and operation of our irrigation systems.

Mr. Aniceto Glodoveza, President of Brgy. Ilayang Binahaan Irrigator's Association

Figure 3. Mr. Cabangon discussing different alternative water management during the awareness raising and capacity building seminar held

CBA2011-18NSY-PENALBA

PROJECT TITLE

Awareness Raising and Capacity Building on Alternative Water Management for Communal Irrigators' Associations in the Philippines

PROJECT DURATION

1 year

APN FUNDING

US$ 30,000

PROJECT LEADER

Dr. Linda M. Peñalba
College of Public Affairs and Development
University of the Philippines Los Baños
Philippines

Tel: +63 49 536 3284

Email: lmpenalba@yahoo.com

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

CRP2010-02CMY-PEREIRA

Strengthening Capacity for Policy Research on Mainstreaming Adaptation to Climate Change in Agriculture and Water Sectors

Introduction

The present 3-year project was initiated in August 2009 to address the need to strengthen research capacity to provide policy-relevant information on adaptation as well as foster networking and communication among researchers and policy-makers focussing on adaptation. Ultimately it aims to support the mainstreaming of climate change adaptation concerns into agricultural and water policies and promote networking for adaptation policy research in the region. The Project will identify practical options for mainstreaming and metrics for monitoring the effectiveness of adaptation policies and measures, exchange of adaptation policy-relevant information through the adaptation research and policy network, as well as disseminate outputs beyond the project boundaries.

Work Progress

Research is progressing on barriers to mainstream climate change adaptation. Initial findings have been published in the Asian Journal on Environment and Disaster Management, Volume 2 Issue 4, on "Climate Change Adaptation: Perspectives in the Asia Pacific". The results attained, particularly on issues and challenges in adapting the agricultural and water sectors to climate change, were also shared in national activities including the UNFCCC Second National Communications of India, Malaysia, and Viet Nam.

In Malaysia, the concepts and criteria for developing climate change indicators have been completed. The menu of indicators has been identified and a policy framework has been developed to link impacts of climate change to national security. Aspects related to adaptive capacity, which is a vital component for successful adaptation responses to climate change have also been identified. A paper on the approach for characterizing the capacity of water institutions in adapting to climate change was prepared and presented in the LESTARI Postgraduate Colloquium, 2011. An assessment framework that comprises six criteria with a total of fifteen indicators is proposed for assessing adaptive capacity of water institutions in the context of climate change. The framework includes criteria on Adaptability and Flexibility comprised of two indicators: Continuous Improvement and Investment for Innovation. The project team has decided to adopt the Selangor River Basin, Malaysia, which is an important area for water resources management and food security, for the pilot study. Background information on the basin, i.e. history of its land use, demographics, socio-economic activities, is being collected using GIS. Arrangement is ongoing for local-level consultation on issues and priorities.

In India, field research was carried out in the state of Tamil Nadu covering five districts representing different agro-climatic zones to review the adaptation measures in practice and their effectiveness at the community level. Workshops and training programmes on "Community level climate risk management" were conducted for selected local government leaders. Having focussed on community perspectives during the first phase, the study would focus on understanding the implications of adaptation from the policy perspective, especially interacting with a variety of policy-makers and other stakeholders involved in implementing adaptation-related policy measures during the coming year. The approach would be to follow through selected policy measures and how they have performed as a policy option. A state-level consultation on adaptation-related policy issues is envisaged during the coming year.

In Japan, a consultation meeting was conducted in June 2011 on "Adaptive Policies and Measuring Mainstreaming Climate Change Adaptation into Institutional Processes: Some Experiences from Japan". The event was attended by several policy-makers and researchers in agriculture and water sectors. Various issues related to the nature of policy-making in Japan and their implications for climate change adaptation were discussed.

In Viet Nam, a questionnaire on the impacts of climate change on agriculture and water resources as well as adaptation strategy was delivered in conjunction with other related activities in the country. It aims to understand the impacts on agriculture and water sectors in case study areas of the Red and Mekong River Deltas. The findings will provide insight on key players for climate change adaptation strategies, barriers to adaptation activities and action to improve adaptation to climate change.

Network Development

Linkages have been established and intensively pursued with several of the active networks and institutions that have ongoing work on climate adaptation at the regional level. These include the Asia-Pacific Adaptation Network (APAN), Asian University Network for Environmental and Disaster Management (AUEDM), University Network for Climate and Ecosystems Change Adaptation Research (UN-CECAR), Orbicom — Network of UNESCO Chairs in Communication, Asian Institute of Technology (AIT), Nanyang Technology University and Kyoto University. It was decided that ARPNAP, constituting the APN Project Partners as a cohesive unit, would initially play an active role in APAN and AUEDM. The activities of the project will be shared with APAN at its upcoming steering committee meeting scheduled in March 2012 in Bangkok, Thailand. A similar plan is proposed for the upcoming AUEDM steering committee meeting.

Knowledge Dissemination and Publication

The fifth objective of the project is to disseminate project outcomes to the wider audience and enhance knowledge of adaptation in Asia through research-policy dialogues and project publications.

Selected Publications

Prabhakar, S.V.R.K., I. Yuuki, R. Shaw, J. Soulakova, T. Yukiko, and K. Takuji. 2012. Climate change implications for disaster risk management in Japan: A case study on perceptions of risk management personnel and communities in Saijo city. Journal of Environmental Hazards, DOI 10.1080/17477891.2011.618821.

Md. Azizul Baria, Rawshan Ara Begum, Abdul Hamid Jaafar, Raja Datuk Zaharaton Raja Zainal Abidin, Pereira, J.J. 2011. Water use by people function of their consumption pattern in Malaysia. Research paper in the National Symposium on Climate Change Adaptation, 16–17 November 2011, Putrajaya, Malaysia.

Norazura, B., Pereira, J.J. & Rawshan, A.B. 2011. Senario Luruan Ribut Dan Kawasan Terjejas Akibat Kenaikan Paras Air Laut: Kajian Kes Pelabuhan Klang. Research paper in the National Symposium on Climate Change Adaptation, 16–17 November 2011, Putrajaya, Malaysia.

Rasyidah Binti Abdul Karim, Pereira, J.J., Datin Halimaton Saadiah Hashim and Shaharuddin Idrus. 2011. Kenaikan Paras Air Laut: Implikasi Terhadap Kawasan Guna Tanah dan Alam Sekitar di Majlis Perbandaran Klang. Research paper in the National Symposium on Climate Change Adaptation, 16–17 November 2011, Putrajaya, Malaysia.

Chee Ping Ngang, Pereira, J.J., Datin Halimaton Saadiah Hashim. 2011. Spatial planning response to climate change: case study of the Selangor River Basin, Malaysia. Research paper in the National Symposium on Climate Change Adaptation, 16–17 November 2011, Putrajaya, Malaysia.

Mamunur Rashid, Rawshan Ara Begum, Pereira, J.J., Sarah Aziz and Mazlin Bin Mokhtar. 2011. Perspective on national security and adaptive capacity in the context of climate change in Malaysia. Research Paper in the National Symposium on Climate Change Adaptation, 16–17 November 2011, Putrajaya, Malaysia.

Pereira, J.J., Tan, C.T. and Komoo, I. 2010. Mainstreaming Climate Change Adaptation and Disaster Risk Reduction — A Malaysian Approach. *In:* Shaw, R., Pulhin, J. and Pereira, J.J. (Eds.) Climate Change Adaptation and Disaster Risk Reduction. Emerald Publishers, Bingley, U.K.

Pereira, J.J., Tan, C.T., Mazlin, M. and Sarah Aziz, A.G.A. (Eds.) 2010. Indicators for Climate Change and Sustainable Development. LESTARI Roundtable Dialogue No. 22, Institute for Environment and Development (LESTARI), Bangi. pp 47. ISBN 978-967-5227-34-9.

Tan, C.T., Pereira, J.J., Mazlin, M., Komoo, I. and Nadzri, Y. 2011. Adaptive capacity of water institutions to climate change: An assessment framework. LESTARI Postgraduate Colloquium 2011, Bangi, Malaysia, 21–23 November 2011.

Tan, C.T., Pereira, J.J., Mazlin, M., Komoo, I. and Nadzri, Y. 2010. Adaptive capacity to climate change: Concept and approaches for the water sector in Malaysia. Asian Journal of Environment and Disaster

Management, 2(4). Research Publishing Services, Singapore.
Tan, C.T. and Pereira, J.J. 2010. Climate change adaptation: An overview of Southeast and East Asia. Asian Journal of Environment and Disaster Management, 2(4). Research Publishing Services, Singapore.
IGES. 2011. Adaptation as a Problem of Decision-Making: Application of Multi-criteria Techniques. IGES Working Paper. Institute for Global Environmental Strategies, Hayama, Japan.
Prabhakar, S.V.R.K. 2011. Climate Change Impacts in Japan and Southeast Asia: Implications for Crop Adaptation. *In:* Crop Adaptation to Climate Change, First Edition. (Eds.) S. S. Yadav, R. J. Redden, J. L. Hatfield, H. Lotze-Campen and A. E. Hall. John Wiley & Sons, Ltd., Oxford, U.K.
Prabhakar, S.V.R.K., R. Mashimo, M. Aoki, I. Tsurita, and S. Hayashi. 2011. How adaptive policies are in Japan and can adaptive policies mean effective policies? Some Implications for Governing Climate Change Adaptation. In Proceedings of the 8th International NAPSIPAG Conference, 15–16 December 2011, Kathmandu, Nepal.
Prabhakar, S.V.R.K., H. Wright, I. Tsurita, L. Jones, M. Spearman, P. S. Villanueva, J. Ayers, C. Ehrhart, S. Hayashi, and T. Rossing. Monitoring and Evaluation of Progress in Adaptation to Climate Change: Advances, Challenges, and Way Forward. *In:* J. Ayers, S. Huq, H. Reed, and L. Schipper. Scaling up community-based adaptation. Earthscan Pub Ltd., London, U.K.
Takama, T., Prabhakar, S.V.R.K., D. Sano, and I. Tsurita. 2011. How Japan Can Contribute to Climate Change Adaptation in Developing Countries in the Asia-Pacific? A Focus on Agriculture and Water Sectors. IGES Working Paper. Institute for Global Environmental Strategies, Hayama, Japan.
Tsurita, I., S.V.R.K. Prabhakar and D. Sano. 2011. Does Japan need to think about adaptation within its own agriculture sector? A case study of initiatives in rice production. *In:* Proceedings of the 8th International NAPSIPAG Conference, 15–16 December 2011, Kathmandu, Nepal.
Nguyen, Van Thang. 2010. On the development of climate change scenarios for Viet Nam. *In:* Proceedings of the Fifth Conference of Asia Pacific Association of Hydrology and Water Resources. APHW Conference in Hanoi, Viet Nam. pp 147–152.
Nguyen, Van Thang. 2010. Assessments of climate change impacts on climate resources. Proceedings of the Fifth Conference of Asia Pacific Association of Hydrology and Water Resources. APHW Conference in Hanoi, Viet Nam, 8–9 November 2010. pp 255–260.
Nguyen, Van Thang. 2010. Methodologies for assessment of climate change impacts on agriculture. Scientific and Technical Hydro-Meteorological Journal, No. 589, pp 20–23. January, 2010.
Nguyen, Van Thang. 2010. Some results of climate change research in Viet Nam. Scientific and Technical Hydro-Meteorological Journal, No. 592, pp 1–8. April, 2010.
Nguyen, Van Thang. 2010. Assessments of climate change impacts on water resources. Scientific and Technical Hydro-Meteorological Journal, No. 594, pp 1–8. June, 2010.
Nguyen, Van Thang. 2010. Climate Change and its impacts in Viet Nam. Scientific and Technological Publishing House, Ha Noi, Viet Nam.
Nguyen, Van Thang. 2011. Guidance Book on Assessments of Climate Change Impacts and Determination of Adaptation Strategies. Viet Nam Publishing House of Natural Resources, Environment and Cartography, Ha Noi, Viet Nam.

CRP2010-02CMY-PEREIRA

PROJECT TITLE

Strengthening Capacity for Policy Research on Mainstreaming Adaptation to Climate Change in Agriculture and Water Sectors

PROJECT DURATION

3 years

APN FUNDING

US$ 210,000

COUNTRIES INVOLVED

India, Japan, Malaysia, Viet Nam

PROJECT LEADER

Dr. Joy Jacqueline Pereira
Institute for Environment and Development (LESTARI)
Universiti Kebangsaan Malaysia (UKM)
Malaysia

Tel: +60 3 8921 4153

Email: joy@ukm.my

EBLU PROJECTS 4

Focussed Activities:

Ecosystems, Biodiversity and Land Use (EBLU)

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

EBLU2010-01NSY(R)-SUNEETHA

Evaluation of Trade-offs Between Conservation and Development — Case of Land-use Change in Malaysia and Indonesia

Suneetha M. Subramanian[1], **Jamal Othman, S.R. Joeni, Heli Lu, Mastura Mahmud, Claudia Ituarte-Lima, Wendy Elliott**
[1]Corresponding Author
United Nations University, Institute for Advanced Studies (UNU-IAS), Yokohama, Japan.
Email: subramanian@ias.unu.edu

KEYWORDS: land-use change, forests, ecosystem, decision-support system, REDD+

Introduction

There is a need for optimum land-use management in tropical forest ecosystems in the light of increasing "carbon emissions" from deforestation (that is led by various land-use decisions). This means that compromises have to be reached between multiple stakeholder priorities; for instance, governments are interested in maximizing incomes, ensuring employment, augmenting environmental goals; whereas local communities are interested in ensuring their livelihoods, sacred areas, etc; and businesses are interested in exploiting natural habitats and resources suited for commercial purposes, and so on.

This project proposes to develop a Decision Support System (DSS) that will incorporate various biophysical and social parameters in arriving at land use options that may be useful for planners. Biophysical parameters would include indicators such as area of forest, type of forest, species richness, water regulation capacity/soil erosion. Data for this would be from records, remote sensing maps, etc. Social parameters would include indicators such as income from different forest-based activities (eg. plantations), energy security, livelihood security, rights to forests and resources of traditional dwellers (indigenous/local communities), cultural value, etc. Data would be from social surveys (notably participatory surveys), interviews with multiple stakeholders including decision-makers, NGOs, analysis of governance systems, etc. Both types of datasets would also give us additional information on policy processes and natural changes to ecosystems, which we could additionally analyze.

Methodology

We organized an inception workshop in Indonesia from 9–10 June, 2011 at the Indonesian Institute of Sciences (LIPI), Bogor, Indonesia, to define parameters that would be examined in the research and identify data and sources. Based on the discussions, team members initiated related field work in their respective constituencies. Dr. Othman is leading research in the Sibu area in Malaysia and Dr. Joeni in Pilang Pisau in the Kalimantan region of Indonesia as the areas for respective field work, both of which are situated in the island of Borneo. Dr. Lu

Heli has been engaged to work on integrating the remote sensing data and socio-economic data to build the DSS; and Dr. Ituarte-Lima is examining the legal dimensions of equity in REDD+ discussions in the countries. Data collection is ongoing and first impressions from the field are highlighted in the paper.

From the Field – Some impressions

Malaysia

Ground truthing and rapid social impact appraisals of the study areas in Sibu and Mukah districts in Sarawak, Malaysia clearly show links between infrastructural development, such as bridges and highways, and deforestation for oil palm expansion. Socio-economic variables, such as land tenure and labour availability from neighbouring Kalimantan (Indonesia), also add to the dynamics of forest conversion in Sarawak. Specifically, when land is alienated to private companies, including state-owned companies, a more pronounced expansion of oil palm areas from forest conversion is seen. On the other hand, oil palm cultivation among the natives is mainly in the form of scattered, disorganized, small farm holdings. There are also cases where the natives attempted to forge partnerships with private companies to develop Native Customary Rights (NCR) areas for oil palm development. Overall, while oil palm expansion has been able to generate new value-adding activities to the state economy, there is little indication that such developments have been instrumental in providing stable employment and hence, has resulted in impacts of poverty alleviation among the poor indigenous communities. There is also no certainty if oil palm expansion in the state, which affects the mainly biodiversity-rich and environmentally-sensitive peat land areas, would result in net economic benefits to the state and the country at large when the non-marketed benefits and costs are taken into consideration in the economic appraisals.

Indonesia

Central Kalimantan is the biggest province on the island of Kalimantan. Forests in Central Kalimantan are primarily peat swamp forest, with the peat depth varying from 2-12 m. Central Kalimantan faces land-use change problems due to an increase in rubber and oil palm plantations. Based on the plantation distribution data (2010), the total area of plantations was about 1.8 million ha, 70% and 25% of them were oil palm and rubber plantations, respectively.

In 1995, a million ha mega rice project was established in the peat swamp forest in Klampangan about 60 km from Palangkaraya (Capital City of Central Kalimantan Province). Biological and physical factors underwent change such as decreased biodiversity, decreased water level in the peat swamp forest, subsidence in the peat swamp forest, and frequent forest fires in this area. These are attributed to forest degradation and the establishment of canals for water irrigation in the project area (see picture of canals). The length of canals is about 4,470 km from Kahayan to Sebangau Rivers. Their establishment has decreased water levels, especially during the dry season. Therefore, the local government and university try to block the canals by using small dams. However, the establishment of dams to block water further affects water levels. About 16 years after the establishment of canals, a resettlement of people from the Klampangan village to the Sebangau river direction has been proposed (Figure 6). This will

Figure 1. Local community (Mukah district) selling agricultural produce at a roadside stall

Figure 2. Pulau—the green area with non-oil palm trees is known as "Pulau" or "island" literally, which refers to the graveyard of the ancestors, lying in the midst of a commercial oil palm area. The area used to be inhabited by natives. Area in Mukah district

Figure 3. Long House—a long house near Dalat, Selangau, in Sibu District. Area nearby is a vast stretch of privately-owned oil palm plantations

Figure 4. New oil palm plantations in Pilang Pisau district

Figure 5. Canoe transport (for transportation along the canal)

Figure 6. Resettlement along the canal

affect the ecosystem and biodiversity of the forests due to increased probability of forest fires and impact of human disturbance.

International Symposium

We co-organized an *"International Symposium on Costs and Benefits of REDD+: What, Who, How and When"* with Hiroshima University; Forest Research Institute Malaysia; the Ministry of Natural Resources and Environment, Malaysia; Forest and Forest Products Research Institute, Japan; and the Research Institute for Humanity and Nature, Japan; Kuala Lumpur, Malaysia from 19–20 September, 2011. The event was attended by about 125 participants comprised of researchers, policy-makers, international organizations, and practitioners from diverse backgrounds, including ecologists, foresters, economists, and political scientists.

Primarily drawn from the Asia-Pacific region, the presentations brought home the need for increased collaboration between various disciplines of researchers — it is imperative that those working on MRV (Measuring, Reporting and Verification) issues understand the complexities of governance and equity and conversely, those examining equity issues understand the reporting requirements for setting baselines for REDD+ related projects. This would also enable development of more comprehensive capacity building measures. The meeting concluded with an expression of intent to further collaborate among the different disciplines with a suggestion to establish an online platform that would facilitate such efforts.

Legal Dimensions of Equity

In Malaysia and Indonesia, equitable legal relationships between forest-dependent people with one or a combination of other REDD+ actors will not develop automatically. Instead, equitable environment-related legal negotiations and policies need to be actively fostered. In REDD+, this implies effective mechanisms to overcome power imbalances in negotiations and difficulties of forest-dependent people in complying with legal requirements. In the context of payment for ecosystem services, the research has aimed to further the understanding of how equity is or is not addressed in existing land use and climate legislation, especially those aspects related to the content of legal provisions concerning REDD+.

The UNFCCC and associated decisions have not spelled out the process for implementing the equity dimensions and social safeguards in REDD+ projects especially at the sub-national level. Hence, it has not been the location where the parameters of equity are being set in practice. In Indonesia, legal dimensions of REDD+ are being shaped, in practice, through REDD+ Ministerial Decrees, as well as by national and pre-existing legal instruments such as the Constitution and the Forest Law.

Analysis of the Indonesian REDD+ Decrees within a multi-dimensional equity framework reveals how these legal instruments provide specific guidance framing the implementation of REDD+ carbon projects in Indonesia such as articulating various REDD+ stakeholders and prescribing the distribution of benefits generated by carbon projects. Yet, the equity outcomes of the procedural and distributive rights that articulated in these Decrees depend on the broader contextual dimensions of equity such as rights to land, resources, and required legal status to engage in contractual negotiations.

Publications

Heli, Lu. 2011. Challenges of Proposed REDD+ Mechanisms on Carbon Stocks and Ecosystem-based and Social Benefits. UNU-IAS Working Paper No. 165: http://www.ias.unu.edu/sub_page.aspx?catID=7&ddlID=196.

Ituarte-Lima, C., McDermott, CL., (forthcoming).

Figure 7. Photos from the workshop "International Symposium on Costs and Benefits of REDD+: What, Who, How and When"

"Operationalising equity in national legal frameworks for REDD+: the case of Indonesia". For submission to Environmental Science and Policy Journal.

Ituarte-Lima, C., Subramanian, S. 2011. "Are there lessons for climate change legal negotiations from access and benefit sharing agreements?" *In:* Linkages between Climate Change and Biodiversity, Edward Elgar Publishing.

Presentations

Ituarte-Lima, C. and Subramanian, M.S. 2011. "Legal dimensions of equity in payment for ecosystem services," invited speaker at the Oxford Centre of Tropical Forests, University of Oxford, 17 June 2011.

Ituarte-Lima, C. and Subramanian, M.S. 2011. "Are there lessons for climate change legal negotiations from access and benefit sharing agreements?" *In:* the Seminar Climate Change Legal Negotiations: Implications for Forest Governance, Equity and Livelihoods, United Nations University – Institute of Advanced Studies, Yokohama, Japan, 9 March, 2011. The video of the presentation can be found at http://www.ias.unu.edu/sub_page.aspx?catID=159&ddlID=737.

Suneetha, M.S., Jamal Othman, Heli Lu, Joeni Rahajoe and Mastura Mohammed. 2011. "Integrated Planning Tool for Effective Monitoring and Implementation of REDD Plus," at the International Symposium on Costs and Benefits of REDD+: What, Who, How and When, Kuala Lumpur, Malaysia, 19–20 September, 2011.

EBLU2010-01NSY(R)-SUNEETHA

PROJECT TITLE

Evaluation of Trade-offs Between Conservation and Development — Case of Land-use Change in Malaysia and Indonesia

COUNTRIES INVOLVED

Indonesia, Japan, Malaysia

PROJECT DURATION

1 year

APN FUNDING

US$ 37,000

PROJECT LEADER

Dr. M.S. Suneetha
United Nations University
Institute for Advanced Studies
Yokohama, Japan

Tel: +81 45 221 2300

Email: Subramanian@ias.unu.edu

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

EBLU2010-02NMY(R)-TAKEUCHI

Forest Carbon Stocks in Shifting Cultivation of Thailand and Lao PDR

The new global initiative for reduction of deforestation and degradation, including the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks, or REDD+, has substantial potential to deliver co-benefits for carbon sequestration, forest and biodiversity conservation, and local livelihoods. Successful REDD+ strategies require integrating and complementing traditional forest management and agro-forestry practices of many local and indigenous communities, rather than enforcing a barrier between them and their forests, as many forest conservation policies seek to do.

Traditional shifting of cultivation often practiced in the tropical forests integrates a short cropping phase and a long forest fallowing phase in rotation. In the cropping phase, many cereals, root crops and vegetables are cultivated to ensure a balanced diet for shifting cultivators. Soil seed bank and tree stumps are conserved through zero tillage to facilitate subsequent forest regeneration. In the fallowing phase, forests not only produce various forest products, but also contribute nutrient inputs to soil through uptake from deep soil horizons and nitrogen fixation, sequester carbon, control weeds, and check soil erosion for the succeeding cropping phase (keep soil erosion in check for the coming cropping phase). Shifting cultivation is under increasing pressure to shorten its forest fallowing phase and switch to other land uses with implications on local livelihoods, carbon sequestration and biodiversity.

The APN-supported project, "Critical Analysis of Effectiveness of REDD+ for Forest Communities and Shifting Cultivation, based on Lessons Learnt from Conservation Efforts in Lao PDR and Thailand," under UN University in partnership with National Agriculture and Forest Research Institutes (NAFRI), Lao PDR, and Chiang Mai University (CMU), Thailand, was launched in January 2011 to assess potential and options for shifting cultivators to build on traditional knowledge and achieve co-benefits from REDD+ in the forested landscape. According to the work plan, the project focussed on surveys of land uses and carbon stocks in two study villages in 2011, one each in Northern Thailand (Tee Cha, a Pwo Karen village in Sop Moei District of Mae Hong Son Province), and Northern Lao PDR (Laksip, a Khmu village in Luang Prabang Province). The rotational shifting cultivation remains the major livelihood in the study village in Northern Thailand, while the shifting cultivation is converting to timber plantations in the study village in Northern Lao PDR. The two villages offer a good comparison of traditional land-use systems in transition with consequences on carbon stock, biodiversity and livelihoods.

Carbon Stock Measurement Methodology

The project methodology for carbon stock estimation was discussed and the development of the methodology has benefited from a case study by research members at JNU. The working manual for carbon stock measurement has been shared with other research members, and adopted for similar sampling design and methods by both the Thai and Lao project teams. The methodology is composed of six elements to: 1) stratify the project site into strata that form relatively homogenous units through classification and mapping of land use/cover types in the village landscape; 2) decide size and number of sampling plots for estimating carbon density in each land use/cover type; 3) estimate the biomass amount in different carbon pools in each sampling plot, including above-ground, below-ground biomass through allometric equation or destructive method and soil organic matter (at depth of 0–30 cm) through soil sampling and analysis; 4) convert the biomass by multiplying a conversion factor of 0.5 for carbon content, and convert the soil organic matter by multiplying a conversion factor of 0.58 for carbon content; 5) sum up carbon content of different carbon pools in each land use/land cover as the carbon intensity (tonne/hectare) for each land use/land cover type; and 6) estimate carbon stock in each land use/land cover by multiplying carbon intensity of each land use/land cover type with its area in the project site village. Carbon stocks of different land use/land cover in the project site can then be summed up as the carbon stock of the village landscape. Both Thai and Lao project teams adopted similar sampling design and methods for biomass estimation, depending on land use/land cover type, and plant size and type.

Results of Carbon Stock Measurement

The results of carbon stock measurements in the sampling plots indicate that the Thai project site had the highest carbon intensity in the conservation forest, with the amount of carbon stock at 230.59 tonne/ha, out of which 110.73 tonne were from plant biomass (stems, branches, leaves, ground cover and litter, root) and 119.86 tonne was from soil organic matter. The conserved forest was followed by the utility forest and the community forest. For the shifting cultivation, the highest carbon intensity was found in the 6-year fallow, with amount of 110.35 tonne/ha, followed by 5-year, 4-year, 3-year, 2-year fallow and the cropping field. Both paddy fields and permanent fields had lower carbon intensity compared with the shifting cultivation plots.

In the Lao PDR project site, the highest carbon intensity in the category of forests was found in the dense forest, with the amount of carbon stock at 236.86 tonne/ha, out of which 172 tonne were from above-ground biomass (stems, branches, leaves, ground cover and litter) and 64.15 tonne were from below-ground (roots and soil). Dense forest was followed by open forest, old fallow (abounded shifting cultivation) and the teak plantation forest. For the fallow lands, the highest carbon intensity was found in the 4–5 year fallow, with an amount of 63.55 tonne/ha, followed by 3-year, 2-year, and 1-year fallow. The carbon intensity in fallow lands was found to be higher than in teak plantations. For the crop fields, the highest carbon intensity was found in the job's tears field, with 31.02 tonne/ha, followed by maize field and rice field. The knowledge gained through the analysis on land use and carbon dynamics will be the basis to educate local communities in the management and monitoring of carbon stocks and support community-based MRV.

Figure 1. Taking forest carbon stock inventory in Thailand

Ongoing and Future Activities

One of the project targets is to establish strong linkages with policy-makers and directly feed the project findings into the policy-making process on issues of REDD+, integrated agriculture and forestry, land use, and sustainable mountain development. The Project is fortunate that the Lao project team coordinator also serves as the National Focal Point for the United Nations Convention to Combat Desertification (UNCCD). The Thai project team coordinator has a long experience of working with the local government in agriculture and

Figure 2. Transition towards teak plantation

forestry development. Both country coordinators will have a chance to feed project findings into the policy-making process in their respective countries. Local government officers participated in the project workshop at Luang Prabang, Lao PDR. Chiang Mai University (CMU) has been conducting ongoing research to develop forest management and agricultural production systems in the highlands of Northern Thailand with the Tambon (sub-district) administrative organization.

The project teams have agreed to review the ongoing policy process related to national implementation of REDD+ and identify knowledge gaps and capacity building needs that the new APN project can help to address. The review indicated that much uncertainty remains on how it will play out on the ground and there is a critical need for capacity building to harness the new international strategy of REDD+ for forest conservation and restoration, and poverty reduction. However, both Thailand and Lao PDR participate in the World Bank's Forest Carbon Partnership Facility (FCPF) to develop reference scenarios, adopt a REDD+ strategy, design monitoring systems and set up REDD+ management at the national level. This APN project has a lot of potential to strengthen national and local capacity to understand REDD+ and build on past forest conservation efforts to better design REDD+ implementation. The project will need to explore and establish linkages to other ongoing initiatives, such as the Greater Mekong Subregion (GMS) initiative on REDD+, for regular exchange, and help support the policy-making process for forest conservation in the region. The project findings will be used to produce policy guidelines on how to minimize the potential negative social and economic impacts from the REDD+ project and maximize the potential co-benefits.

EBLU2010-02NMY(R)-TAKEUCHI

PROJECT TITLE

Critical Analysis of Effectiveness of REDD+ for Forest Communities and Shifting Cultivation Based on Lessons Learnt from Conservation Efforts in Lao PDR and Thailand

COUNTRIES INVOLVED

Japan, Lao PDR, Thailand

PROJECT DURATION

3 years

APN FUNDING

US$ 120,000

PROJECT LEADER

Kazuhiko Takeuchi
Vice Rector
United Nations University
Institute for Sustainability and Peace, Japan

Email: Takeuchi@unu.edu

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

EBLU2010-03NMY(R)-SCHEYVENS

Participatory Approaches to Forest Carbon Accounting to Mitigate Climate Change, Conserve Biodiversity and Promote Sustainable Development

The destruction of forests contributes to global climate change by releasing carbon dioxide and other greenhouse gases into the atmosphere and by reducing the capacity of forests to sequester carbon dioxide. A global mechanism known as REDD+ is being developed under the United Nations Framework Convention on Climate Change (UNFCCC) to provide incentives to developing countries to implement activities that protect and enhance their forest carbon stocks. Accurate monitoring of forest carbon is required to assess the contribution of REDD+ activities to global climate change mitigation. Through a process of action research (Figure 1), this Project sets out to elaborate approaches to engage local communities in estimating carbon stock changes in their forests by establishing and measuring permanent sample plots. The Project is based on the premise that community engagement in forest carbon monitoring can increase local understanding of, and commitment to, REDD+ activities without compromising scientific rigour, and promote the implementation of the REDD+ social and environmental safeguards that have been agreed by Parties to the UNFCCC.

In 2011, a project advisory/planning committee and web platform: http://www.iges.or.jp/en/fc/activity_cca.html were established, and action research activities were conducted at sites in Cambodia, Indonesia, and Lao PDR. In Cambodia, IGES, RECOFTC—The Centre for Forests and People, the Wildlife Conservation Society, and the Forestry Administration trained groups from three villages in the buffer zone of Seima Protection Forest, Mondul Kiri Province, to estimate forest carbon stocks. Sample plots were established and measured in natural deciduous and evergreen forest, land use and land cover classification using satellite imagery and aerial photos was undertaken, and biomass sampling was conducted to provide more accurate carbon stock estimates.

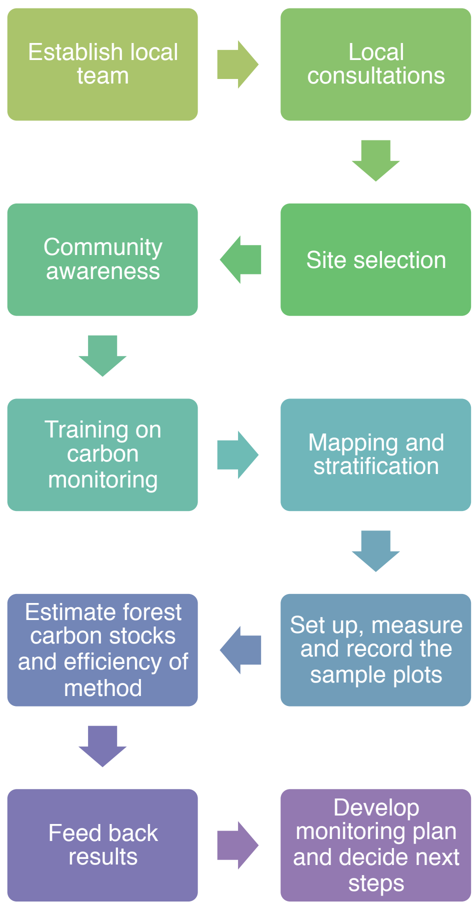


Figure 1. Participatory forest carbon assessment action research flow

Figure 2. Farmers measuring tree diameter to estimate carbon stocks, Java, Indonesia

Figure 3. Villagers being trained on tree height measurement, Mondul Kiri, Cambodia

In Java, Indonesia, IGES, the National Forestry Council, and ARuPA secured the support of local governments for the action research, and provided training to farmers in three villages (Semoyo, Burat, Terong), who then went on to establish and measure sample plots in their planted woodlots. Experiences were shared at a district workshop. It is clear that local enthusiasm for village-level carbon accounting is building. One of the villages is developing a module on climate change, REDD+ and participatory accounting which it plans to introduce to other villages using radio. In Lao PDR, the Faculty of Forestry, National University of Laos, ran a workshop on participatory carbon monitoring, made preparations for village baseline surveys and, through consultations with local government, decided to launch action research in the Sangthong District.

EBLU2010-03NMY(R)-SCHEYVENS

PROJECT TITLE

Participatory Approaches to Forest Carbon Accounting to Mitigate Climate Change, Conserve Biodiversity, and Promote Sustainable Development

COUNTRIES INVOLVED

Cambodia, Indonesia, Japan, Lao PDR

PROJECT DURATION

3 years

APN FUNDING

US$ 120,000

PROJECT LEADER

Dr. Henry Scheyvens
Natural Resources Management Project
Institute for Global Environmental Strategies (IGES) Japan

Email: scheyvens@iges.or.jp

EBLU2010-04NMY(C)-SKOLE

Developing an MRV System for REDD+: Scaling up from Project Level to National Level REDD+ MRV Systems for Lao PDR and Viet Nam

The present APN-funded capacity building project is a cooperative effort involving scientists from Viet Nam, Lao PDR, and the United States. The project aims to develop the technological capacity for supporting REDD+ efforts in these two important Southeast Asian tropical forest countries in order to support mitigation actions combating climate change. Project co-leaders are linked closely with policy-makers in their respective countries. The project is cross-cutting with respect to the APN Science Agenda: measuring and monitoring changes in forest cover and land use and the role of biotic carbon fluxes in climate change; supporting the ecosystem services provided by forests and trees; linking measurement and monitoring tools to carbon finance opportunities in REDD+ that support sustainable resource use and sustainable rural development. The project emphasizes training and capacity building for regional scientists in remote sensing analysis, Internet-enable GIS systems and developing an MRV system for REDD+ projects.

The main objectives of the project are: 1) to develop two sub-national pilot REDD+ project activities in coordination with national efforts in Lao PDR and Viet Nam and 2) to implement a scalable, Internet-enabled REDD+ MRV management application that uses remote sensing data and Web-GIS tools to support the two pilot area projects.

The project is nearing the end of year one in the two year project. We began in January 2011 with a project planning/coordination meeting and remote sensing training at the Forestry University of Viet Nam in Xuan Mai, Hanoi, Viet Nam (Figure 1). The planning and coordination meeting focussed on defining the MRV system and its functionality, deciding the pilot study areas, reviewing the timeline and work plan, identifying key partners and agencies to build linkages with, identifying the remote sensing acquisition strategy and the fieldwork data collection plans, as well as identifying existing data sets to include in the REDD+ MRV. The remote sensing training used ERDAS Imagine and eCognition software to process Landsat and ASTER VNIR data and high-resolution (e.g. QuickBird data) data for forest cover, forest fractional cover, and forest carbon mapping. All meeting presentations and training materials are available through the project website www.goes.msu.edu/apn/index.html.

The project pilot area sites are Bac Kan Province, Viet Nam at two scales — province wide and two community forest areas near Kim Hy Forest Reserve in Na Ri District. We have developed close collaboration with ICRAF-VN who is implementing a project in these two villages testing REDD+ mechanisms. The MRV system we are developing will help support this activity, which is linked closely to UN-REDD efforts in Viet Nam. In Lao PDR, we have selected Sangthong District, Vientiane Prefecture (just northwest of Vientiane, the capital city) and Savannakhet Province (Figure 3).

We conducted fieldwork in Bac Kan Province in May 2011 to validate the forest/non-forest products derived

Figure 1. Participants at the Project Planning and Coordination Meeting, Viet Nam Forestry University, Hanoi (January 2011)

Figure 2. Location of the Pilot Project Areas, Google Earth KMZ file (available online at: http://g.co/maps/6m4ad)

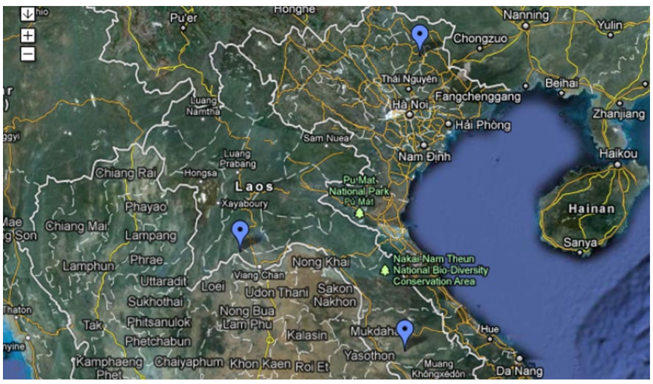
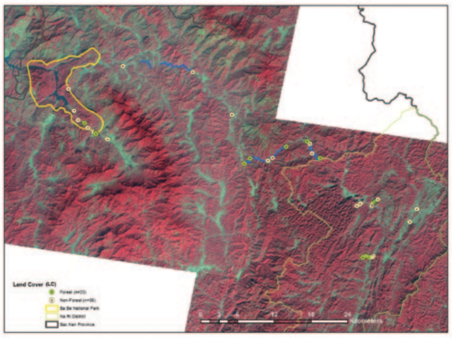


Figure 3. Location of Forest/ Non-Forest Field Validation from May 2011 in Bac Kan Province, Viet Nam



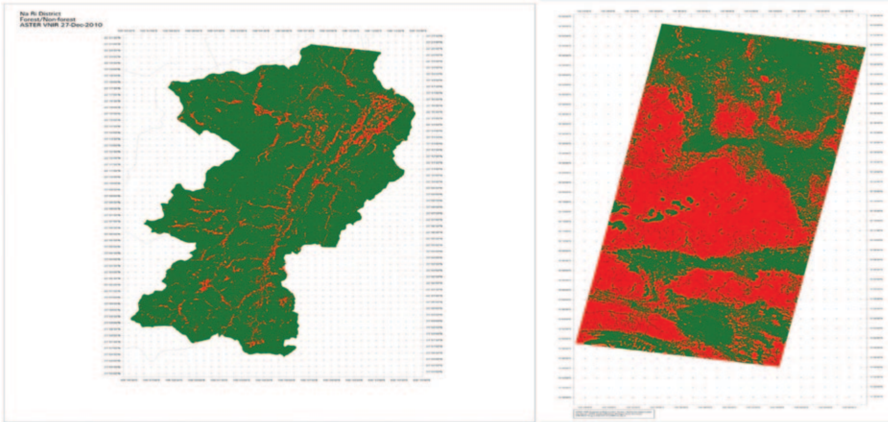


Figure 4. Example of Forest / Non-Forest maps derived from ASTER VNIR data for Na Ri District, Bak Kan Province, Viet Nam (left) and part of Savannakhet Province, Lao PDR (right)

from Landsat and ASTER VNIR data (Figure 3). A report of the field activity is available on the project website. Google Earth kmz files of GPS point and line data are also available through the project website.

Fieldwork data has also been collected for the two pilot areas in Lao PDR. In both sites sample plots were established to measure biomass in the forest areas. GPS point locations, tree species, tree height, and DBH were recorded. In Savannakhet Province, percentage of tree cover was also recorded in all forest and agricultural field plots. We will use these data to validate and calibrate the forest fractional cover data derived from Landsat and ASTER VNIR data. In Sangthong District field plots were established in both older natural forest areas and also fallowed shifting cultivation, secondary forest areas (3, 6 and 9-year fallows).

We have developed forest/non-forest and forest factional cover data sets derived from Landsat and ASTER VNIR data for Bac Kan, Viet Nam and for Savannakhet Province, Lao PDR. We are in the process of acquiring data for Sangthong District, Lao PDR. The "raw" satellite data comes as Level 1G processed data with geometric and radiometric corrections applied. Our data processing stream ingests the "raw" data, which are co-registered to an orthorectified Landsat image, and then converted to sensor spectral radiance (or top of atmosphere, ToA, reflectance correction). We use the multi-spectral bands to create a modified soil-adjusted vegetation index from which we can level slice forest/non-forest and use to also run a spectral un-mixing algorithm with soil and vegetation end-members to map vegetation fractional cover in continuous fields from 0–100%. Examples of these data products are available from the project website and shown in Figure 4.

The project still has much work to complete. We will continue to process and analyze multi-temporal remote sensing satellite data and then develop carbon maps using the forest and forest fractional cover data first using the IPCC Tier 1 biomass estimates for these forest ecosystems and then using the Tier 3 plot-level data scaled up to the project area boundaries. The time series analysis will report biomass and carbon changes over time which serves as Reference Emissions Levels (REL) from which a REDD+ intervention could be measured against over time. These data will be published to the on-line MRV system. In year two, we will conduct MRV demo meetings with local and national officials seeking feedback on potential utility of the system. We will analyze the data and plan to submit at least two manuscripts for peer-reviewed publications.

EBLU2010-04NMY(C)-SKOLE

PROJECT TITLE

Developing an MRV System for REDD+: Scaling up from Project Level to a National Level REDD+ MRV Systems for Lao PDR and Viet Nam

COUNTRIES INVOLVED

Lao PDR, USA, Viet Nam

PROJECT DURATION

2 years

APN FUNDING

US$ 65,000

PROJECT LEADERS

Dr. David L. Skole
Michigan State University
USA

Email: skole@msu.edu

Mr. Jay H. Samek
Dept. of Forestry
Global Observatory for Ecosystem Services
Michigan State University
1405 S. Harrison Rd.
Suite 101, East Lansing
MI 48823, USA

Tel: +1 517 432 3924

Email:
samekjay@msu.edu

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

EBLU2010-05NMY(C)-SEKIYA

Capacity Building of ALOS Satellite Data to Support Mapping and Monitoring of Deforestation and Degradation in Indonesia

Since the 1990s, forest monitoring in Indonesia has been carried out using Landsat images. Cloud cover is considered to be the main obstacle to getting consistent images that cover the whole area of the country and 10% of images are generally always cloud covered. This situation contrasts with the increasing need to obtain more rapid, reliable and consistent information of the current status of land use and land cover as well as their dynamic changes over time.

Radar data has the capacity to penetrate cloud and is essential to overcome the cloud-cover problem. Integrating data from the Phased Array type L-band Synthetic Aperture Radar (PALSAR) on the Advanced Land Observing Satellite (ALOS) into the current forest monitoring system will provide cloud free results. In addition to the capability of providing cloud-cover free information, ALOS/PALSAR data, specifically dual polarimetric data, also has potential to discriminate between forest cover types and other major types of land cover. This implies that in the establishment of improved (new) reliable methods, solely for forest cover monitoring, detecting change and monitoring deforestation and degradation, ALOS/PALSAR data is promising.

Unfortunately, the lifetime of ALOS satellite ended in May 2011 due to a power generation anomaly onboard. However, during its five-year operation period from 2006–2011, ALOS collected 6.5 million images of Earth, including images from Indonesia. The Japan Aerospace Exploration Agency (JAXA) has a plan to launch the ALOS-2 satellite which will also carry a radar sensor, in 2013. In the APN project, we have been using a large volume of ALOS archived data for research and will use it for capacity building so that Indonesia will be in a position to use ALOS-2 data effectively soon after its launch in 2013.

We held a workshop on 19 July, 2011 in Bogor,

Indonesia, which is one of the highlights of the APN project in its first year. In this workshop, participants shared and organized information on research and capacity building activities related to RS forest monitoring in Indonesia as well as the political and administrative needs of the Indonesian government. In addition, the Remote Sensing Technology Centre of Japan (RESTEC) introduced the latest satellite technologies to the participants and successful examples of forest monitoring as well as Japan's future satellite development and launching plans.

The participants recognized that some forest monitoring projects that are using ALOS/PALSAR data are currently ongoing and agreed that the present APN project should collaborate with these existing projects as far as possible. Some participants pointed out that techniques to analyze data from the Advanced Visible and Near Infrared Radiometer type 2 (AVNIR-2) on ALOS is also useful and should be incorporated into the upcoming training workshop in Japan. In addition, polarization will be one of the key factors to classify forest cover when ALOS-2 is launched. Therefore, the upcoming training workshop will include a lecture on the polarization theory as well as hands-on training using polarization data. The training workshop will also cover basic theories and techniques for better understanding.

Based on the discussion and requirements at the workshop, we developed a basic method of forest monitoring with PALSAR data customizing RESTEC's existing techniques, experiences and algorithms, which were mainly focussed on domestic forest cover in Japan. The existing techniques need to be customized and adjusted to Indonesian forests because the forest types of both countries are quite different. In order to generate a forest/non-forest classification map, we calculated the intensity of backscatter pixel by pixel, and fixed the threshold at -13 db. This will allow us to detect deforestation areas their transition by generating time series data sets of the classification map. The most important target in the second year is the training workshop to be held in Tokyo, Japan and we look forward to sharing these results in due course with the APN community.

EBLU2010-05NMY(C)-SEKIYA

PROJECT TITLE

Capacity Building of ALOS Satellite Data to Support Mapping and Monitoring Deforestation and Degradation in Indonesia

COUNTRIES INVOLVED

Indonesia, Japan

PROJECT DURATION

2 years

APN FUNDING

US$ 58,000

PROJECT LEADER

Mr. Tomotaka Sekiya
Remote Sensing Technology Centre of Japan (RESTEC), Japan

Email: sekiya@restec.or.jp

RUSD PROJECTS 5

Focussed Activities:

Resources Utilization and Pathways for Sustainable Development (RUSD)

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

APN

RUSD2010-01NMY(R)-SURJAN

Advancing Locally-Based Green Practices to Realize Establishment of Sound Material Cycle Society in Asian Cities

"Sound Material Cycle Society" and "Material Flow" largely remains an alien concept for most cities of Asia's developing countries, which are routinely struggling to manage increasing daily waste within their municipal limits. However, the huge populace fuelling the growth of these cities has its own frugal ways and modest means which have catapulted them to the top spot in the world's Green Index (study conducted by National Geographic), making them the most environmental-friendly denizens of Planet Earth. To arrest this diverse reality, this multi-country research is attempting to review urban expansion and economic growth analysis of life-styles to ascertain changing material flows in domestic and industrial sectors as well as prevailing re-use and recycle practices which may be considered as a precursor to the ideas of establishing a Sound Material Cycle (SMC) Society. This APN supported-research explores SMC/3R practices in selected case study cities in India, Japan, Indonesia and Viet Nam.

India

In India, the city of Bhopal has a million plus population, and is representative of waste management problems of a typical medium size Indian city, and was therefore selected for detailed survey. Bhopal generates an estimated 814 tonne/d of solid waste. The bulk of the waste comprises of inerts and biodegradables. The quantity of solid waste transported by the Municipal Corporation is estimated to be around 610 tonne/d. The project team documented municipal solid waste composition in the city of Bhopal, the hierarchy of waste dealers, details of waste disposal sites and gave an insight into the collection methods and recycling and re-use practices at the household level as well as the initiatives of the Bhopal Municipal Corporation.

It was found that the practice of recycling is not well organized and segregation of recyclable waste at source has not yet been adopted, and recyclable waste gets mixed with disposed garbage. The emphasis of the municipal corporation is on the collection and transportation of solid waste. The issue of waste disposal is of a lesser priority. Solid waste in Bhopal comprises materials that can be composted (approximately 50%). However, composting plants in Bhopal compost only about 20% of the total waste. The Municipal Corporation has paid special attention to legal impediments and labour concerns for private sector participation.

The Project team identified some recycling activities at the household level and categorized them into seven categories of recycling for storage and packing purposes; storage purposes for outside mobility; re-use as a utility item in the house; re-use to generate cash; re-use after repairs at a nominal cost; old clothes given to maid servants, domestic helps, or orphanages for re-use; and re-use of edibles.

Indonesia

Firstly, the project team collected background information on the case study city of Yogyakarta, which is the third most densely populated city in Indonesia. The team assessed urban policies and then identified some community-based 3R practices. They also collected secondary data about economic production and consumption at the city level. Yogyakarta's waste consists of six materials: organic, plastic, paper, metal, glass, textile and ribbon. The largest quantity is organic material (46.17%) that is mainly produced by the construction and agriculture sectors. The smallest quantity is glass, textile and ribbon, which are mainly produced by the trade, hospitality and service sectors; transportation and communication sectors; and business services and manufacturing. Only 5.3% of organic material is composted and gets converted to fertilizer and 14.3% of glass material is recycled.

Community-Based 3R Practices

There are some companies which buy unused paper. With a pickup vehicle, they transport this material from dumping areas near government offices, private services, and business units. While plastic waste is not easy to sell, unused PET bottle can be resold. Other products such as instant noodle packages, sachets and plastic bags cannot be resold. Having analyzed the issue, a solution presented itself. There are many communities in Indonesia practicing 3R. *Migunani,* in the Sorosutan sub-district, was a pilot project in 2008 that received crusher machines. Another example in the Suryodiningratan sub-district is *Budipolah,* a community that is a member of *Jaripolah* (Waste-Recycled Community Network), also implemented 3R practices by making handicrafts from plastic material, i.e. wallet, pillow, and handbag, etc.

Viet Nam

According to the National Report on the Environment in Viet Nam (MONRE, 2010), Viet Nam produced over 27.8 million tonne of waste in 2008 from various sources. More than 45% (12.8 million t/yr) was from municipal sources including households, restaurants, markets, and businesses. More than 9 million tonne (32%) of waste was from rural areas, making it the second most significant source. Industries generate over 4.7 million tonne/yr of waste (17%), making it the second most significant source. Handicraft villages generate over 1 million tonne of waste (3.5%) each year. About 179,000 t/yr (1%) of Viet Nam's waste is considered healthcare waste.

The project team found that re-using and recycling are popular practices in many households in Viet Nam. People re-use items that would otherwise become waste, either within the home, by giving the items away, or by selling them in second-hand markets and repair shops. Households routinely select recyclable wastes such as metal (iron, copper, lead, aluminium…) and paper (cartons, old books…) and sell them to collectors. Other types of waste (vegetables, fruits, clothes…) are collected and mostly sent to landfill sites, while some are used for composting. Re-usable and recyclable waste are also being separated by waste pickers, and then sold to recycling businesses. About 20% of the municipal waste in Hanoi is recycled. The majority of recyclable and

Figure 1. Handicraft from recycled plastic material

A)
B)

Figure 2.
A) Transporting waste;
B) Scavenging

re-usable waste in Viet Nam is collected by the informal sector (Figure 2). The trading of recyclable materials generates sufficient income for informal sectors in urban areas. More than 80% of non-hazardous industrial waste from selected industries is recyclable.

Community-Based 3R Practices

In November 2006, Hanoi conducted a 3R Initiative Project in 4 pilot precints with funding from JICA. After 3 years of implementation, 18,000 households at the 4 pilot precincts joined the project. Up to September 2009, the project attracted more than 250 volunteers and implemented many promotion activities in order to raise residents' awareness of 3R; such as 3R cinema, smile check contests, environmental education at schools, etc. The activities aimed at bringing together collection workers, residents, composters and farmers who use compost. In Viet Nam, 3R-related activities such as green consumption, separation at source, and cleaner production, have been implemented in various cities but have not been widely adopted.

Japan

The project team documented examples of best practices of SMCS from various places in Japan. The team explored various aspects of SMCS, by developing an understanding of traditional Japanese practices of 3R like the *"Mottainai"* philosophy and the policy and legal framework which supports the establishment of an SMCS. The team gained insight into the flourishing second-hand markets and recycle shops, and looked at examples such as the Shibuya Umbrella Campaign where discarded umbrellas are collected and then lent to people, and the Shinjuku Eco-Jiman Project in which customers receive points and benefits if they exhibit eco-friendly behaviour when they shop.

The Biomass Nippon Strategy was also explored in detail. In a Biomass Town, there is a wise and practical use of biomass and effective conversion of biomass into energy. In the Yokohama G30 campaign, by simply segregating and recycling, the amount of waste was reduced by almost half. The most interesting example was of Atsugi city, which can be considered a model city for SMCS, where activities such as the Kitchen Recycle Project, Rooftop farm project, etc. are conducted. Another interesting example is the Eco-life promotion project which provides points to people who cooperate in efforts such as the reduction of plastic grocery bags, bringing their own chopsticks, promotion of simple packaging, sale by measure, and bringing their own bags.

Through an extensive literature review, the team has developed a detailed understanding of how SMCS is linked with 3R, Resource Circulating Society and, above all, a sustainable society. Various facets of the "Fundamental Law for Establishing a Sound Material Cycle Society" were explored, along with gaining clarity on definitions and concepts like Material Flow analysis, locally-based green practices, SMCS, and similar concepts such as Life Cycle Management (UNEP), Circular Economy in China, sustainable waste management in the U.K., sustainable consumption and production (EU), and Integrated Solid Waste Management.

A project Workshop was conducted at the School of Planning and Architecture, Bhopal on Sustainable Urban Futures on 24 September, 2011. The technical session on Sound Material Cycle Society elaborated on the SMCS vision and the APN project outline, including the research being conducted in India, Indonesia and Viet Nam. The workshop was successful in bringing together people from government organizations and researchers from different parts of the world on the same platform for a discussion on sustainable futures.

Lastly, the project team explored ways in which SMCS can be established in Asian Cities and at the national and regional scale, along with the possible challenges.

RUSD2010-01NMY(R)-SURJAN

PROJECT TITLE

Advancing Locally Based Green Practices to Realize Establishment of Sound Material Cycle Society in Asian Cities

COUNTRIES INVOLVED

India, Indonesia, Japan, Viet Nam

PROJECT DURATION

3 years

APN FUNDING

US$ 120,000

PROJECT LEADER

Dr. Akhilesh Surjan
United Nations University, Japan

Email: surjan@unu.edu

APN Science Bulletin
Issue 2, March 2012
ISSN 2185-761x

RUSD2010-02NMY(C)-SUN

Assessment and Promotion of Japanese Strategies and Techniques for Biomass Use in Countryside of China — Concentrating on Agricultural Straw Residue

The aims of the project are to: 1) Find and disseminate suitable strategies and technologies on the recycling of agricultural straw in China; and 2) Help Chinese scientists develop sophisticated recycling technologies for agricultural straw.

We investigated the recycling of agricultural straw in Japan and China, especially in the rural area of Tianjin. The total amount of straw produced in China in 2009 was 8.20×10^8 tonne, and only 69% of the straw was re-utilized. A questionnaire on the utilization of straw resources in Tianjin was carried out in 2009. It showed that 30% of the straw produced in Tianjin was discarded or burnt off randomly. The Tianjin government is planning to forbid the burning of straw in open surroundings completely by 2015 and increase the utilization of straw to more than 90%. In Tianjin, several attempts have been made to recycle agricultural straw and good results have been obtained in converting agricultural straw to energy.

Biochar is produced by the incomplete combustion of biomass and it has recently been advocated to supplement soil with biochar to lessen the impacts of climate change, the fossil fuel crisis, and soil depletion. We synthesized and characterized a series of biochar. The impacts of biochar on the growth of wheat and vegetables, absorbance efficiency of nitrogen and soil enzyme activities were evaluated in a comparative study with raw and composted straw. The impact of biochar on the fate of typical pollutants was also studied. Preliminary results indicate that biochar may enhance the growth of wheat and vegetables, and favour nitrification. Biochar also demonstrates the ability to fix heavy metals and PAHs and catalyze the hydrolysis of some pesticides such as atrazine. To date, the results have been published in a review paper and research paper in Chinese journals, and two English manuscripts are under preparation.

The Chinese and Japanese scientists of the project

Figure 1. Dr. Zhang Yanfeng giving a presentation on the situation of the recycling of agricultural resources in Tianjin

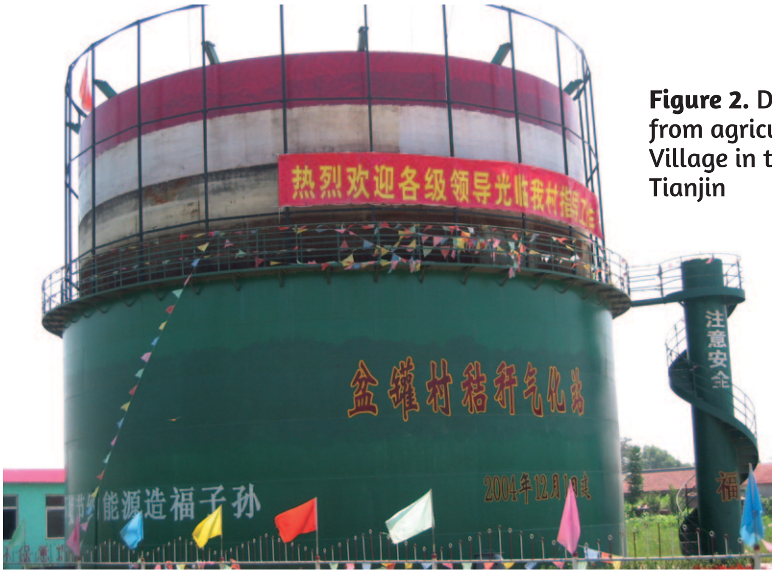


Figure 2. Device for producing CO from agricultural straw in Waguan Village in the Baodi District of Tianjin

organized a workshop on "Integrated Development of Urban and Rural Areas" at the University of Tokyo from 11–13 March, 2011. Prof. Sun, Dr. Zhang, a PhD candidate from Nankai University, and about 20 other delegates from Tianjin, China and Japan took part in the workshop. Unfortunately, the planned visit to a biomass town in Niigata was cancelled due to the Great Tohoku Earthquake and Tsunami.

In addition to the aforementioned workshop, Prof. Sun assisted in organizing and chairing a session on "Control of Nonpoint Source, Energy Saving and Resource Exploiting" at the "4th National Symposium on Agricultural Environment" in Hohhot, China from 22–25 July, 2011. Two graduate students from Nankai University introduced their work on biochar in the session and over 100 scientists and graduate students took part in the session. Several English books on biochar were purchased to grasp the newest development in biochar research in the West and a monograph is under preparation.

Publications

Sun, Hongwen. 2011. Research Progress on the Environmental Impacts & Application of Biochar. Environmental Chemistry (Chinese), Vol.30, No.8.

Zhang, P., Wu, J., Li, L., Liu, Y., Sun H., Sun, T. 2011. Sorption and Catalytic Hydrolysis of Carbaryl on Pig-Manure-Derived Biochar. Journal of AGRO-Environment Sciences (Chinese). *In Press*.

RUSD2010-02NMY(C)-SUN

PROJECT TITLE

Assessment and Promotion of Japanese Strategies and Techniques for Biomass Use in Countryside of China — Concentrating on Agricultural Straw Residue

COUNTRIES INVOLVED

China, Japan

PROJECT DURATION

2 years

APN FUNDING

US$ 55,000

PROJECT LEADER

Prof. Hongwen SUN
College of Environmental Science and Engineering, Nankai University
Tianjin, 300071, China

Tel: +86 22 2350 9241

Email: sunhongwen@nankai.edu.cn

APN Scientific Planning Group (SPG) Representatives

The SPG Members recommend a scientific programme including proposals for priority of funding and allocation of current available funding for consideration by the Inter-Governmental Meeting (IGM); works with the Steering Committee and the Secretariat in arranging scientific programme activities; and interacts on the APN's behalf with other international research programmes on global change. SPG Members also interact with the national Focal Point of their respective countries, the Secretariat, and the national and global change communities.

AUSTRALIA
Vacant

BANGLADESH
Md. Giashuddin MIAH
giash1960@gmail.com

BHUTAN
Peldon TSHERING
Peldon@nec.gov.bt

CAMBODIA
Veasna KUM
veasna_kum@yahoo.com

CHINA
Wenjie DONG
dongwj@bnu.edu.cn

FIJI
Vacant

INDIA
B.N. GOSWAMI
goswami@tropmet.res.in

INDONESIA
Erna Sri ADININGSIH
ernasri@lapan.go.id;
ernasri@yahoo.com

JAPAN
Kensuke FUKUSHI
fukushi@ir3s.u-tokyo.ac.jp

LAO PEOPLE'S DEMOCRATIC REPUBLIC
Oulaphone ONGKEO
kho-doi@yahoo.com;
oulaphone@wrea.gov.la

MALAYSIA
Subramaniam MOTEN
subra@met.gov.my

MONGOLIA
Tsogtbaatar JAMSRAN
tsogtbaatarj@magicnet.mn;
geoeco@magicnet.mn

NEPAL
Madan Lall SHRESTHA
madanls1949@gmail.com

NEW ZEALAND
Andy REISINGER
andy.reisinger@nzagrc.org.nz

PAKISTAN
Amir MUHAMMED
amir.muhammed@nu.edu.pk;
amir.muhammed@gmail.com

PHILIPPINES
Marcial C. AMARO Jr.
erdb@denr.gov.ph;
amaromarsjr@yahoo.com

REPUBLIC OF KOREA
Changsub SHIM
marchell@gmail.com;
cshim@kei.re.kr

RUSSIAN FEDERATION
Alexander STERIN
sterin@meteo.ru

SRI LANKA
G.B. SAMARASINGHE
sbaladev@gmail.com

THAILAND
Jariya BOONJAWAT
jariya@start.or.th

UNITED STATES OF AMERICA
Luis M. TUPAS
ltupas@nifa.usda.gov

VIET NAM
Kim Chi NGO
chikimngo2@yahoo.com;
chikimngo2008@gmail.com

Invited Experts to Scientific Planning Group

AILIKUN
Director, International Program Office of Monsoon Asia Integrated Regional Study (MAIRS)
aili@mairs-essp.org

Congbin FU
Director, Temperate East Asia Regional Committee for START
fcb@tea.ac.cn

Lance Clive HEATH
Project and Business Development Manager, Climate Change Institute (CCI), Australian National University
lance.heath@anu.edu.au

Kanayathu Chacko KOSHY
Professor, Centre for Global Sustainability Studies, Universiti Sains Malaysia
kanayathu.koshy@gmail.com

Chao Han LIU
Chairman, Southeast Asia Regional Committee for START
chliu@cc.ncu.edu.tw

APN

Asia-Pacific Network for Global Change Research

APN Secretariat
East Building, 4F
1-5-2 Wakinohama Kaigan Dori
Chuo-ku, Kobe 651-0073
JAPAN

Tel: +81-78-230-8017
Fax: +81-78-230-8018
Email: info@apn-gcr.org
Website: www.apn-gcr.org

Ministry for the Environment
Manatū Mō Te Taiao

United States Global Change Research Program