

# Coastal Area Capability in Southeast Asia

Coastal area ecosystems are very complex, containing some of the highest levels of biodiversity and primary productivity on earth, but they are also subject to intensive human use and easily degraded. This project uses advanced methods of ecological and social analysis to develop a comprehensive account of how people in several areas of Southeast Asia use coastal resources. It will promote dialogue of how rational and appropriate measures to for social and ecological sustainability can be established.

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## Purpose of the project

This study investigates the biodiversity and productivity of Southeast Asian coastal ecosystems, their vulnerability in relation to human activities, and assesses how social practices and ecological processes can be better aligned. We reconsider the existing regime of resource management, centering on “optimal” production (or maximum sustainable yield), and propose the concept of “area capability” as a framework for assessing ecosystem-livelihood linkages in complex and uncertain future environments.

## Research approaches

The study is developed in three components:

### 1) Ecosystem mechanisms and dynamism

Specimens, including organisms, water, sand, soil and suspended materials, are collected from marine, mangrove and terrestrial ecosystems, entered into a Geographical Information System (GIS) and subjected to stable isotope analysis in order to evaluate ecosystem features and food web structures and geographical ranges. Mitochondrial DNA sequence analyses and AFLP analyses of the organism specimens will describe genetic biodiversity and clarify the reproducible units of each species within the ecosystems. Chemical analyses will be performed in order to estimate pollution of land and waters. Biomass is evaluated by several methods, including through satellite image analysis and acoustic estimations.

### 2) Local livelihoods and adaptive management

Anthropological, social and economic research methods are used to describe the relationship between human

action and ecosystem structure and services. Such data and analyses will be used to establish dialogue between project members and local people, and to amplify, concentrate or improve data collection and methods of evaluation as necessary.

### 3) Environmental governance and local community development

Household interviews and observation surveys are used to gather data on local livelihoods, ethnicity, kinship, employment and educational backgrounds, and use of ecosystems. Logbook surveys will be conducted in order to collect data related to fishing and other key ecosystem-related livelihood activities. Conjoint and CVM analyses describe different viewpoints regarding ecosystem services and values. The key elements necessary for consensus building are clarified, and appropriate policies are proposed.

## Expected outcomes

This project will establish a robust database of ecological and social data that can be subject to extensive scientific analysis. By facilitating public access to the database and to information regarding key resource problems in coastal Southeast Asia, many people directly involved in coastal resource management will be able to discuss their understanding of the problems they face, and exchange ideas regarding potential solutions. The idea of “area capability”, a synthesis of coastal ecosystem- and livelihood-resilience under uncertain and complex environmental conditions, will be proposed for popular and academic debate.



**Photo 2** Over-exploited fishing grounds at Batang Bay, Panay Island, Philippines



**Photo 1** Set-Net at Rayong area in Thailand

# The Effect of Local Governance on Incentive Programs for Forest Ecosystem Service Conservation

This project examines forest degradation and possible recovery in two states of Malaysia. It examines the scope of deforestation and its effect on forest ecosystem services, and the potential of several international incentive mechanisms, such as carbon and biodiversity offsets, for reducing emissions of greenhouse gases from deforestation and forest degradation, protecting the pristine forests, slowing deforestation and securing forest ecosystem services. We will investigate local community response to the incentive mechanisms in order to describe how local governance systems can facilitate good and sustainable use of forest ecosystem services.

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## Objectives of the study

This project examines the process of deforestation in two different states of Malaysia. It documents the background spatio-temporal dynamics associated with forest degradation and deforestation. It also examines the local governance structures that can maintain the ecosystem services and natural resources provided by tropical forests. With this goal, we adopt two approaches to the question of forest governance. First, we examine local governance and the extent to which local people respond to locally-adopted initiatives. Second, we examine the effect of forest protection/development measures adopted by state and federal administrations. Comparative analysis of the two approaches will allow description of the best opportunities in forest preservation policy, and the challenges that remain to be addressed.

## Methodology and approach

Field study takes place in Negeri Sembilan, and either Sabah or Sarawak, Malaysia, all of which have experienced significant deforestation and are now targeted for reforestation. Background study in these areas will include:

- spatio-temporal analysis of forest cover and of variable

definitions of “forest land”;

- The history of deforestation caused by timber exploitation, and associated degradation of forest ecosystem services;
- Simulation focusing the future possible changes of ecosystem services of the target area.

A second component of field study examines the response of local people to the new incentive mechanisms intended to reduce deforestation and forest degradation. It includes:

- Local reaction and response to forest degradation;
- Description of the different forest ecosystem service programs adopted or planned;
- Assessment of how incentive mechanisms have been or may be accepted and utilized by local communities.

## Significance

The proposed study will thus contribute interdisciplinary evaluation of contemporary schemes to enhance biodiversity, and of the significance of local actors in long-term governance of forest ecosystems.

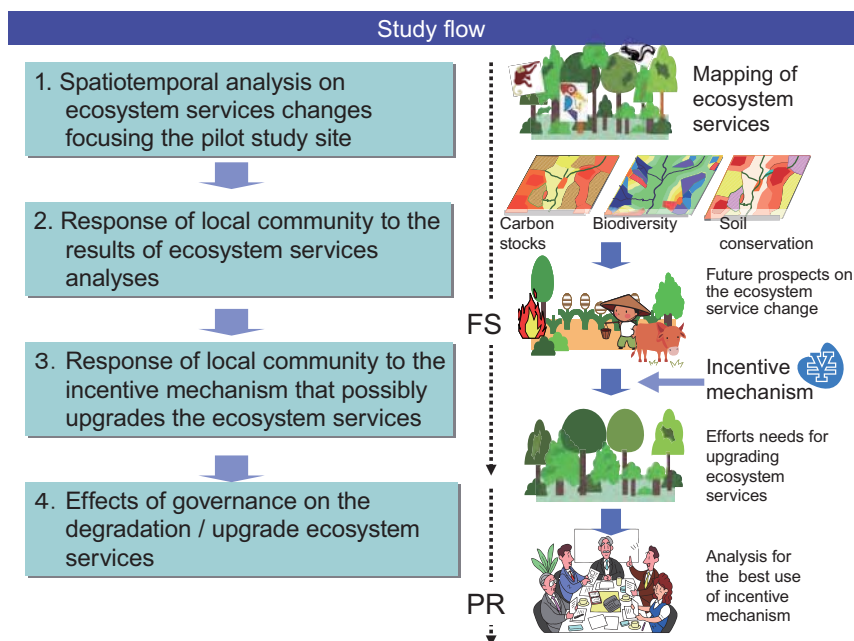


Figure 1 Flow of the study (FS: Feasibility Study; PR: Pre-Research)

# Managing Environmental Risks to Food and Health Security in Asian Watersheds

This study examines the sources, diffusion and impact of environmental contaminants in the Laguna Lake Watershed, Philippines. The Laguna Lake Watershed area is heavily but unevenly populated; it includes urban and industrial areas of Metro Manila, rural agricultural communities, and many areas undergoing land conversion. Drawing on the methods and insights of the natural, medical and social sciences, project researchers trace heavy metal and chemical pollutants from their sources through surrounding ecosystems and into the human food chain. Based on assessment of the impact of these contaminants on public health in several communities dependent on agriculture and marine food resources, the project will recommend socially and ecologically acceptable watershed management policies.

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### Project overview

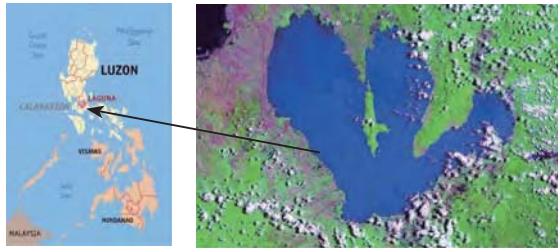
As it undergoes rapid economic development and urbanization, the Lake Laguna area faces three major challenges: pollution, disposal of solid waste, and maintaining food quality and nutrition as the foundation of public health. Addressing these challenges requires recognition of the interconnections between people and environment. Sustainable economic development in the region will depend on a healthy environment, especially for the people who are directly dependent on the Lake Laguna Watershed ecosystem.

This research project has four principal objectives. First, it documents the current levels of heavy metals (lead,

mercury, and cadmium) in the aquatic resources of Lake Laguna, the routes of this pollution and its impact on public health. Second, it analyzes the presence of chemicals in agricultural fields and their impact on food production and relation to subsequent ecosystem deterioration. Third, it describes land-use change in Lake Laguna area and the impact of this change on groundwater level and water quality. Finally, it combines the social, medical and physical sciences in order to develop strategies of ecological risk management for sustainable food, health security and watershed planning in Southeast Asia.

### Research structure

Four research teams are organized and carry out research as follows: the *Environmental Risk Analysis Team* identifies the exact sources of particular pollutants and factors responsible for their presence in the food chain. The *Health Risk Evaluation Team* will collect data on nutrition, history of disease, and life expectancy in relation to socio-economic data. The *Ecosystem Degradation Evaluation Team* will use stable isotope and other analytical techniques to investigate how land use change is associated with downstream pollution. Finally, the *Socio-Economic Evaluation Team* will explore how both market- and non-market-based instruments can be used to improve water quality, food security and public health.



**Figure Expanding Ecological Risks in Lake Laguna Region (Luzon Island, Philippines)**

Rapid urbanization and land use changes are associated with pollution of aquatic resources and food-related health risks.



**The blessings of nature are endangered by demographic and economic pressures around Lake Laguna. Heavy metals and other pollutants will be analyzed in this research. (Photo taken in December, 2009)**

# Desertification, Local Husbandry and Livelihoods in Sub-Sahara Africa

Semi-arid Sub-Sahara Africa is known as a front of desertification. The area is home to numerous nomadic and cultivating peoples, each employing various livelihood strategies and husbandry practices. Set in the West African Sahel of Niger and Burkina Faso, this project investigates the socio-ecological conditions of several peoples and their local husbandry systems and livelihood strategies, the processes of their change, and their adaptability to new techniques. Based on this deepened understanding, we will describe practical and feasible techniques to cope with desertification and guide rural development assistance that improves household economy and livelihood security.

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## Research Objectives and Outline

Poverty and environmental degradation are serious problems in semi-arid Sub-Saharan Africa. In ratifying the United Nations Convention to Combat Desertification in 1994, the international community, including Japan, signaled its commitment to solve the problems related to desertification. Although desertification is a global concern, its prevention depends on human-scale activities and conscientious field work.

This project sets three objectives, as described below, with corresponding sub-topics. Dark bullets indicate emphasis in the FS period; open bullets indicate emphasis in Full Research.

### A. Socio-ecological characteristics of semi-arid Sub-Saharan Africa

1. Livelihood and local husbandry systems ●
2. Significance of small-scaled livelihood activities on household economy ●
3. Architectural techniques and house environment of different ethnic groups ○
4. Soil fertility mechanism and human-soil interactions ○

### B. Local husbandry systems and livelihood strategies of different ethnic groups in the Sahel

1. The “year of crisis” and coping activities for different peoples ●

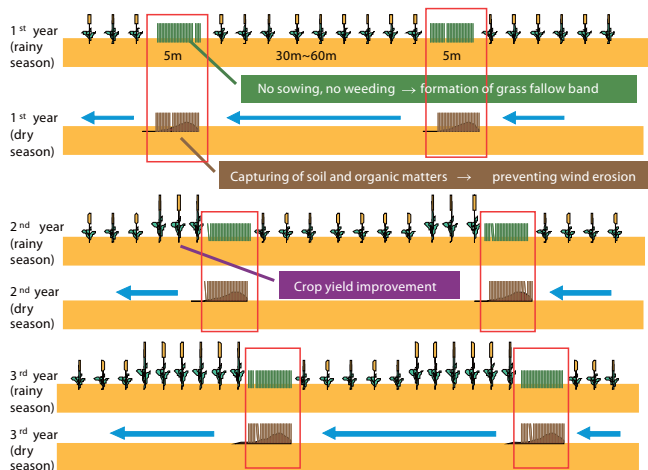
2. Significance of seasonal and/or periodical migration laboring on livelihood security ○
3. Seasonal interactions of nomadic and cultivating peoples ○

### C. Preventing desertification and assisting rural development

1. Comparison of the perception gaps between local people and outsiders regarding desertification ●
2. Adaptability of introduced techniques for desertification prevention and rural development ○
3. Adoption of introduced technique, using the case of the “petit-fallow system” ○
4. Rural development for prevention of desertification ○

## Further studies

Our research emphasizes the topics which have received little attention, such as seasonal and/or periodical labor migration, interaction of livelihood activities among different peoples, significance of small-scale livelihood activities, indigenous dissemination channel of knowledge and techniques, and resilience to desertification and shocks. In sum, we reappraise the general state of socio-ecological knowledge of the Sahel and academic and practitioners' specific understandings of appropriate techniques for adoption.



**Figure 1** The petit-fallow system

Using a shifting “petit-fallow band”—a field area that is not sown or weeded—prevents wind erosion and improves crop yields.



**Photo 1** Wind erosion in Niger

# The Hydrological Cycle and Water Problems in the Changjiang River Basin: Human-Nature Interaction in a Transforming China

China is in a period of rapid economic growth and looming water shortage, even in inland and humid regions such as the Changjiang River basin. This study describes the basin's hydro-ecological conditions, and the potential risk posed by water shortage and pollution. The project also describes the modern history of social development and water management in order to develop realistic socio-economic and ecological system scenarios for proper water management in the Changjiang basin.

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**Project overview**

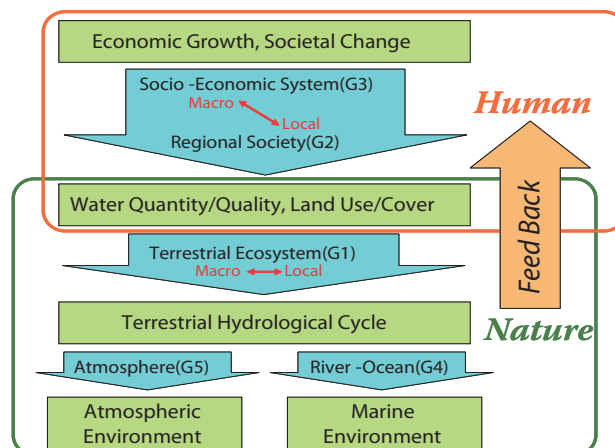
The Changjiang River is the largest river in China, and at the center of China's dynamic economic growth. The rapid pace of change in this region has destabilized human-nature interaction there and caused a number of serious environmental problems. As demand for water increases along with economic growth, the humid Changjiang basin has begun to experience water shortage in and around its large cities. Global climate change, which is expected to affect the hydrological cycle, may further increase the risk of drought and flood in the area.

This study develops realistic socio-economic and ecological system scenarios for proper water management in the Changjiang basin. It investigates spatial and temporal variability of precipitation, spatial distribution and trends of demand for water, spatiotemporal distribution of water capacity in terrestrial ecosystems and the corresponding societal processes in the modern period. Finally, this study evaluates how such processes originating in China may influence Japan and the East Asian environmental region through oceanic and atmospheric circulations

**Research methods and expected results**

In order to elucidate the mechanism of land use/cover change and change in water quantity and quality, we investigate how economic growth and societal change has influenced demand for water, waste water drainage, agricultural practices, and community life. Second, we elucidate change in the hydrological system through investigation of the changes in the hydrological functions of forest, agricultural, and freshwater ecosystems. The use of on-site field surveys and analysis of satellite data and socio-economic statistics will enable both local-scale and macro-scale description. Information on detailed processes, special distributions, and macro-scale dynamics will then be integrated in order to develop a model of human-hydrological interactions in the Changjiang basin.

This study thus improves human capability to mitigate and adapt to contemporary environmental change in the Changjiang basin, and provides fundamental information for better management of the East Asian environmental region.



**Study Frame and Research Groups**

Five groups elucidate the mechanisms of four impact flows (light blue arrows). All groups keep close contact to understand how the water-related risks due to environmental changes feed back to human activity.

# Atmospheric Methane and Agriculture in Monsoon Asia

This project examines atmospheric methane (CH<sub>4</sub>) and agriculture in monsoon Asia. In terms of radiative forcing, CH<sub>4</sub> is the second most significant greenhouse gas (after carbon dioxide [CO<sub>2</sub>]). Agriculture, especially paddy rice cultivation and the keeping of ruminant animals, produces large amounts of CH<sub>4</sub>. Monsoon Asia, where approximately 90% of the world's rice fields are located, is therefore a major source of CH<sub>4</sub> emissions. Research in this project quantifies CH<sub>4</sub> emissions and attempts to describe a culturally appropriate low-methane food system.

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## Project objectives

This study combines the methods and insights of meteorology, climatology, atmospheric chemistry, agricultural science, social engineering, and economics in order to examine methane-agriculture linkages in monsoon Asia. It consists of three parts: (1) quantification of CH<sub>4</sub> emissions in Monsoon Asia; (2) building a new model toward low-carbon agriculture and evaluating the atmospheric environmental load of agriculture by applying life cycle assessment from the point of view of food lifestyle; and (3) elucidating the interaction between human and nature in the Asian monsoon region through process studies.

## Research methods and organization

Research is conducted through field measurements, computer simulations, and analysis of appropriate statistical and remotely sensed data. The project is organized through five groups according to the following subthemes:

1. Satellite data analysis and forward/inverse modeling;

2. Measurement of methane emissions attributable to rice production and livestock in the study region;
3. Interactions of climate change and agriculture in monsoon Asia;
4. Atmospheric methane and isotope measurements over monsoon Asia;
5. Material flow analysis of present and possible future patterns of food production and consumption.

## Research significance

This study will improve understanding of the direct environmental impact of food production and consumption in Monsoon Asia and of the global significance of rice and livestock production to global greenhouse gas (GHG) emissions. A final objective is to suggest how methane emissions associated with agriculture can be reduced, and so to contribute to the design of low-GHG societies.



Using the closed chamber technique to monitor greenhouse gas emissions from rice paddies.

# Green Earth: Plant, Human and Earth Interactions

The Earth is covered in vegetation. This is generally considered positive for human existence, but in certain places, certain kinds of vegetation may have distinctly ill effects on local environments and human well-being. This study will develop a general index capable of indicating the suitability of specific kinds of vegetation in particular places.

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Plants are essential in supporting life on earth. Owing to the fact, people are often mistaken that plants are unconditionally beneficial for human survival. This project will develop a general index (tentatively named the Human-Green Index, or HuG index) to evaluate how specific plant species impact the wellbeing of local human populations and affect their surrounding environment.

In order to create the index we must “measure the green”, for example the impact of reforestation projects in particular places. We must examine how to “govern the green”, as where overgrowth may have negative effects on overall ecological conditions (as in the case of the former Japanese satoyama landscape). Finally, we must think of how best to “utilize the green”, for example in tropical zones where vegetation plays an important role in regulating large-scale climatic systems. Case studies will be chosen to illustrate each of the three situations.

The HuG index will include a wide spectrum of variables, including a number addressing human quality of life. We also incorporate parameters that allow us to link genetic diversity of living organisms and LCA (Life Cycle Assessment) to greenhouse gas emissions in different scenarios.

How do the plants in these pictures affect the global environment and the happiness of local people?

- A) poplar trees planted in a semiarid area (Uxin Banner, Inner Mongolia)
- B) a fallow field with grasses (Okuizumo-cho, Japan)
- C) an oil palm plantation behind rice paddies (Sulawesi Island, Indonesia)

