Ecosophy Program

Global Area Studies

Program Director **ABE Ken-ichi**

Climate warming is one of the truly *global* environmental problems. It affects almost all systems of the world, including sea-level, hydrological regime, vegetation, agricultural production, marine life, and so on. On the other hand, most environmental problems are described as specific phenomena — as declining water quality or loss of forest or biodiversity in a particular place — yet these can also be viewed in global perspective. In arid regions, for example, the construction of large reservoirs and irrigation systems has greatly enhanced agricultural productivity. Such transformations of hydrology and landscape have clear local effects, yet as humankind comes to view the biophysical phenomena found in a place as *iterations* of larger processes, we recognize that the world is characterized by linkage and connection. Water shortage or soil degradation in one area may lead to food shortage or air pollution in another.

Humans have created new global cycles and scales of interaction with nature. The exchange of people, ideas and materials can stimulate human creativity, yet at present there is little agreement of how to establish patterns of exchange that will simultaneously enhance human wellbeing and ecological integrity. This is the fundamental problem of our time.

Projects in this domain examine the manner in which contemporary environmental problems both contribute to and result from global phenomena and processes. These research projects focus on specific social and environmental contexts in which environmental problems are found, the linkages of these problems to social and material phenomena in other places, and on the conceptual models used to describe such interconnection.

Completed Research	Leader	Title
E-02	**SEKINO Tatsuki**	Interaction between Environmental Quality of the Watershed and Environmental Consciousness
E-03	**TAKASO Tokushiro**	Interactions between Natural Environment and Human Social Systems in Subtropical Islands
Full Research	**Leader**	**Title**
E-04	**UMETSU Chieko**	Vulnerability and Resilience of Social-Ecological Systems

Interaction between Environmental Quality of the Watershed and Environmental Consciousness:
With Reference to Environmental Changes Caused by the Use of Land and Water Resource

This project examined the relationship between environmental perception, environmental attitudes and values—or environmental consciousness—and the quality of a forested watershed ecosystem. Theoretical analysis and empirical surveys were used to identify the environmental factors that affect formation of environmental consciousness. We then developed response-prediction models and used a choice experiment to establish people's preferences in several scenarios of environmental change.

Project Leader: **SEKINO Tatsuki** RIHN

Project Findings

This project examined the relationship between people's environmental consciousness and the environmental quality of a forested watershed ecosystem. Using response-prediction models, which can simulate environmental changes in a forest-river-lake ecosystem caused by artificial environmental modification, project researchers analyzed popular perception of environmental change around Lake Shumarinai, the largest reservoir in Japan, in Horokanai, Hokkaido. We conducted a choice-experiment with members of Lake Shumarinai and other watershed communities in which people were asked to indicate their preferred of several model-generated virtual scenarios of environmental changes accompanying different forest management plans. Results of the "Scenario questionnaire" indicated that people preferred area tree-cutting that does not negatively affect water quality. The most common next concern was for "Decreases in plant biomass and diversity". Surveys also suggested that people distinguished between the direct, indirect and non-use values of forested watershed environments.

Contribution to Global Environmental Studies

Human beings enjoy the benefits of nature; their perception of these environmental benefits affects their attitudes toward and values concerning their surrounding environments. Environmental perception, attitudes and values together indicate environmental consciousness, an important, but often overlooked, dimension in the consideration of appropriate interactions between humanity and nature. How do people evaluate human-caused environmental change? People's environmental values should be a key factor in environmental decision-making. The methods developed in this project can enhance public involvement in environmental impact assessment and city and regional planning.

Communication of Research Findings

A scenario workshop was held in Horokanai town, Hokkaido. Residents described their ideas and visions of future natural environments and social life. Social and natural scientists contributed to the workshop as interpreters and facilitators. As an outcome of the project, we conducted an open symposium in Horokanai in November, 2008. In addition, a number of original papers have been published for academic audiences.

Publications

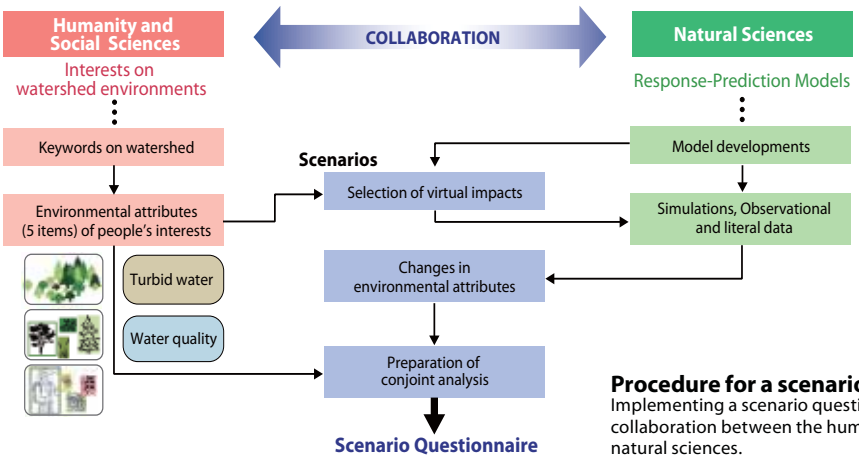
Fujimaki, R., R. Tateno and N. Tokuchi (2007) Root Development across a chronosequence in a Japanese cedar (*Cryptomeria japonica* D. Don) plantation, Journal of Forest Research, 12:96-102.

Fukuzawa, K., H. Shibata, K. Takagi, F. Satoh, T. Koike and K. Sasa (2007) Vertical distribution and seasonal pattern of fine-root dynamics in a cool-temperate forest in northern Japan: implication of the understory vegetation, Sasa dwarf bamboo. Ecological Research 22: 435-495.

Kawano, T., H. Takahara, T. Nomura, H. Shibata, S. Uemura, N. Sasaki and T. Yoshioka (2007) Holocene phytolith record at Picea glehnii stands on the Dorokawa Mire in northern Hokkaido, Japan. The Quaternary Research, 46:413-426.

Fukuzawa, K., H. Shibata, K. Takagi, M. Nomura, N. Kurima, T. Fukuzawa, F. Satoh and K. Sasa (2006) Effects of clear-cutting on nitrogen leaching and fine root dynamics in a cool temperate forested watershed in northern Japan, Forest Ecology and Management, 225:257-261.

Sekino, T. and T. Yoshioka (2005) Diagrammatic representation of environmental monitoring data. Korean Journal of Limnology, 38:76-83.



Procedure for a scenario questionnaire
Implementing a scenario questionnaire requires intensive collaboration between the human and social sciences and natural sciences.

Interactions between Natural Environment and Human Social Systems in Subtropical Islands

A variety of environmental problems have arisen on islands around the world, leading to the deterioration of precious natural environment and the disappearance of local cultures. In order to resolve environmental issues on islands, it is necessary to thoroughly understand the interaction between unique islands environments and the social systems. This project examined Iriomote Island in Okinawa Prefecture as an example of contemporary island dynamics. We aim to provide guidelines for building island human social systems that are sustainable in the future

Project Leader: **TAKASO Tokushiro** Tropical Biosphere Research Center, University of the Ryukyus (RIHN until March 2009)

The Purpose of the Project

Islands throughout the world are faced with ongoing deterioration of their precious natural environment due to water shortages, industrial development and other factors. Along with this, local cultures are at risk of disappearing. To solve these problems, it is important to fully understand interaction between natural environment and human social systems on islands. As islands are geographically limited areas, their natural environment and human social systems tend to be different from others, as well as vulnerable to rapid social and environmental changes. Iriomote Island, a typical subtropical island located in Okinawa Prefecture, provides an ideal study example, as it is rich in natural resources such as water and virgin forests, as well as traditional art and culture.

Research

We built a water balance model of Iriomote Island based on the estimated amount of precipitation, river flow, and evapotranspiration. The model is used as a standard for future water usage. We also assess the human impact on rivers.

We described the functions and maintenance mechanisms of evergreen and mangrove forests, while studying biodiversity and interaction among organisms. We examined the dynamism of forests in an island environment and assessed the human impact on forests.

We examined the background of human activities causing deterioration of natural environments, including industrial development, demographic structure and government policies. In particular, we explored how the main industry of the island has changed from traditional agriculture to tourism and how this change has affected the island's social system.

Field school on seagrasses

Regarding the community decision-making process, we studied how local people understand the impact of human activities on the natural environment and how common rules have been modified over time according to changes in the use of natural resources.

Progress Status, Achievements, and Future Challenges

To clarify the water balance on Iriomote Island, we have installed a monitoring device on the island. The database is built up to help us make more accurate predictions about the quantity and quality of water that will be available in the future. Our observations have indicated that rain on the island is acidic throughout the year. We have more or less identified the origins of the substances that cause the acid rain and estimated the total amount of such substances falling on the island.

Our studies have shown that typhoons affect turnover in broadleaved evergreen forests. In forests including those of mangroves, we have been keeping track of production/circulation of substances, while monitoring the impact of human activities. We are providing information on effective maintenance and management of forests in the near future.

We have gathered a variety of reference materials including demographic statistics, administration policies and information on local industries, and categorized them for further analysis. We use these materials to develop measures to promote networking of small-scale industries from the viewpoint of island economics. In this process, we have focused on tourism, agriculture, health and education.

We have been in close contact with the islanders by participating in various local events and educational programs designed for schools and communities. As a result, we have learned that community centers on the island play a large role in the communities' decision-making processes.

To solve environmental problems on Iriomote Island, local people need a solid economic infrastructure to build self-esteem and become independent. To achieve this, it is important to share useful information with the islanders. We will proceed with this project so that the findings can contribute to promoting local industries and developing new ones. We take part in education at schools and in communities, and would like to help locals promote the island's traditional culture and communication of its performing arts to younger generations.

*http://www1.gifu-u.ac.jp/~kawakubo/iriomote/index01.html

Vulnerability and Resilience of Social-Ecological Systems

A cycle of poverty and environmental degradation is a principal cause of several global environmental problems. Forest degradation and desertification are prevalent throughout the semi-arid tropics, including in Sub-Saharan Africa and South Asia, where the majority of the world's impoverished people live. Many people in the semi-arid tropics depend on rain-fed agricultural production systems that are vulnerable to climate variability. Environmental resources such as vegetation and soils are also vulnerable to human activities. A key factor in preventing such problems lies in the ability of human societies and ecosystems to recover from social or environmental shocks, or in *social-ecological resilience*. This project examines the factors affecting social-ecological resilience in rural Zambia and the ways in which it can be enhanced.

Project Leader
UMETSU Chieko
RIHN

Dr. Chieko Umetsu is an associate professor of resource and environmental economics at RIHN. She received a M.A. from the International University of Japan, and a doctorate from the University of Hawaii at Manoa, Honolulu, U.S.A. Her publications include "Basin-wide water management: A spatial model" in *Journal of Environmental Economics and Management (2003)* and "Efficiency and technical change in the Philippine rice sector: A Malmquist total factor productivity analysis" in *American Journal of Agricultural Economics* (2003).

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Project Objectives

In the past, poverty in the developing world was seen as a social, not environmental, problem. As a consequence, disaster relief and environmental conservation were conceived of as entirely separate endeavors; there was little consideration of livelihood or human wellbeing as products of interacting social and ecological systems, or of the manner in which humans adapt to environmental change.

This project uses the concept of social-ecological resilience in order to evaluate the attempts of agricultural societies in Sub-Saharan Africa to adapt to environmental change, population increase and rural social collapse. We investigate the mechanisms that facilitate recovery from specific social and environmental perturbations, the factors that determine the adaptive capacity of households and communities, and the role of institutions in strengthening overall social-ecological resilience. Such analysis can improve policies intended to enhance human security in developing countries.

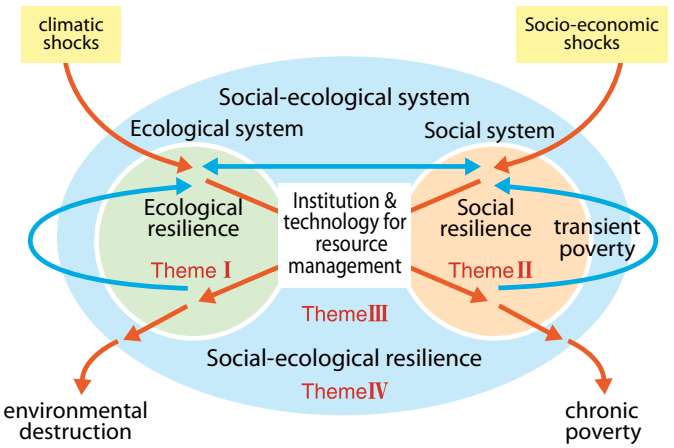

Figure 1 **Close Relationship between Social and Ecological Resilience**

Research Methods and Target Areas

The project is organized by four research themes. Theme I analyzes ecological resilience through examination of soil and forest resources. In theme II, we will conduct intensive interviews of farm households/communities and identify the factors affecting social resilience. Theme III considers historical changes in land tenure systems made by government policies and their effects on natural environment. It also examines the social and political factors that cause vulnerability, collapse and that aid in recovery in different communities. Theme IV uses statistics, remote sensing data and aerial photographs to help trace long-term changes in land cover, rainfall and temperature. Analysis of the four themes should allow us to develop robust methods for assessing social-ecological resilience.

The main field site is in Zambia, where subsistence farmers depend on rain-fed agriculture. Such agricultural systems are extremely vulnerable to environmental irregularities; food security, poverty and environmental conservation are thus highly interrelated. The concept of social-ecological resilience can provide an integrative approach to human wellbeing and ecological integrity.

Research Outcomes to Date and Expected Results

1) Field trials at several sites in Southern Province showed that topography and water availability significantly influenced maize yield. Farmers responded to serious floods by shifting from cultivation of maize to sweet potato and beans during the 2007/2008 cropping season.
2) We collected rain gauge data from the fields of 48 households during the 2007/08 rainy season and 2008 dry season. Data show that plot-level rainfall can vary within a single village by as much as 190 mm/season.
3) We continued weekly household interviews in our three sample villages throughout the 2008 dry season and into the 2008/09 rainy season. Interviews address production, consumption, time allocations, social

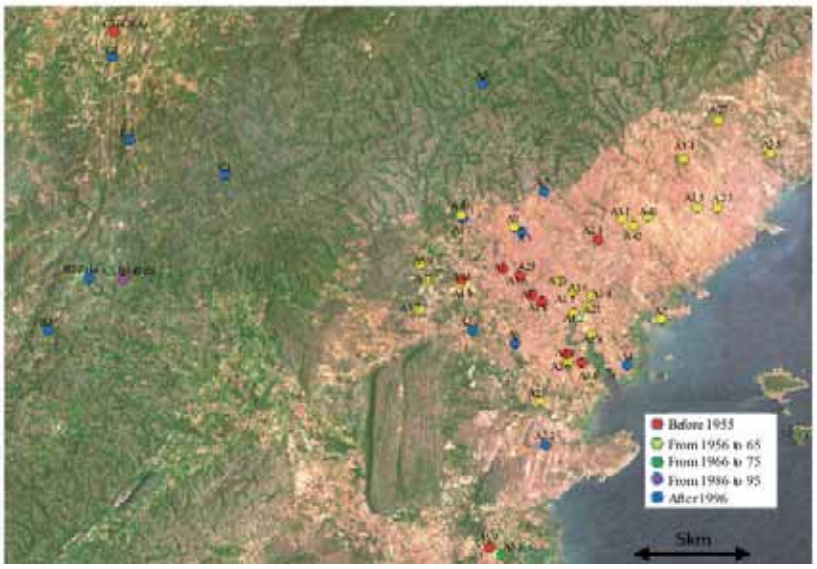

Figure 2 **Distribution of villages along Lake Kariba by year of their establishment**

Photo 1

Weeding is usually done by female household members using simple and labor intensive technology.

Photo 2

A Tonga village at site B, Southern Province.

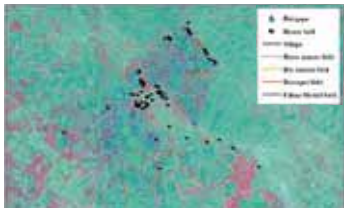

Figure 4

Distribution of fields in rainy and dry season, site A, Southern Province.

Figure 3 **Agro-ecological zones of Zambia classified by annual rainfall**

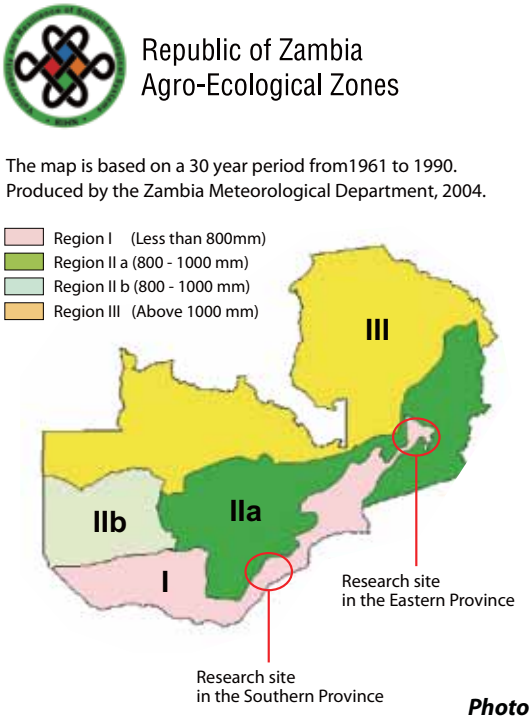

Photo 3

Raising cattle is an important form of saving among the Tonga population.

Photo 4

Villagers meet to grant their consent to the study, Eastern Province.

Photo 5

Field experiment to examine ecological response to human activities and climatic factors, Eastern Province.

activities; body measurements are also made.

4) We investigated agricultural land use in several principal study sites. To supplement satellite imagery, we conducted land use analysis using aerial photographs and GPS observations.
5) Various ethnographic studies were conducted to examine mechanisms and roles of alternative livelihoods in reducing household vulnerability to environmental variability. Additional anthropological studies were initiated to examine social networking, livestock rearing, and the effect of food aid.
6) A field experiment in Eastern Province showed that tree-burnt areas provided significantly higher maize yield than did non-burnt areas. Field trials for maize production, soil and vegetation survey were carefully conducted. Data collection and analysis of the effect of burning on overall ecological resilience are in progress.
7) Integration of four themes has advanced, especially through the linkage of temporal and spatial data.

Future plans

We will continue with data collection from household surveys, body measurements, and anthropological surveys and in qualitative and quantitative analyses of the factors affecting resilience.