Ecosophy Program

Global Area Studies

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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 Resources

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 identify people's preferences in several scenarios of environmental change.

Project Leader: SEKINO Tatsuki RIHN

Project findings

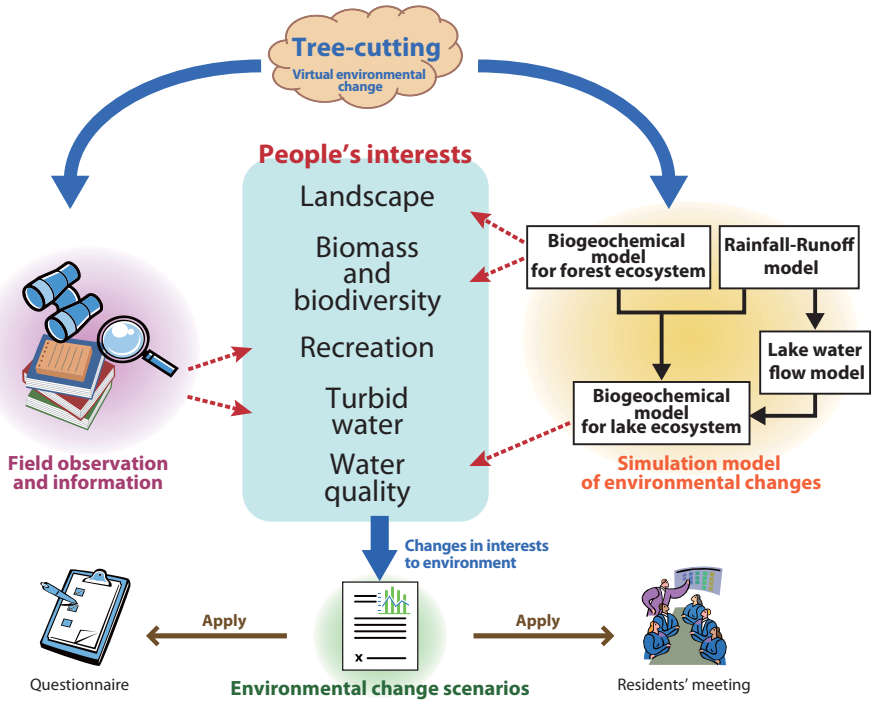
This project examined the relationship between people's environmental consciousness and the environmental quality of a forested watershed ecosystem. Using response-prediction models, which can simulate environmental changes in a forest-river-lake ecosystem caused by artificial environmental modification, 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 the 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? 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 and published a book (in Japanese), entitled "A Method for Analyzing Environmental Consciousness with Environmental Scenarios". A number of original papers for academic audiences have also been published.



Analysis of environmental consciousness

People's interests in an environment were first revealed through social research (questionnaires). Simulation models and field observations were used to query desirable and undesirable kinds of environmental change (especially in relation to different patterns of tree cutting and afforestation). Several environmental change scenarios were generated from the results and follow-up questionnaires and discussion group meetings were conducted to develop further description of individual and community perceptions of positive and negative land cover and ecosystem change.

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, thorough understanding of interactions between islands' unique natural environments and social systems is necessary. Using Iriomote Island in Okinawa Prefecture as a model, this project will help to resolve these issues. Further, we have provided some 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

The purpose of the project

Throughout the world, islands 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 other areas, and more vulnerable to change. The main subjects of this project were environmental issues related to the unique features of islands. Iriomote Island, a typical subtropical island located in Okinawa Prefecture, was an ideal model, as it is rich in natural resources such as water and virgin forests, as well as traditional art and culture.

Research

1) 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 assessed the human impact on rivers.
2) We clarified the functions and maintenance mechanisms of broadleaf evergreen and mangrove forests while studying biodiversity and interaction among organisms. We took a closer look at the dynamism of forests and assessed the human impact on forests on Iriomote.
3) We looked into the background of human activities causing deterioration of natural environment, including industrial development, demographic structure and government policies. In particular, we explored how the main industry of the island changed from traditional agriculture to tourism and how the social system changed during the transfer period.
4) Regarding the decision-making process in communities, we studied how local people understand the impact of human activities on the natural environment and how local common rules were modified according to changes in the use of natural resources.

Field school on seagrasses

Progress status, achievements, and future challenges

1) To clarify the water balance on Iriomote Island, we placed (and are still placing) monitoring devices on the island. The database was 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.
2) Our studies have shown that typhoons affect turnover in broadleaf forests. We have been keeping track of production/circulation of substances in forests and mangroves while monitoring the impact of human activities. We have provided information on effective maintenance and management of forests.
3) 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 in the island economy. In this process, we have focused on tourism, agriculture, health and education.
4) 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 community decision-making processes.

In order 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 are still proceeding with the project so that the findings can contribute to promoting local industries and growing new ones. We take part in education at schools and in communities from the planning stage, and would like to help locals promote the island's traditional culture and transmission 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 severe 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. 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 soil 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's specialization is in Resource and environmental economics. 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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Research objectives: Building rural household and community resilience

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

This project uses the concept of social-ecological resilience in order to evaluate the attempts of agricultural peoples in Sub-Saharan Africa to adapt to environmental change, population increase and rural social collapse. We investigate how households and communities recover from specific social and environmental perturbations, the factors influencing their capacity to adapt, and the role of institutions in strengthening the overall resilience of social-ecological systems. Such analysis can inform policies intended to improve human security, productive livelihoods and social wellbeing in developing countries.

Research methods and target areas: How do agricultural households cope with shocks?

The project is organized into four research themes. In **Theme I**, ecological resilience is examined in relation to soil and forest resources. In **Theme II**, we conduct intensive interviews of farm households/communities and identify the factors affecting social resilience. **Theme III** considers how government policies have historically affected land tenure systems and use of the natural environment. Theme III also considers the social and political factors that cause vulnerability and collapse, and that can aid in community recovery. In **Theme IV**, statistical analysis, remote sensing data and aerial photographs are used to describe long-term changes in land cover, rainfall and temperature. In combination, 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 variability. Food security, poverty and environmental conser-

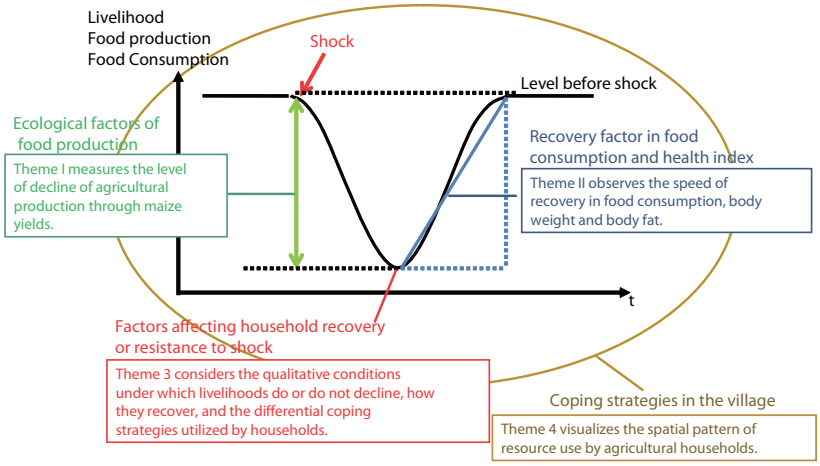

Figure 1 **Approaches to the study of resilience**

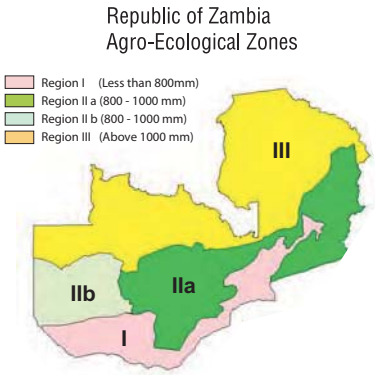

Figure 3 **Agro-ecological zones of Zambia classified by annual rainfall**

Photo 1 **Taking anthropometric measurements, Southern Province**

Photo 2 **Household field measurement using GPS, Southern Province**

Photo 3 **A house garden in the dry season, Southern Province**

Photo 4 **Communication of project findings to local farmers, Eastern Province**

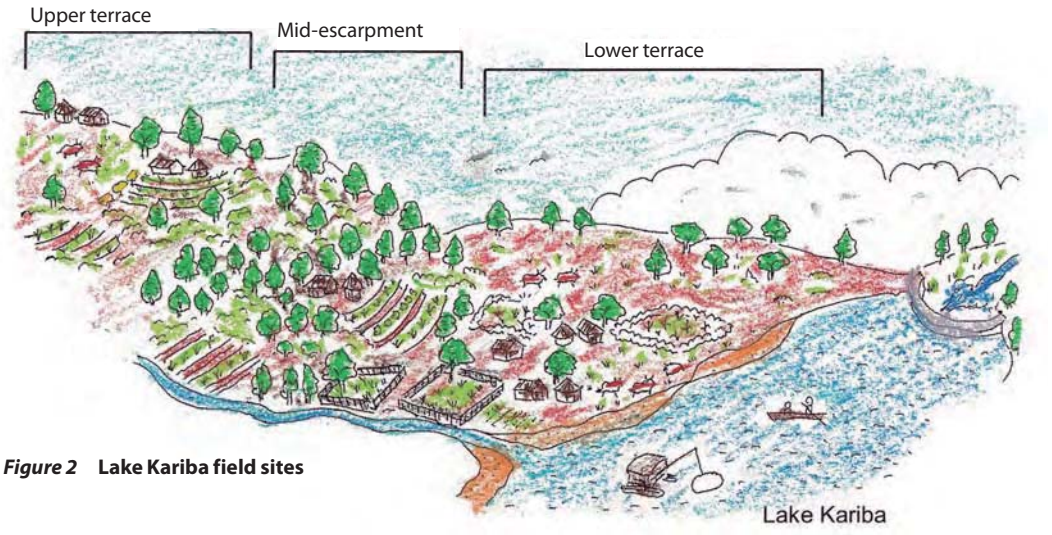

Figure 2 **Lake Kariba field sites**

vation are thus highly interrelated. The concept of social-ecological resilience can provide integrative assessment of how biophysical conditions support human livelihood and wellbeing.

Research outcomes to date and expected results

- We approach the resilience of agricultural households empirically by examining how, and how quickly, food consumption recovers from shocks such as drought and flooding (Fig. 1). Key indicators of household resilience include decline in agricultural production, especially in yield of maize (Theme I) and the speed of recovery in food consumption, as indicated by body weight and skinfold thickness (Theme II). We also make qualitative assessment of the conditions affecting livelihood vulnerability or resilience, including household coping strategies and recovery (Theme III). Theme IV describes the spatial pattern of resource use by agricultural households.
- Rainfall in Southern Province in 2007/08 was extraordinarily heavy, but according to our record of rainfall, its impact on agricultural yields depended on field topography. GIS analysis of damaged fields during the 2007/2008 rainy season indicated that flood damages were concentrated in poorly-drained fields in lower terrace areas (Site A), steep fields in mid-escarpment (Site B), and valley bottom fields in the upper terrace area (Site C). We also measured the area of damaged fields for each household.
- Field experiments confirmed that in high rainfall years, fields in the upper terrace (Site C) produced better yields than those at the bottom of the slope (Site A). Similarly, our household survey and anthropometric measurements found a significant reduction of food consumption and body weight among households with fields in lowland areas.
- Households adopted a variety of methods to cope with flooding. In order to compensate for lost income, farmers replanted maize, planted potato and beans in place of maize, sold livestock for cash, or engaged in other seasonal activities such as fishing and wage labor.
- Field experiment in Eastern Province revealed that the pattern of soil nutrient release and weed growth differed according to the number of years a field had been cultivated, which in turn affected maize yield.
- The Resilience Project organized two sessions at the International Human Dimensions Programme 2009 Open Meeting in Bonn in order to present our latest work to the wider 'resilience' research community.
- Project reports, working papers and a Japanese translation of a resilience workbook are all available at the project web site.

Future plans: Enhancing rural community resilience

We will continue with data collection from the household survey, body measurements, and anthropological survey. Further integration of field and survey data will improve our qualitative and quantitative description of the factors that create vulnerability and the mechanisms enabling household and community resilience.