



Waiting for high tide

Mafia, Tanzania

A wooden ship anchored on the mangrove flat
NAKAMURA Ryo



Fishing in rice paddies

Assam, India

Villagers fish in the rice paddies while planting rice
in the monsoon flood season
KOSAKA Yasuyuki

Golf course? No, taiga in Siberia

Russia

Meadows, or alas, which are formed
over several thousand to ten thousand
years, found in the boreal forestland
in East Siberia
HIYAMA Tetsuya



Water chestnut harvest

Vietnam

ABE Ken-ichi

Ecosophy Program

Global Area Studies



E

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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.

Full Research	Leader	Title
E-04	UMETSU Chieko	Vulnerability and Resilience of Social-Ecological Systems

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

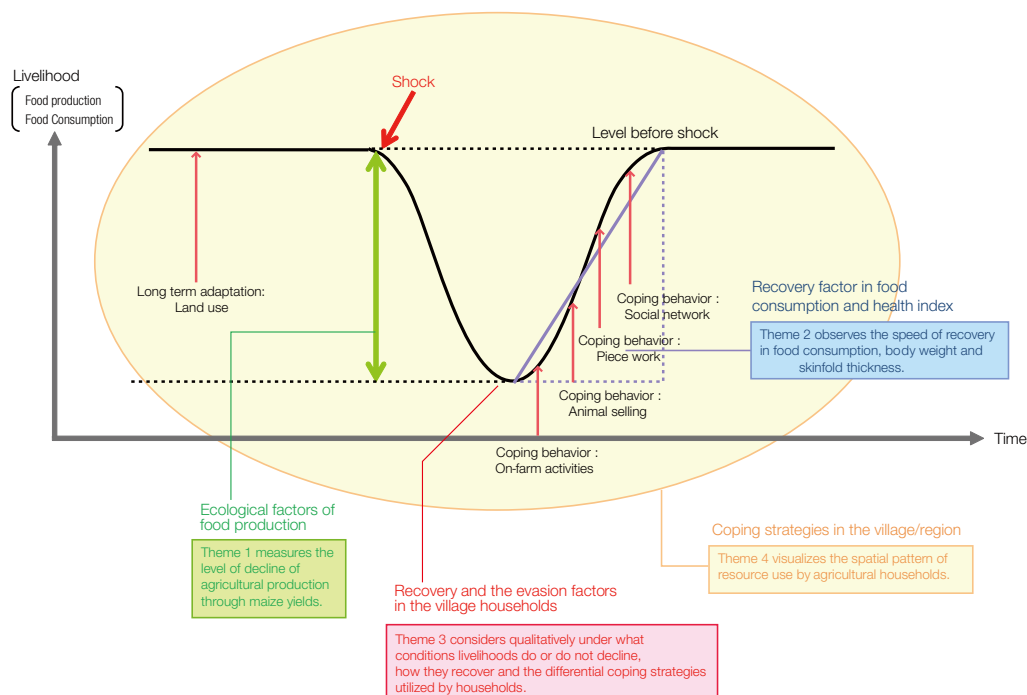
In the past, poverty in the developing world was seen principally as a social, not environmental, problem. As a consequence, disaster relief and environmental conservation were undertaken as entirely separate endeavors; there was little consideration of human livelihood and wellbeing as products of interacting 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 analyses can inform policies intended to improve human security, productive livelihoods and social wellbeing in developing countries. Our primary study sites are in Eastern and Southern provinces of Zambia, in southern Africa.

Research outcomes to date and expected results

Project research is guided by four interrelated themes designed to describe how quickly agricultural households recover adequate food consumption after shocks such as drought or flood, and the mechanisms that allow or



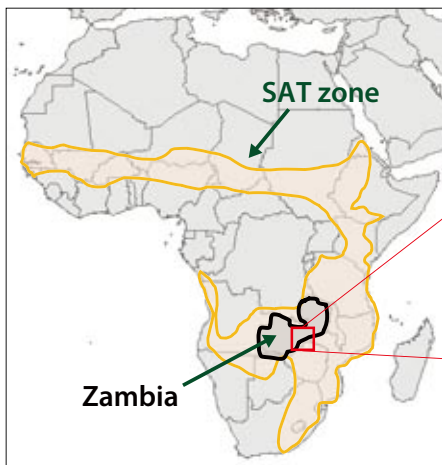


Figure 2 Location of study site

- Photo 1** Local fieldworkers take anthropometric measurements, Southern Province
- Photo 2** The new bridge replacing the older one destroyed by heavy rains, Southern Province
- Photo 3** Field day, Eastern Province
- Photo 4** Household storage of harvested maize, Southern Province



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4

inhibit recovery. Theme 1 measures decline in maize yields—the staple consumption crop of the area—following environmental shock. Theme 2 measures the speed of recovery in household food consumption through changes in individual body weight and skinfold thickness. Theme 3 qualitatively assesses household resilience, analyzing the conditions affecting livelihood decline and recovery, and the range of household coping strategies. Theme 4 describes the spatial and dynamic pattern of resource use through analysis of land cover use and change, including household agricultural land use.

● **Agricultural production**

Field investigation in Southern and Eastern Province, where rainfed agriculture is the dominant production system, shows rainfall is the most significant limiting factor in maize yields, and thus on food availability, household consumption, and household livelihood. Maize yields are also affected by topography and temperature in Southern Province and by availability of soil nutrients following tree burning in the fields in Eastern Province. Reduced productivity associated with delayed planting indicated that sowing date is critical for maize yields.

● **Rainfall variability**

In the past, El Niño years saw reduced rainfall and La Niña years increased rainfall. While drought has been a major climatic shock in the region, in our study sites rainfall in the 2007/2008, 2008/2009 and 2009/2010 cropping seasons was higher than the annual average. The seasonal pattern of rainfall varied across these three rainy seasons.

● **Heavy rainfall and its impacts on households production and food consumption**

In December 2007, heavy rainfall affected maize production. Food consumption and body weight decreased as a result. In this situation, project researchers analyzed household resilience by focusing on adaptation and coping strategies and factors that affected the recovery of food production. Some farmers also shift topographical location of their fields as method of ex-ante adaptation.

● **Household livelihood coping strategies after shock**

In upper terrace areas, farmers affected by heavy rains

often switched from maize to sweet potato cultivation. Households suffering significant crop losses tended to reduce consumption while increasing working hours. Analysis of livestock assets shows that poor farmers tend to maintain cattle by reducing household consumption; wealthier farmers tend to maintain household consumption by selling cattle. With yield declines, household heads try a range of other measures to secure access to food. In such conditions, cash-in-hand played a very important role in smoothing food consumption levels, especially of staple foods.

Aid agencies and local institutions and organizations involved in food distribution and access to resources also can improve household survival and the maintenance of livelihoods. The amount and timing of food distribution, however, tended to be too little and too late. Social networks also play an important role in securing goods and cash in times of need. Use of cellular phones now enables and extends household support networks.

● **Recovery of food consumption**

Long-term weekly survey interview data identified a rapid decline and gradual recovery of food consumption after heavy rainfall. This recovery path became the basis for quantitative analysis of resilience. Most households did not recover food consumption after extreme rainfall for one year, with poor households receiving the most severe and long lasting impacts.

● **Assessing resilience through recovery in agricultural production and food consumption**

Household assets in general, and land, livestock and cash-in-hand in particular, significantly affect resilience of food consumption. Regional infrastructure, including roads, also plays an important role in stabilizing food prices in times of shock.

● **Future plans: Enhancing rural community resilience**

We will continue with data compilation and analysis. Further integration of field and survey data will improve our comprehensive assessments, with qualitative and quantitative description of the factors that create vulnerability and the mechanisms enabling household and community resilience.