

E-04 (FR4)

Vulnerability and Resilience of Social-Ecological Systems

Project Leader : Chieko UMETSU

Short name : Resilience Project

Home page : <http://www.chikyu.ac.jp/resilience/>

Program : Ecosophy program

Keywords : resilience, poverty, social-ecological system, resource management, environmental variability, vulnerability, human security, semi-arid tropics, adaptive capacity

SUMMARY OF RESEARCH OBJECTIVES AND CONTENTS

1. Research Objectives

The objective of this research is 1) to consider impacts of environmental variability on vulnerability and resilience of human activities in the semi-arid tropics; 2) to study factors affecting social-ecological systems and their recovery from shocks; 3) to analyze factors determining ability of households and communities to recover from environmental shocks and the roles of institutions in improving household resilience; and 4) to identify the factors affecting resilience of social-ecological systems and ways in which the resilience of subsistence farmers in the semi-arid tropics to environmental variability can be strengthened.

2. Background

A vicious cycle of poverty and environmental degradation, such as forest degradation and desertification, is a major cause of global environmental problems. This is especially the case in the semi-arid tropics (SAT) including Sub-Saharan Africa and South Asia, where a majority of the world's poor are concentrated. Within the SAT, communities' livelihoods depend critically on fragile and poorly endowed natural resources, and poverty and environmental degradation are widespread. People in these regions depend largely on rain-fed agriculture, and their livelihoods are vulnerable to environmental variability. Environmental resources such as vegetation and soil are also vulnerable to human activities. To surmount these environmental challenges, human society and ecosystems must be resilient to (recover quickly from) environmental shocks. Thus in this project we consider society and ecology as one social-ecological system and empirically analyze its resilience.

3. Research Methods

a. Research Contents and Methodology

The research is organized into four themes focusing on different dimensions of resilience. Theme I investigates the influences of ecological resilience on human activities by comparing soil properties in different landscapes (e.g. valleys, hill slopes and plains), the types and histories of land use, and agro-ecological succession. Theme II evaluates household resilience in risky environments in terms of income-smoothing, consumption-smoothing, and nutrition status. Theme III focuses on the institutional aspects of social resilience in the SAT. It examines how social, political, economic and ecological changes shape social resilience. Theme IV clarifies the relationship between ecological vulnerability, resilience and human activities, through investigations of historical and spatial changes

in land use and multi-level social-ecological systems.

b. Research Areas

The primary study sites are in the drought-prone Eastern and Southern provinces of Zambia, Southern Africa (Figure 1).

4. Project Organization

Research Organization

The four themes interlink and thus provide a comprehensive assessment of resilience of social-ecological systems

Theme I: Ecological resilience and human activities under variable environment

Theme II: Household and community responses to variable environment

Theme III: Political-ecology of vulnerability and resilience: historical and institutional perspective

Theme IV: Integrated analysis of social-ecological systems

5. Research goals in FY2010

During the FY2010, we continue household surveys and weather monitoring for the third cropping season 2009/2010.

- We refined and sharpened working hypotheses for our resilience empirical studies and proceed with qualitative and quantitative analyses.
- Factors controlling maize yields will be clarified from the field experiments in Eastern and Southern Province. Those factors will be spatially evaluated in the study area of Southern Province.
- The household survey, anthropometric measurements, and rainfall recording that were initiated in November 2007 (the onset of the rainy season of 2007/08) in the project site in Southern Province of Zambia will continue until November 2010. The analyses of the impact of rainfall variability on household consumption and nutritional conditions will be extended covering two cropping seasons, namely 2007/08 and 2008/09.
- Multi-temporal and spatial change analysis caused by environmental change in 2008-09 and its effects on household's livelihood and food aid activities by the Zambian Government and NGO in Sinazongwe will be investigated.
- Based on the analysis from two-decades of field survey in a village of Central Zambia, we examine the reasons and process of increased vulnerability among farmers and households.

6. Progress up to Now

In FY2006 (PR) we focussed on establishing research collaborations with various institutions in Zambia. In FY2007 (FR1) we prepared experimental field sites and installed monitoring equipment such as weather stations, on-farm rain gauges and soil moisture measurement devices. Comprehensive household surveys and monitoring of rainfall and crop growth commenced in November 2007. Intensive field data collections for the 2007/2008 and 2008/2009 agricultural seasons and data compilations were completed in subsequent fiscal years of FY2008 (FR2) and FY 2009 (FR3). For the current fiscal year of FY 2010 (FR4), field surveys, other field monitors and data compilations for the 2009/2010 seasons

have just been completed.

- We approach resilience of farming households to climatic variability by focusing on mechanisms and speed of consumption, food production and livelihood recovery after experiencing shocks such as drought and floods (see conceptual diagram in Figure 2). Theme 1 measures the level of decline of agricultural production through maize yields. Theme 2 observes the speed of recovery in food consumption and health and nutritional status such as body weight, growth and skinfold thickness. Theme 3 qualitatively considers conditions under which livelihoods decline or do not decline; how they recover; and how differential coping strategies and the household access to resources in response to shocks. Theme 4 visualizes the spatial pattern of agricultural households' resource use and cross-scale interactions.
- Analysis of household food consumption after climatic shocks using data from high frequency household surveys is in progress.
- In the field experiment in Eastern Province, impacts of tree burning on soil nutrient status and maize yield varied according to the amount of tree biomass burnt. The field experiment in Southern Province suggested that maize yield was strongly influenced by topography and temperature.
- Dataset covering two cropping seasons of 2007/08 and 2008/09 was established for the analyses. Using the dataset, resilience at household level was quantitatively measured and factors affecting the resilience were identified. The decline of food consumption through calorie intake before harvest (February) was observed during both 2007/08 and 2008/09 cropping seasons. After March 2008, food consumption gradually recovered, however the speed of recovery was slow. The effect of heavy rainfall in December 2007 appeared after one year as the hike of maize price. It took more than one year for most households to recover food consumption (calorie intake) to the level before December 2007 heavy rainfall.
- After floods, farmers responded by replanting maize, shifting from maize to potato and beans. In addition, some new activities for getting cash income, such as livestock sales, fishery and wage labor, emerged to offset a shortfall of income, which indicated varieties of coping mechanisms exist for affected households.
- We could explain that the increased process of vulnerability differs by each actors, such as farmers, households and rural societies. And also we revealed that vulnerability increased by various reasons, and it could be transmittable among economic, socio-political and even cultural sphere.
- Cellular phones are playing an important role in helping farmers to cope with shocks. Farmers under financial and non-financial stresses started utilizing cellular phones to garner support from their social network.
- We disseminated our project outcomes at the international conferences. We presented at ISPRS 20101 (Kyoto), GLP Open Meeting 2010 (USA), AIWEST-DR2010 (Indonesia), and plan to participate at Resilience2011 (USA), EnvironmentAsia (Thailand). We organized a session at the JASID 2010 (Japan Society for International Development). We also organized Resilience Workshops (12th, 13th) and Resilience Seminars (30th, 31st, 32nd).
- Project annual reports (FS,PR,FR1,FR2,FR3,FR4), working papers (#001-#012) and a Japanese

translation of a resilience workbook by Resilience Alliance, are all available at the project web site.
http://www.chikyu.ac.jp/resilience/publication-W_e.html

- Three project members are now participating IHDP committee and sub-committee of the Science Council of Japan and actively contributing to international community.

7. Research Plan until the next PEC Meeting in FY2010

For the next two years of research (FR4, FR5), we plan to conduct the following:

1. While refining the theoretical aspects of resilience, we need to consider the practical applicability of the resilience approach based on the field research.
2. Integration of the research and data should be accelerated for the common goal for analyzing resilience of the farm households qualitatively and quantitatively.
3. For FY2010 and early FY2011 weather monitoring, plot experiments, household surveys, and the accumulation, compilation and analysis of data sets will be continued.
4. The first monitored 2007/2008 cropping season was an abnormal flood year, against which the 2008/2009 and 2009/2010 cropping season should be compared.
5. Coping strategies of farm households to environmental changes will be analyzed and assessed qualitatively and quantitatively.
6. To give feedback to the local community we provided rainfall information for the first cropping season 2007/2008 to local farmers. We will continue to do so.
7. We prepare for the RIHN International Symposium and RIHN Forum for FY2011. We also prepare for working workshop for book publication.
8. Collaboration with other international research organizations should be enhanced.
9. The concept of resilience can be applied to other RIHN project as well. We continue promoting inter-project initiatives within RIHN projects and other research groups.

8. Research Activities from FY2006 to FY2011

Time Schedule

	2005 FS	2006 PR	2007 FR1	2008 FR2	2009 FR3	2010 FR4	2011 FR5
Research Methodology	xxx	xx	xx	x			
Zambia							
I. Ecological Resilience	x	xx	xxx	xxx	xxx	xx	x
II. Household/Community	x	xxx	xxx	xxx	xxx	xx	x
III. History/Institution	xx	xx	xxx	xxx	xxx	xxx	x
IV. Integrated Analysis	x	xx	xxx	xxx	xxx	xxx	xxx
India		x	x	x	x		
Burkinafaso			x	x	x	x	
International Workshop			x		x		x
Project Report	FS Report	PR Report	Annual Report	Interim Report	Annual Report	Annual Report	Final Report

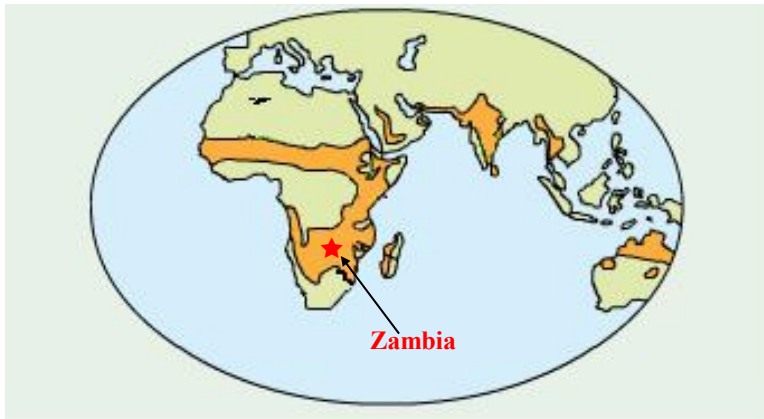


Figure 1. Regions of Semi-Arid Tropics and Study Areas

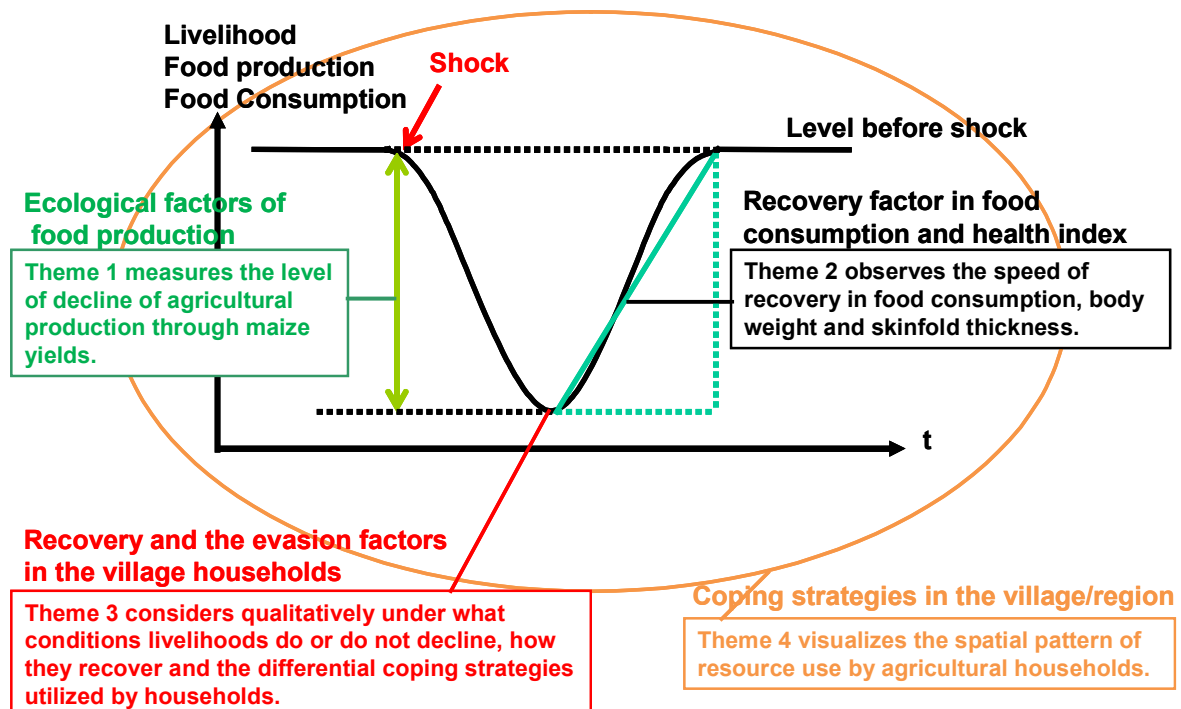


Figure 2. Approaches to Resilience

E-04 (FR4) Project Member List (FY2010)

revised Dec, 2010

	Name	Affiliation	Department	Title	Field	Role
Leader	Chieko UMETSU	RIHN	Research Department	Associate Professor	resource & environmental economics	Regional analysis, farm survey
A	Shigeo YACHI	Center for Ecological Research, Kyoto University		Associate Professor	mathematical ecology	Advisor
	<i>Theme I</i>					
○	Hitoshi SHINJO	Graduate School of Agriculture, Kyoto Univ.	Division of Environmental Science and Technology	Assistant Professor	soil science	organic materials and soil fertility
	Kaoru ANDO	Graduate School of Agriculture, Kyoto Univ.	Division of Environmental Science and Technology	Graduate Student (Ph.D)	soil science	organic materials and soil fertility
	Hajime KURAMITSU	Graduate School of Agriculture, Kyoto Univ.	Division of Environmental Science and Technology	Graduate Student (MS)	botany	grass/herb components and its succession
	Reiichi MIURA	Graduate School of Agriculture, Kyoto Univ.	Division of Agronomy and Horticulture Science	Lecturer	botany	grass/herb components and its succession
○	Hidetoshi MIYAZAKI	RIHN	Research Department	Project Researcher	soil science	measurement of land plot, crop components
○	Moses MWALE	Mt. Makulu Central Research Station, Zambia Agricultural Research Station	Ministry of Agriculture and Cooperatives	Vice Director	soil science	soil analysis
	Shozo SHIBATA	Field Science Education and Research Center, Kyoto Univ.	Kamigamo Experimental Station	Professor	forest ecology	tree/shrub components and its succession
○	Ueru TANAKA	Graduate School of Global Environmental Studies, Kyoto Univ.	Terrestrial Ecosystems Management	Associate Professor	agronomy	Landuse and risk management
	<i>Theme II</i>					
○	Takeshi SAKURAI	Hitotsubashi University	Institute of Economic Research	Professor	development economics	household survey and analysis
	Hirimitsu KANNO	National Agricultural Research Center for Tohoku Region	Laboratory of Agricultural Meteorology	Team Leader	agricultural meteorology	measurement of rainfall data
	Akinori KITSUKI	Hitotsubashi University	Graduate School of Economics	Graduate Student (MS)	development economics	household survey and analysis
	Sayuri KON	Graduate School of Health Sciences, Hokkaido University	Devision of Health Sciences	Graduate Student (MS)	human ecology	human growth, nutrition and health
	Harutaka KUBO	Graduate School of Health Sciences, Hokkaido University	Devision of Health Sciences	Graduate Student (MS)	human ecology	human growth, nutrition and health
	Ken MIURA	Hitotsubashi University	Graduate School of Economics	Graduate Student (MS)	development economics	household survey and analysis
	Hiroyuki SHIMONO	Faculty of Agriculture, Iwate University	Crop Science Laboratory	Associate Professor	crop science	Crop Science Modelling
	Taro YAMAUCHI	Graduate School of Health Sciences, Hokkaido University	Devision of Health Sciences	Associate Professor	human ecology	human growth, nutrition and health
	<i>Theme III</i>					
○	Shuhei SHIMADA	Graduate School of Asian and African Area Studies, Kyoto University	Division of African Area Studies	Professor	environmental geography	village society and institution
	Kazuo HANZAWA	College of Bioresource Sciences, Nihon University	Department of International Development Studies	Professor	agricultural economics	farm household survey
○	Yudai ISHIMOTO	RIHN	Research Department	Project Researcher	ecological Anthropology	emergency food of farm household
	Chihiro ITO	Graduate School of Asian and African Area Studies, Kyoto University	Division of African Area Studies	Graduate student	human geography	labor migration in rural area
	Gear M. Kajoba	University of Zambia	Department of Geography	Senior Lecturer	geography	land tenure system and food security
	Shiro KODAMAYA	Graduate School of Social Sciences, Hitotsubashi University	Division of African Area Studies	Professor	African sociology	agricultural development and social change
	Akie KYO	Graduate School of Asian and African Area Studies, Kyoto University	Division of African Area Studies	Graduate student	palliative medicine	co-existence with sickness and care
	Chileshe MULENGA	University of Zambia	Institute of Economic and Social Research	Senior Lecturer	economic geography	analysis of social behaviors
	Noriko NARISAWA	Graduate School of Asian and African Area Studies, Kyoto University	Division of African Area Studies	Graduate student	gender anthropology	economic activities of female farmers
	<i>Theme IV</i>					
○	Mitsunori YOSHIMURA	PSCO Corporation	Research and Development Center	Senior Researcher	remote sensing	ecological change monitoring
○	Thamana LEKPRICHAKUL	RIHN	Research Department	Senior Project Researcher	environmental & health economics	household survey and analysis
	Keiichiro MATSUMURA	Rikkyo University	Department of Sociology	Assistant Professor	cultural anthropology	land tenure system and rural livelihood
	Tazu SAEKI	National Institute for Environmental Studies	Center for Global Environmental Research	NIES Assistant Fellow	atmospheric physics	climate monitoring
	Chieko UMETSU	RIHN	Research Department	Associate Professor	resource & environmental economics	regional analysis
○	Megumi YAMASHITA	Survey College of Kinki		Lecturer	geographic information	vegetation monitoring
	<i>India</i>					
○	K. Palanisami	International Water Management Institute	IWMI-TaTAs Program	Program Coordinator	agricultural economics	household survey and analysis
	V. Geethalakshmi	Tamilnadu Agricultural University	Department of Agricultural Meteorology	Professor	agricultural meteorology	monsoon rainfall analysis
○	Takashi KUME	RIHN	Center for Coordination, Promotion and Communication	Associate Professor	soil hydrology	tsunami impact study
	C.R. Ranganathan	Tamilnadu Agricultural University	Department of Mathematics	Professor	mathematics	economic modelling
	Akiyo YATAGAI	RIHN	Research Department	Assistant Professor	climatology meteorology	monsoon rainfall analysis
	<i>Burkina Faso</i>					
○	Tom Evans	Indiana University	Department of Geography	Associate Professor	geography	agent-based modelling

○=Core Member; A = Advisor; MAFF=Ministry of Agriculture, Forestry and Fisheries