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Short name : Resilience Project

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

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 analyse 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 analyse its resilience.

3. Research Methods

a. Research Contents and Methodology

The research is organised 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 2). Minor study areas are located in Burkina Faso, West Africa, and India, South Asia.

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. Progress up to Now

During the FY2006 (PR) we focussed on establishing research collaborations with various institutions in Zambia. During the 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. The surveys of the first cropping season of 2007/2008 were completed. In Kyoto, Japan, data were compiled into historical tables. The translation *Resilience Alliance* workbook into Japanese is under preparation, and methods were discussed for integrating the research outputs to meet the project's objectives.

Theme I

A field experiment in Eastern Province, Zambia, commencing in 2007, showed significantly higher maize yield in tree-burnt areas (comprising 10% of total cultivated area) compared with non-burnt areas. Field trials at several sites in Southern Province showed that topography significantly influenced maize yield through water availability. Farmers responded to serious floods by shifting crops from maize to sweet potato and beans.

Theme II

In October 2007, at the beginning of the rainy season (2007/08) we commenced weekly household interviews, body measurements, and rainfall measurements. These continued throughout the 2008 dry season and into the 2008/09 rainy season. We collected and analyzed rain gauge data from each sampled household's field during the 2007/08 rainy season and 2008 dry season. Data collected from the household interviews are under preparation for quantitative analysis.

From September 2007, local meteorological conditions were monitored at our study sites in Sinazongwe District. Daily precipitation data at three sites showed distinct seasonal variations, and we defined the 2007/2008 rainy season as being between early December and mid March.

Precipitation varied according to topography, with highest rainfall at a lowland site (1600 mm), followed by a mid elevation site (1586 mm) and lowest at an upland site (1426 mm). There were

evening precipitation peaks at the lowland and mid elevation sites, but the upland site showed little diurnal variation. The mid elevation and lowland sites had high evening precipitation compared with the upland site, contributing to higher total daily precipitation.

There were differences in rainfall ranges between observation points: 176 mm at the upland site, 190 mm at the mid elevation site, and 140 mm at the lowland site. Also precipitation distribution at each site showed systematic patterns. Precipitation minima were concentrated at the upland site at the centre of the village, medium values were measured at the mid elevation site, and precipitation maxima were measured at the southeastern part of the lowland site.

Theme III

Mr. Nakamura, Ms. Ito, Mr. Ishimoto, and Dr. Okamoto conducted field surveys in Zambia. Mr. Nakamura studied destructive lumbering activities, Ms. Ito investigated migration patterns, Mr. Ishimoto researched kinship networks, and Dr. Okamoto focused on interrelationships between people and cattle to elucidate the complex relationship between social vulnerability and ecological resilience. Prof. Hanzawa and Prof. Kodamaya continued their study in village C. on the impact of political change on agricultural production. Prof. Shimada reviewed geographical, political and ecological studies, and emphasized the importance of textual and historical analysis. Shimada participated in a seminar at Oxford University, U.K. on “Resilience, realities and research in African environment”, and collated research on resilience and vulnerability and their application to development assistance.

Theme IV

IV-1 We installed meteorological observation robots and rain gauges to monitor atmospheric conditions in Southern Province, Zambia in September 2007. We started analysis of objective analysis data and observational data obtained from the Zambia Meteorological Department.

IV-2 Satellite imagery was obtained from the internet in FY2006. In FY2007, we purchased additional satellite images, which were captured before and after the agricultural and meteorological drought conditions in order to identify and quantify land use/coverage. In FY2008 we investigated agricultural land use in some principal study sites to collaborate with the investigations in Theme I. In addition, we collected documents and statistical data. Land use analysis using aerial photographs and GPS observations is currently underway.

IV-3 We collected documents on food security policies of the Zambian government and donors, and conducted research on the food relief program in Sinazongwe District in Southern Province. The distribution of food relief itself also can be considered as a shock to the farm households.

IV-4 During the field survey in September 2007, we visited some sample households surveyed earlier in the year. The 2008 extensive survey results showed that the dominant coping strategy in times of drought for farm households in Southern Province was skipping meals, and engaging in part-time work in Eastern Province. We also reviewed Geographic Information System (GIS) analysis methods for socio-economic data using various land-use modelling approaches.

6. Future Issues

Research Plan until the next PEC Meeting in FY2010

For the next two years of research (FR3, FR4), we plan to conduct the following:

For the entire project

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.
3. For FY2009 and FY2010 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 cropping season should be compared.
5. Coping strategies of farm households for environmental changes will be analysed and assessed qualitatively and quantitatively.
6. To provide feedback to the local community we started to provide rainfall information for the last cropping season 2007/2008 to local farmers. We will continue to do so. We will organize two sessions at the IHDP 7th Open Meeting in Bonn in April 2009 to share our research outcomes with the academic community.

For research themes

- I. The field experiment in Eastern Province is expected to reveal the dynamics of ecological resilience, while farmers' responses to variable environments will be understood in the context of Southern Province ecosystems.
- II. Data quality of household interviews should be improved. Delays in data entry and data quality control (including consistency checks) need to be minimized. In parallel with data collection we are starting quantitative and qualitative analysis.
- III. Prof. Hanzawa and Prof. Shimada will continue field studies at C. village in Central Province, and other research team members will continue their studies in Southern Province. One new researcher is expected to start a long-term field study in a village in the Gwembe Tonga area.
- IV. In addition to the baseline satellite and meteorological data acquired so far, we need to obtain further data sets of different spatial and temporal scales. Satellite imagery and aerial photographs are now partially available, and we plan to utilize this information together with land use surveys to characterize land use dynamics and natural resources near Lake Kariba. The study of the institutional aspects of emergency food distribution is underway. Based on extensive household survey data, more analysis will be conducted. The collaborative research of other team members should be accelerated for data integration.

7. 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. Resilience of Social-Ecological System and Four Themes

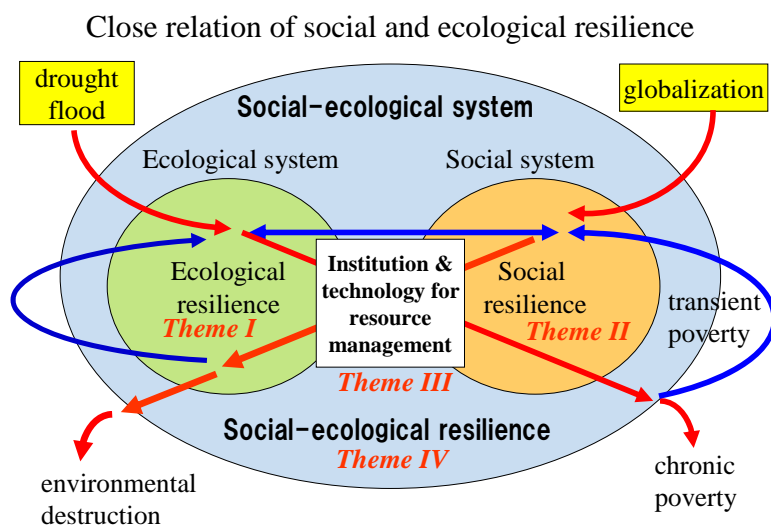


Figure 2. Regions of Semi-Arid Tropics and Study Areas



E-04 (FR2) Project Member List (FY2008)

revised 25 November 2008

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>					
O 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 (MS)	soil science	organic materials and soil fertility
Reiichi MIURA	Graduate School of Agriculture, Kyoto Univ.	Division of Agronomy and Horticulture Science	Lecturer	botany	grass/herb components and its succession
Masako MIYASHITA	Graduate School of Global Environmental Studies, Kyoto Univ.	Terrestrial Ecosystems Management	Graduate Student (MS)	agronomy	Landuse and risk management
O Hidetoshi MIYAZAKI	RIHN	Research Department	Project Researcher	soil science	measurement of land plot, crop components
O Moses MWALE	Mt. Makulu, Central Research Station, Zambia Agricultural Research Station	Ministry of Agriculture and Cooperatives	Vice Director	soil science	soil analysis
Yoko NORO	Graduate School of Agriculture, Kyoto Univ.	Division of Environmental Science and Technology	Graduate Student (MS)	soil science	organic materials and soil fertility
Shozo SHIBATA	Field Science Education and Research Center, Kyoto Univ.	Kamigamo Experimental Station	Professor	forest ecology	tree/shrub components and its succession
O Ueru TANAKA	Graduate School of Global Environmental Studies, Kyoto Univ.	Terrestrial Ecosystems Management	Associate Professor	agronomy	Landuse and risk management
<i>Theme II</i>					
O Takeshi SAKURAI	Wako University	Faculty of Economics and Business Management	Professor	development economics	household survey and analysis
Hirimitsu KANNO	National Agricultural Research Center for Tonoku Region	Laboratory of Agricultural Meteorology	Team Leader	agricultural meteorology	measurement of rainfall data
Hiroyuki SHIMONO	Faculty of Agriculture, Iwate University	Crop Science Laboratory	Assistant Professor	crop science	Crop Science Modelling
Taro YAMAUCHI	Graduate School of Health Sciences, Hokkaido University	Division of Health Sciences	Associate Professor	human ecology	human growth, nutrition and health
<i>Theme III</i>					
O Shuhei SHIMADA	Graduate School of Asian and African Area Studies, Kyoto University	Division of African Area Studies	Professor	environmental geography	village society and institution
Minako ARAKI	Faculty of Letters and Education, Ochanomizu University	Geography	Associate Professor	development study	village society and institution
Kazuo HANZAWA	College of Bioresource Sciences, Nihon University	Department of International Development Studies	Professor	agricultural economics	farm household survey
O 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. Kaoba	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
Chieshe MULENGA	University of Zambia	Institute of Economic and Social Research	Senior Lecturer	economic geography	analysis of social behaviors
Tetsuya NAKAMURA	Graduate School of Asian and African Area Studies, Kyoto University	Division of African Area Studies	Graduate student	agricultural economics	sector-economic responses to environmental change
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
Masahiro OKAMOTO	RIHN	Research Department	Project Researcher	anthropology and area studies	Local community and subsistence system
<i>Theme IV</i>					
O Mitsunori YOSHIMURA	Remote Sensing, Technology Center of Japan (RESTEC)		Senior Researcher	remote sensing	ecological change monitoring
O Tamana LEKPRICHAKUL	RIHN	Research Department	Senior Project Researcher	environmental & health economics	household survey and analysis
Keiichiro MATSUMURA	Graduate School of Human and Environmental Studies, Kyoto University	Cultural, Regional and Historic Studies on Environment	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>					
O K. Palanisami	Tamilnadu Agricultural University	Centre for Agri. & Rural Development Studies	Director	agricultural economics	household survey and analysis
B. Chandrasekaran	Tamilnadu Agricultural University	Directorate of Research	Director	agronomy	rice production analysis
V. Geethalakshmi	Tamilnadu Agricultural University	Department of Agricultural Meteorology	Professor	agricultural meteorology	monsoon rainfall analysis
O Takashi KUME	RIHN	Research Department	Senior Project Researcher	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>					
Kimseyinga Savadogo	University of Ouagadougou	Department of Economics	Professor	economics	household data analysis
Tom Evans	Indiana University	Department of Geography	Associate Professor	geography	agent-based modelling

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