ISBN　978-4-902325-40-9

Vulnerability and Resilience of Social-Ecological Systems

社会・生態システムの脆弱性とレジリアンス

FY2008 FR2 Project Report

平成20年度FR2研究プロジェクト報告

Project E-04 (FR2)
プロジェクトE-04 (FR2)

Project Leader: Chieko Umetsu
プロジェクトリーダー　梅津　千恵子

February 2009
2009年2月

Inter-University Research Institute Corporation, National Institutes for the Humanities
Research Institute for Humanity and Nature

大学共同利用機関法人　人間文化研究機構

総合地球環境学研究所

ISBN　978-4-902325-40-9

Vulnerability and Resilience of Social-Ecological Systems

社会・生態システムの脆弱性とレジリアンス

FY2008 FR2 Project Report

平成 20 年度 FR2 研究プロジェクト報告

Project E-04 (FR2)
プロジェクト E-04 (FR2)

Project Leader: Chieko Umetsu
プロジェクトリーダー　梅津　千恵子

February 2009
2009 年 2 月

Inter-University Research Institute Corporation, National Institutes for the Humanities
Research Institute for Humanity and Nature

大学共同利用機関法人　人間文化研究機構

総合地球環境学研究所

TABLE OF CONTENTS

目　　次（和文掲載分）

Preface

Fiscal year 2008 is the second year of five-year RIHN Full-Research (FR) for our project "Vulnerability and Resilience of Social-Ecological Systems." Our project is grouped into one of the members of Ecosophy program under the new five RIHN research programs.

The year 2008 was the year of world financial crisis as well as political transition. The stock price depreciated tremendously. At the same time, the crude oil price reached 100USD/ barrel in early 2008 hiked up to 139USD/barrel in June and ended up 43USD/barrel in December. In September 2008, President Levy Mwanawasa passed away in Paris and Zambia elected a new president Rupiah Banda. The transition to the new regime proceeded quite peacefully. Also the U.S. elected first African American to be a president.

During the FY2008, project researchers stayed for long-term field research in Zambia. The field experiment for the impact of various fallow systems on agricultural yield and soil nutrients in the Petauke District, Eastern Province is underway. In the Sinazongwe District, Southern Province, annual rainfall for the 2007/2008 cropping season was twice the normal level. The rain gauges and weather stations we installed in 2007 September to collect farm-specific rainfall and weather information effectively detected this year's abnormal weather conditions. The annual rainfall reached 1600 mm in some areas of our field site. Extensive damage to road and fields are observable. Farmers were trying to overcome this situation via various coping strategies including shifting cropping patterns. The intensive household survey is progressing. The land use and forest cover information using satellite data and aerial photographs as together with intensive ground survey analysis is also underway. We also launched Resilience Working Paper Series in early 2008 and published them on-line at our project home page so that information can be easily disseminated to public through the internet. Papers are contributed both by visiting fellows and project members. Also two interesting working papers by graduate students were just added to our publication.

Our project has just finished the second year of full-research. We appreciate our project members for their efforts and contributions to the steady progress of our project. We also appreciate the Project Evaluation Committee (PEC) members, director, program directors, administrative staff and the colleagues of RIHN for their kind support and for facilitating this trend setting integrated research program.

February 2009

Chieko Umetsu
E-04(FR2) Project Leader
Research Institute for Humanity and Nature, Kyoto, Japan

E-04 (FR2)

Vulnerability and Resilience of Social-Ecological Systems

Project Leader : Chieko UMETSU 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

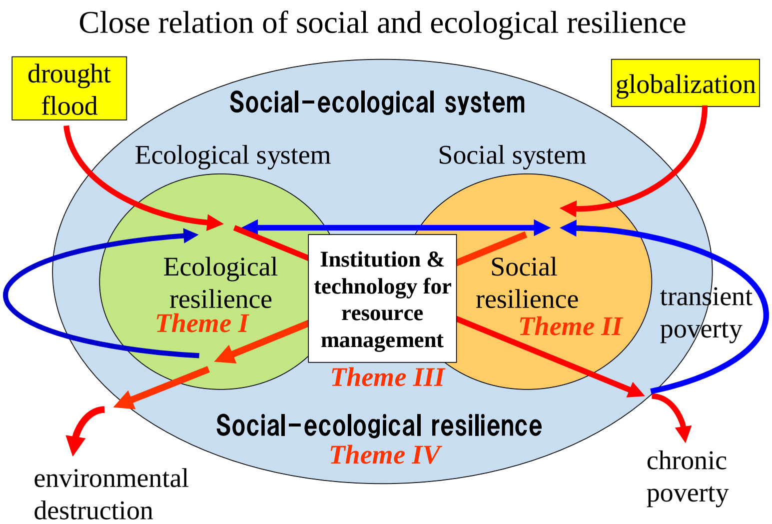
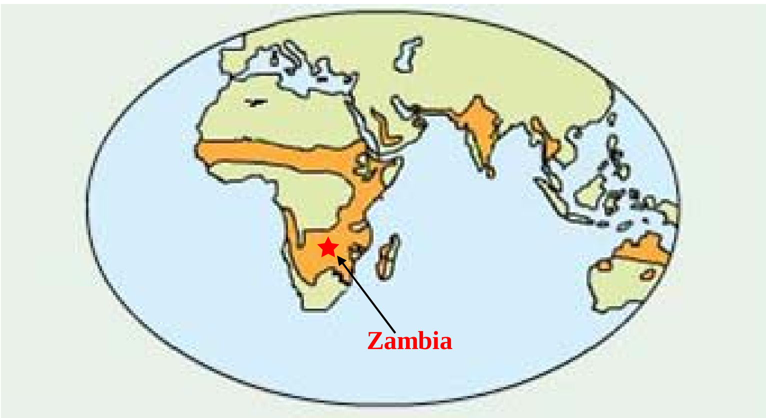


Figure 2. Regions of Semi-Arid Tropics and Study Areas



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
	Theme 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 (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
○	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
	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
○	Ueru TANAKA	Graduate School of Global Environmental Studies, Kyoto Univ.	Terrestrial Ecosystems Management	Associate Professor	agronomy	Landuse and risk management
	Theme II					
○	Takeshi SAKURAI	Wako University	Faculty of Economics and Business Management	Professor	development economics	household survey and analysis
	Hiromitsu KANNO	National Agricultural Research Center for Tohoku 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	Devision of Health Sciences	Associate Professor	human ecology	human growth, nutrition and health
	Theme III					
○	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
○	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
	Tetsuya NAKAMURA	Graduate School of Asian and African Area Studies, Kyoto University	Division of African Area Studies	Graduate student	agricultural economics	socio-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 sysytem
	Theme IV					
○	Mitsunori YOSHIMURA	Remote Sensing Technology Center of Japan (RESTEC)		Senior Researcher	remote sensing	ecological change monitoring
○	Thamana 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
	India					
○	K. Palanisami	Tamilnadu Agricultural University	Centre for Agrl. & 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	agriculatural meteorology	monsoon rainfall analysis
○	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
	Burkina Faso					
	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

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

Vulnerability and Resilience of Social and Ecological Systems Project Progress Report for Theme I: Petauke Research Site, Eastern Zambia

M. Mwale, S.B. Sokotela, G.K. Siulemba, and M.J.Malambo
Zambia Agriculture Research Institute, Mount Makulu Central Research Station, Chilanga, Zambia

1. Introduction

The Vulnerability and Resilience of social and ecological systems in Zambia are being studied in the context of climate change as it affects both the social and ecological factors in a given local environment. Vulnerability and resilience research studies with themes I, II, III and IV aim to serve to develop a comprehensive methodology for assessing social-ecological resilience. Theme I main focus is on soils and forest resources to analyze ecological resilience.

In the Agro-Ecological Region II (medium rainfall zone) of Zambia this is being conducted as part of the ecological resilience and sustainable productivity agriculture demonstration in a *Miombo* woodland ecological system at Mwelwa village in Chief Sandwe's area, Petauke District, in the Eastern Province.

Whilst the theme II focus is to conduct intensive interviews with village farm households and communities to identify factors of social resilience, historical, land tenure systems, government policy change effects on a natural environment and socio-political factors constitute subjects for focus in theme III, as theme IV deals with the use of statistics and remote sensing data to help trace long term changes in soils, forests, and analyze climatic data like rainfall, temperature, wind direction and speed including measurement of sunshine hour periods, through the establishment of Automatic Weather Stations in selected research sites.

The objective for this report is to present the progress of the activities of the ecological studies of the programme being conducted by research scientists from the Zambia Agriculture Research Institute Department of the Ministry of Agriculture and Co-operatives, over the period from April 2007, to November 2008, with the main focus on the theme I. The programme activities are being carried out in eastern Zambia located within the village of Headman Mwelwa, Chief Sandwe, Petauke District.

2. Materials and Methods

To effectively implement and undertake the Vulnerability and Resilience Research Project in Zambia, three main methodological approaches were adopted. For the Themes I and II, the Research Institute for Humanity and Nature (RIHN) of Japan in conjunction with other collaborative institutions such as Kyoto University, Ministry of Agriculture, Fisheries and Forestry (MAFF) in Japan, and others, together with the Zambia Agriculture Research Institute (ZARI) Department of the Ministry of Agriculture and Co-operatives (MACO) of Zambia and other partners, such as the University of Zambia (UNZA), Survey Department, Central Statistical Office, (CSO) undertook to establish respective memoranda of understanding (MoUs) to facilitate carry out the various activities of the Vulnerability and Resilience Research studies in Zambia.

Out of three main target study areas of the Social and ecological Resilience, one is the soils and forest ecological research at the Petauke site area in the Eastern Province of Zambia, and will be the subject of this report.

2.1 Soil and Ecological Research at Petauke, Eastern Province

In collaboration with the RIHN Resilience Research Project, the ZARI Department researchers commenced to conduct experiments and demonstrations for soil fertility restoration and sustainable agriculture at Mwelwa village, Chief Sandwe, in Petauke, Eastern Province.

The studies are aimed to use agro-forestry and green manure plant cultivation in an integrated soil fertility management agricultural system introduction to benefit local farmers, the ecology and soil resources, at the same time help promote both social and ecological resilience through increased soil and land resources productivity, without impairing the ecological environment nature.

2.1.1 Location and Site Characterization

The research site in Mwelwa village is located some 38 Km north-east of the Petauke township, along the Sandwe-Ukwimi Settlement scheme road, with geographical co-ordinate location at approximately 14^0 55’ S and 31^0 25’ E at an elevation about 980 m above mean sea level. The area falls within the Agro-Ecological Region IIa, (Veldkamp et al., 1984), which is characterized by medium rainfall precipitation of about 900 mm in an average year. Like most of Zambia the area falls in a sub continental and subtropical savanna climatic, and vegetation conditions, respectively.

The main local vegetation comprises the *Miombo* woodland (Forestry Department, 1974), dominated by the *Brachystegia* genera trees and *Hyperhania* grass species. The geology in the area lies within the Mvuvye Paragneis and Minga Granites rock formations. These consist of a variable sequence of biotite-gneisses and granulites. One of the commonest rock types is medium grained mafic gneiss composed of quartz, sodic plagioclase and biotite (Drysdall, 1960). The soils in the area have been generally described as to include very deep to deep, well drained, strong brown to red, friable, moderately leached fine loamy to clay, classified as *Chromi-haplic* LIXISOLS (Soil Survey Unit, 1991).

Prior to establishment of the research plots detailed site characterization were conducted including the determination of soil spatial variability, topographical and botanical spatial variability assessments (Noro, 2007). The main soil types were classified as *Typic Plinthustalfs*.

2.1.2 Evaluation of Agro-Forestry Plants for Soil Fertility Restoration and Enhancement of Sustainable Agriculture

The ZARI Department researchers selected two fast growing agroforestry plant species, namely; *Grilicidia sepium* (Grilicidia) and *Cajanus cajan* (Pigeon pea) and two green manure plants represented by *Mucuna repensis* (Velvet bean) and *Chlotolaria juncea* (a Sunnhemp) to undergo experimentation and demonstrations to evaluate their effectiveness in enhancing soil ecology resilience as measured by their efficacy in soil fertility restoration for enhancement of sustainable agricultural practices. Three specific objectives were to be investigated

1) To demonstrate the named plant species in soil fertility improvements for improved short fallow agricultural technology practices,
2) To measure soil properties dynamics and characteristics that occur as a result of defined practices in land use and imposed field practices and
3) To assess any socio-economic impact of (long-term) benefit achieved on adoption of the technologies by various households and community, thereby re-enforcing social and ecological resilience concept and principles.

2.1.3Experimental Design

The field trial was laid out in a Completely Randomized Block Design (CRBD) with three replications at a sub-plot size of 20 x 20 m^2 (Figure 1).

Figure 1: ZARI Research Plot Layout, Mwelwa Village

ROAD							N
	F 13	D 14	A 15	C 16	B 17	E 18	
	A 12	C 11	D 10	E 9	B 8	F 7	
	B 1	E 2	C 3	F 4	D 5	A 6	

Note: A = Treatment; 1 = Sub-plot No. 1

2.1.4 Experiment Treatments

The following treatments were imposed:

A *Grilicidia sepium* fallow (GSF)
B Maize continuous fertilizer (MCF)
C Native Forest fallow (NFF)
D Maize, no Fertilizer (M0F)
E Green Manure fallow (GMF *Mucuna* and *Chrotolaria*)
F *Cajanus cajan* fallow (CCF)

Notes:

a) At the time of implementation each sub plot measuring 20 x 20 m^2 was soil sampled at two depths, the top soil at 0 – 20 cm and the subsoil at 40 – 60 cm depths, respectively. Each soil sample was taken for soil laboratory analyses for pH, Bases, CEC Organic Carbon, total Nitrogen, available Phosphate and Particle Size Distribution (PSD).

b) Gliricidia was initially raised in nursery beds, and later planted into the field from potted seedlings at the spacing of 1 x 1 $m^{2.}$ The spacing for Pigeon pea in the field was the same as for Gliricidia, but the crop was direct planted in the field by seed.

c) A hybrid maize variety MM 604 was used as a test crop and planted at the spacing of 90 cm between rows and 25 cm between stations within the rows. Fertilizer application rate followed the LIMA recommendation of 4 x 50 Kg/ha Compound D (10N, 20 P_2O_5, 10K_2O 4 – 6 S), and the same rate for Urea (46% N) as top dressing in the continuous maize with fertilizer treatment. (MCF).

d) The Native forest fallow was left without carrying out any land clearing or preparation. The bush was left in the virgin state as it was found before implementation of the experiment.

e) The green manure plot was split by planting one half with Velvet bean and the other with Sunnhemp. These are considered to give similar effects and were also introduced for seed multiplication purposes and comparison for soil vulnerability and resilience factors.

f) On all the cultivated plots land preparation consisted of cutting down and stumping all trees, followed by digging with hand hoes well before the onset of the rainy season in October.

g) After planting crop performance monitoring activities were instituted and included replanting, weeding and scoring for disease, pests, etc. Grain yield and Stover were harvested in Maize plots and measured by weight to determine the yield performance. Pigeon pea seed was harvested from dry pods later in the dry season at the time when fields were being protected from fire by clearing the fire breaks around all trial plots.

3. Results and Discussion

In the current results presentation no attempt has been made at any statistical data analyses, since this first progress report mainly serves as a record of raw data observed and collected during the course of and after year 1 of the implementation of the experiment and demonstration activities. The study is scheduled to last for at least four years at the end of which a final report will be compiled. However, from year 2 more comprehensive data generation is expected, and then the results are to be treated with appropriate analytical tools.

3.1 Soil and Ecological Resilience Studies, at Petauke

Progress monitoring and evaluation on the ZARI plots was carried out early in March and the following field observations were made.

1. Between mid-December, 2007 and the end of February, 2008 most of the experimental plots suffered from incidences of attacks by pigs, goats and cattle from surrounding villages (Table 1)

Table1: Incidence of Pigs, Goats, Cattle and Wild Rabbit (Hare) attack on experimental crops at Mwelwa Village Research Site, Petauke.

Animal	Pigs	Goats	Cattle	Hare
Incidence of attack (%)	40	25	18	17

2. Crop performance observations were related to general crop stand, vigour, pest, disease and/or observed nutrient deficiency (Table 2).

Table 2: Observed Crop Performance, Petauke Research Site, 2007/08

	Crop	**Establishment, crop stand, vigour**	**Pest type, severity**	**Disease type, severity**	**Nutrient deficiency**	**Other remarks**
1.	Maize with fertilizer (MCF)	Medium; milk stage, small to medium cob size formation	Goats 70% Pigs 5% Mice 20% Cattle 5%	Necrotic GLS (few) Streak virus (isolated)	*Chlorosis*, N (yellow) P (purple) Mg (green veins in leaf)	Weed pressure, Too much Rain (January)
2.	Maize without Fertilizer (M0F)	Generally small, stunted;; nothing to small cobs	Goats 60% Pigs 20% Cattle 10%	GLS mild Necrosis	Widespread N -*Chlorosis*; Few signs of P Deficiency	As above
3.	Grilicidia (GS)	Good survival rate (90%)	Very slight black aphids -	Not observed	Not observed	Resilient to pest damage once established
4.	Pigeon pea (CC)	Very good, survival rate (98%)	Goats Cattle Hare Pig	Not observed	Not observed	Very good establishment
5.	Velvet bean (V VB)	Medium good cover and growth	Non observed	Non observed	Slight yellowing	Yet to fully establish; planting was late
6.	Sunnhemp (SNH)	Good establishment, severely attacked	Severe by Goats, Hare/rabbits and other rodents (> 90% wiped out)	Not observed	Not observed	Very vulnerable to attack due to good palatability for goats and Hares
7.	Native fallow (NC)	Bush fallow	N/A	N/A	N/A	Some mushrooms growing in association with rotten woody materials

Notes

1. It was noted that continuous heavy rainfall in January soon after top dressing in maize may have induced loss of nitrogen (N) in the MCF treatment.

2. Replanting was necessary for all maize plots due to mice rodents attack at germination. In Grilicidia it was necessary to replant to gap for failure of initial establishment due to dry weather experienced at the time of transplanting in late November to early December 2007.
3. A serious source of concern was the high incidence of domestic stock attack, despite employing two full time guards for the security of the crop and the experiments in general.
4. The following interim recommendation was made to be observed in the meantime to the time the crop was to be safely harvested and all the necessary data collected by researchers.
   a) The need to slash around all the trial plots for crop hygiene
   b) To clearly label all treatments with bill boards for identification of experiment treatments and for the work to be informative.
   c) The need to protect all the experimental plots from roaming, or stray livestock (and possible theft by people). It may be necessary to re-enforce a mesh wire fence barrier to stop/prevent access by pigs, goats and cattle to trial fields, or otherwise, boost security patrol intensity by employing more guards.
   d) Fire breaks must be established early. Ox-ploughing along the experimental site perimeter up to five (5) metres wide should be established. At the same time all subplots must be protected from fire, especially during the dry season, after the crop is harvested. This was to be done soon after harvesting in May-June, 2008.
   e) The vulnerability of sunnhemp by animals was a source of concern in the introduction of the green manures technology. The Velvet bean should be evaluated more closely in this context as it seemed to provide greater resilience potential than Sunnhemp, and a decision should be made to remove it all together from the trial, so that the Velvet bean can cover the entire plot as the sole green manure demonstration.

3.2 Soil Laboratory Analytical Results

Composite soil samples were taken from all the experimental plots at topsoil (0-20 cm), subsoil (40-60) depths. Exchangeable bases (Ca, Mg, K, Na), soil pH ($CaCl_2$), Organic Carbon (C), Nitrogen (N) and Cation Exchange Capacity (CEC) including Phosphate are the soil properties to be used as estimation measurements for the soil fertility status (Table 4). The current results were taken prior to planting the trial, representing the virgin state of soil fertility of the land.

At the tome of reporting the soil laboratories were yet to analyse for available Phosphate (P_2O_5) by the Bray 1 procedure. Similarly, the soil Cation Exchange Capacity (CEC) results had not been received. However in terms of soil chemical properties, the soil reaction condition may be described as strongly to medium acid (pH 5.1 – 5.7), with a medium exchangeable Bases content, but low in soil organic matter content and low total soil Nitrogen (N) composition. General indications are that the soils at the research site may be characterized as of low-medium soil fertility status.

Table 4: Soil laboratory analytical results

Plot	Treatment	Depth	Exchangeable Bases					CEC	Org.C	Total N	Avail. P
Units		(cm)	Ca	Mg	K	Na	pH ($CaCl_2$)	(cmol Kg^{-1})	%	%	(ppm)
1	MCF	0-20	2.0	0.4	0.56	0.52	5.3		0.87	0.06	
		40-60	1.5	0.6	0.90	0.22	5.9		0.17	0.02	
2	VGF	0-20	2.9	0.5	0.72	1.22	5.3		0.53	0.05	
		40-60	2.2	0.8	1.01	0.35	5.5		0.10	0.02	
3	NFF	0-20	2.0	0.7	0.72	0.01	5.3		0.88	0.07	
		40-60	1.4	0.7	0.89	0.01	5.1		0.21	0.02	
4	CCF	0-20	1.9	0.6	0.64	0.01	5.3		0.48	0.04	
		40-60	0.9	0.4	0.49	0.01	5.2		0.18	0.01	
5	M0F	0-20	2.3	1.2	0.77	0.04	5.2		1.14	0.10	
		40-60	1.8	0.7	0.90	0.01	5.3		0.54	0.04	
6	GSF	0-20	2.7	0.5	0.66	0.04	5.1		1.08	0.08	
		40-60	2.5	0.6	0.77	0.04	5.4		0.61	0.05	
7	CCF	0-20	2.6	0.6	0.61	0.13	5.1		1.21	0.10	
		40-60	2.5	0.7	0.74	0.30	5.5		0.54	0.05	
8	MCF	0-20	1.6	0.5	0.59	0.09	5.3		1.04	0.08	
		40-60	1.9	0.4	0.59	0.52	5.4		0.66	0.05	
9	VGF	0-20	2.1	0.7	0.49	0.17	5.6		1.33	0.11	
		40-60	1.6	0.5	0.74	0.22	5.4		0.77	0.06	
10	M0F	0-20	1.4	0.6	0.74	0.17	5.3		1.48	0.09	
		40-60	2.6	0.4	0.90	0.65	5.3		0.55	0.05	
11	NFF	0-20	1.2	0.5	0.59	0.66	5.3		1.09	0.08	
		40-60	2.5	0.6	0.59	1.13	5.7		0.41	0.04	
12	GSF	0-20	1.5	0.6	0.82	0.22	5.2		1.21	0.09	
		40-60	1.7	0.5	0.82	0.13	5.4		0.66	0.05	
13	CCF	0-20	1.3	0.7	0.74	0.53	5.3		1.49	0.11	
		40-60	1.8	0.5	0.90	0.43	5.3		0.54	0.05	
14	M0F	0-20	1.5	0.6	0.64	1.00	5.2		1.31	0.10	
		40-60	3.1	0.7	0.77	0.43	5.2		0.67	0.05	
15	GSF	0-20	2.4	0.8	1.00	0.70	5.2		1.33	0.09	
		40-60	2.1	0.8	0.99	0.61	5.5		0.66	0.05	
16	NFF	0-20	1.6	0.7	0.74	0.04	5.5		1.23	0.10	

		40-60	2.3	0.4	0.66	0.43	5.6		0.52	0.05	
17	MCF	0-20	4.5	1.0	0.66	1.26	5.7		1.21	0.08	
		40-60	2.3	0.4	1.00	0.65	5.5		0.44	0.03	
18	VGF	0-20	2.4	0.6	0.72	0.26	5.3		1.10	0.08	
		40-60	2.1	0.5	0.61	0.19	5.2		0.28	0.03	

CCF	Cajanus cajan fallow (Pigeon pea)
GSF	Grilicidis Sepium fallow (Grilicidia)
MCF	Maize with fertilizer continuous

3.3 Crop Performance for Maize

The maize crop was harvested on 27th March 2008. Maize harvest data were measured both in the field to obtain biomass weight, and at the laboratory to estimate the grain yield, and then to compare both parameters for the effects of cultivation without fertilizer and with fertilizer (Table 3)

Table 3a: Maize harvest data biomass (Field) per plot

Plot No	Treatment	# Cobs	Wt. of Cobs (Kg)	Wt Stover (Kg)	Biomass Wt. (Kg)
8	M0F	136	6.6	9.9	16.5
17	M0F	81	5.9	6.4	12.3
1	M0F	121	6.1	6.1	12.2
Av.	M0F	112.7	6.2	7.4	13.7
5	MCF	160	12.2	25.4	37.6
10	MCF	124	6.2	11.8	18.0
14	MCF	138	11.1	11.2	22.3
Av.	MCF	140.7	9.8	16.1	25.9

Table 3b: Maize grain yield data

Plot No	Treatment	Grain Yield Mass (Kg)	Moisture (%)	Grain Yield/Plot	Yield (Kgha-1)
8	M0F	3.852	12.4		
17	M0F	4.297	11.3		
1	M0F	3.403	11.9		
Av.	**M0F**	**3.851**	**11.9**	**3.076**	**769**
5	MCF	5.009	12.6		
10	MCF	4.572	12.0		
14	MCF	4.529	12.2		
Av.	**MCF**	**4.703**	**12.3**	**4.125**	**1031**

Notes:

1. Harvest area: 2x2 M2 x10 = 40 M2
2. MCF = Continuous Maize with Fertilizer
3. M0F = Continuous Maize without Fertilizer

4. Discussion and Recommendation

4.1 Soil Properties

Soil chemical properties represented by soil reaction conditions are strongly to medium acid (pH 5.1 – 5.7), with a medium exchangeable Bases content, but low in soil organic matter content and low total soil Nitrogen (N) composition. General indications are that the soils at the research site may be characterized as of low-medium soil fertility status.

4.2 Maize Crop Performance

In general the maize crop performance appears to have been rather suppressed as observed by *chlorosis* symptoms, indicating low Nitrogen intake during crop plant growth. This may be attributed to high amounts of rainfall received during the season. However in terms of grain yield, the continuous Maize with fertilizer treatment out yielded the one without fertilizer by at least 25 %. The result represents a first season crop and an abnormally higher than usual rainy season.

4.3 Agro-Forestry and Green Manure Technology Demonstration

The establishment for both the Grilicidia and Pigeon pea plots was successful. The pigeon pea plants were able to flower during the dry season (July to September 2008), and a small amount of pulse grain was harvested. Yield quantities will be measured in the second season (Year 2) of plant growth.

Whereas both the green manure plants of Velvet bean and Sunnhemp established successfully, a set back was experienced with the Sunnhemp as it was wiped out from all the plots, having been grazed by wild rabbits (Hare) and other rodents such as mice. Subsequently a decision was reached to phase out the Sunnhmp, and instead to plant all the green manure plots with Velvet bean 100 % in the coming seasons.

The second season (Year 2) trial crop of maize has been planted during the last week of November 2008 as adequate rains for planting were received in the area. The Velvet bean green manure crop was planted at the same time.

References

Drysdall, A.R. 1960. Graphite of the Petauke District, Eastern Province. Geological Report No. 14. Ministry of Labour and Mines, Geological Survey, Government Printer, Lusaka.

Edmonds, A.C.R. 1976. The Republic of Zambia Vegetation Map (Scale, 1:500,000), Forest Department, Lusaka.

Noro, Y. 2007. Spatial variability of soil properties in a Miombo woodland in Eastern Zambia. Laboratory of Soil Science, Graduate School of Agriculture, Kyoto University, Kyoto.

Soil Survey Unit, 1991. Exploratory Soil Map of Zambia (Scale, 1:1,000,000). Department of Agriculture, Lusaka

Veldkamp, W.J., Muchindu, M and Delmotte, A.P., 1984. Agro-climatic Zones of Zambia, Soil Survey Unit, Department of Agriculture, Lusaka

Off-Farm Labor Supply as a Risk-Coping Strategy
-Preliminary Evidence from Household Survey in the Southern Province, Zambia-

Takeshi Sakurai
Wako University, Machida, Tokyo, Japan

Abstract

This report presents the results of preliminary analyses of household survey data collected for Theme 2 of the RIHN's Resilience Project so that it would convey the idea as to what kind of research output can be expected. From the viewpoint of "resilience", it is very important to investigate how a farm household recovers its consumption from a shock that negatively affects its income and hence reduces its consumption. If the recovery is quick, such a household is considered to be resilient relative to those who have difficulty in recovering consumption level. Theme 2 aims to provide the evidence of the household-level resilience and to examine its determinants based on the survey data of 48 sample households spread over three agro-ecologically distinctive zones in the Southern Province of Zambia, where variable precipitations often cause shocks at farm household level.

It is well known that rural households in Sub-Saharan Africa have adopted a variety of *ex ante* as well as *ex post* risk response strategies so that consumption be smoothed in the presence of various shocks. Household survey of Theme 2 is designed to deal with all the potential strategies at household level. Among them, this report focuses on off-farm economic activities since they are significant sources of household income in the study site.

Time allocation to 6 categories of activity at household level (hours per day per adult) were obtained from weekly interview on household members' daily time use, and then the average time used for each activity and its variance were compared over the three periods in cropping season: planting season (period 1), before harvest season (period 2), and after harvest season (period 3). It is found that significantly longer time is used for agricultural work in period 1 than other periods, while time used for non-agricultural work is significantly longer in period 3 than other periods. Even in period 3, some households do not increase time allocated to non-agricultural work, while the others increase it. As a result, the variance in time allocation to non-agricultural work is significantly larger in period 3 than other periods. These findings may suggest that some (not all) households use non-agricultural work as an *ex post* risk-coping strategy to respond to crop production shock in the previous cropping season. However, the findings are not sufficient to conclude it: it is necessary to separate *ex ante* portion of non-agricultural work from *ex post* portion of non-agricultural work, and to test if *ex post* non-agricultural work actually smoothes consumption. Such robust analyses remain for future studies. The on-going weekly interview of the household survey together with daily precipitation recorded at plot level as well as weekly body measurement of household members will constitute a rich dataset to investigate household-level resilience in variable environment.

1. Introduction

From the viewpoint of "resilience", it is very important to investigate how a farm household recovers its consumption from a shock that negatively affects its income and hence reduces its consumption. If the recovery is quick, such a household is considered to be resilient relative to those who have difficulty in recovering consumption level. Theme 2 of the RIHN's Resilience Project aims to provide the evidence of the household-level resilience and to examine its determinants based on the data collected from sample households in the Southern Province of Zambia, where variable precipitations often cause shocks at farm household level.

It is well known that poor households in developing countries, particularly in Sub-Saharan African countries, adopt various *ex ante* as well as *ex post* strategies in the variable environment, where insurance and credit markets have rarely developed (Dercon, 2005). Those strategies include *ex ante* crop and income diversification, *ex post* off-farm economic activities including temporary migration, assets typically livestock sales, and receiving gifts and remittances. Relative importance among the strategies should depend on household's characteristics as well as socio-ecological environments. Socio-ecological environment determines local off-farm income opportunities such as natural resource collection, off-season gardening (which is considered to be an off-farm activities), gift-receiving from neighbors, and so on, and consequently should affect the choice of strategies. In spite of the adoption of various strategies, consumption cannot be unaffected in the presence of frequent shocks (Dercon, 2002). Particularly in the case of covariate shock such as drought, informal risk coping mechanisms that depend on neighbors are not effective because many households within a certain region suffer simultaneously, and as a result the reduction of consumption level is not only severer but also more persistent (Hoddinott and Harrower, 2005 and Dercon, Hoddinott, and Woldehanna, 2005). It is still unknown, however, what makes farm households resilient in such cases.

Household survey of Theme 2 is designed to deal with all the strategies mentioned above and to investigate their impact on income/consumption smoothing. Among them, this report focuses on off-farm economic activities since in the study site, the Southern Province of Zambia, they are significant sources of household income. Rose (2001) analyzed off-farm labor supply of agricultural households under rainfall risk in India, and showed that households more relying on rainfall (i.e. with greater risk) were more likely to participate in the labor market (*ex ante* response) and that unexpected low rainfall also increased labor market participation (*ex post* response). As such, Rose's analysis distinguishes *ex ante* and *ex post* off-farm labor supply, but it considers a single labor market outside the farm without making distinction between agricultural employment and non-agricultural employment. On the other hand, Ito and Kurosaki (2006) categorized agricultural household based on the type of work, i.e., self-employment in agriculture, self-employment in non-agriculture, wage work in agriculture, and wage work in non-agriculture, and analyzed labor supply in relation to rainfall risk in India. They showed that rainfall risk increased households' participation in non-agricultural off-farm wage work much more than agricultural off-farm wage work because agricultural wage is negatively affected by the rainfall risk. However, unlike Rose (2001), Ito and Kurosaki (2006) do not distinguish *ex ante* and *ex* *post* labor supply. Hence, this report makes the distinction of off-farm labor supply between agriculture and non-agriculture as well as between *ex ante* and *ex post*.

Moreover, in the study site, or in Sub-Saharan Africa in general, labor markets either agricultural or non-agricultural have not developed well, and hence farm households rely almost exclusively on self-employment, which situation is unlike in India where the data used by Rose (2001) and by Ito and Kurosaki (2006) were collected. Because of the relative relevance of non-agricultural self-employment, this report considers natural resource collection and grazing as separate categories from off-farm labor supply. In terms of risk coping, natural resource collection and grazing may have different effects: labor supply to the former activity will have an immediate impact on household consumption as it brings something edible directly back to home, while the latter activity is itself just an asset-keeping and does not generate revenue unless livestock is sold. In addition, if a farm household depends on human networks as risk coping strategies, investment in social capital is also critical (Sakurai, 2006). Since one way to accumulate social capital is to participate in social activities such as church activities, this report regards time spent for social activities as risk-responding labor supply (at least potentially).

2. Study Site and Data

The study site of the Resilience Project Theme 2 is located in "Sinazongwe area" of the Southern Province, Zambia. The Sinazongwe area consists of three distinctive zones in terms of not only agro-ecology but also historical settlement pattern: namely lower slope flat land zone near Kariba lake, middle slope zone, and upper slope flat land zone. We carried out a rapid extensive survey over the three zones, and conducted a group interview in intentionally selected 17 villages to gather village-level information. Out of the 17 villages surveyed, 5 villages representative of the diversity of the study site were chosen. In the lower slope flat land zone, two contrasting adjacent villages were selected: one has been originally located in the current location and the other was relocated to the current location due to the construction of Kariba dam in the 1950's. The two villages together are named site A. In the middle slope zone, most villages were newly established during the 1990's by migrants from the populous lake side zone. Since each village in this zone is relatively small, two adjacent villages were selected to have enough number of population from which we would sample, and were together named site B. As for the upper slope flat land zone an old village that has been receiving immigrants from the lake side zone were selected as site C. Administratively, sites A and B belong to Sinazongwe district, while site C belongs to Choma district.

Then, population census was carried out in July and August 2007 in the three sites. The results of the census are reported in Sakurai (2008a; 2008b). Census information was used for the sample selection so that the sample households are representative of agro-ecological diversity in each site. Based on the census, 16 households in each site, thus 48 households in total were selected. Household survey including weekly interview on household members' time allocation started just before the onset of the rainy season in November 2007. The household survey is still going on at the time when this report is being written in December 2008. Hence, this report presents only the results of preliminary analyses of household survey data: that is, characteristics of the sample households as of November 2007 and the change of time allocation pattern during the rainy season of 2007/08.

Table 1 Characteristics of Household Heads and Wives as of November 2007[1]

	Site A (Low)	Site B (Middle)	Site C (High)
Male Household Heads			
Number of Spouses per Head	1.31 (0.48)	1.31 (0.48)	1.57 (0.94)
Year of Birth	1969 (13)	1968 (14)	1971 (14)
Number of School Years Completed	6.2 (2.7)	3.4 (3.4)	5.1 (2.9)
Total Number	13	16	14
Female Household Heads			
Number of Spouses per Head	0 (0)	NA	0 (0)
Year of Birth	1946 (4.9)	NA	1963 (8.5)
Number of School Years Completed	2.0 (3.4)	NA	2.0 (2.8)
Total Number	3	0	2
Household Head's Wives			
Year of Birth	1975 (8.1)	1975 (9.4)	1971 (14)
Number of School Years Completed	4.0 (2.2)	2.5 (3.0)	4.2 (2.8)
Total Number	17	21	22

[1] Standard deviations are in the parentheses.

3. Characteristics of Sample Households

Table 1 shows some characteristics of the head and its spouses of sample households. Out of 48 sample households, 43 households are headed by a male. Although most of the farmers in the study site identify themselves as Christian, polygamy is often practiced even by Christians, and hence average number of wives is more than one in each site. Male household heads in site C have more wives than those in other sites, which probably reflects relatively favorable agricultural environment in site C. Average age of male household heads does not differ much among the three sites as shown in the Table 1, but average school years completed are different. While male household heads in site A are relatively more educated, those in site B are relatively less educated on average. This implies that less educated people tend to settle in the escarpment area like site B and/or highly educated farmers may not stay long in the unfavorable area and are likely to move out.

On the other hand, female household heads are either divorced or widowed, and consequently relatively more aged than male household heads on average. In addition, these female heads are less educated. The low human capital endowment among them may be either because they are female or because they are old. If they are compared with the wives of the male household heads, it is confirmed that females are generally less educated than males and that relatively old females are less educated than relatively young females: as shown in Table 1, wives' age on average is the same or younger than that of their spouses, and wives' education level on average is much lower than that of their spouses. Among the wives, those in site B is the least educated. As discussed above, people that have settled on the slope are not highly educated.

Table 2 Occupations of Male Household Heads (Nov. 2006 – Oct 2007)[1]

Primary Occupation	Secondary Occupation	Site A (Low)	Site B (Middle)	Site C (High)
Agriculture (self)	None	6	6	5
	Agriculture (employed)	1	0	1
	Non-Agri. (self)	4	10	7
	Non-Agri. (employed)	2	0	0
Non-Agri. (self)	None	0	0	0
	Agriculture (self)	0	0	1
	Agriculture (employed)	0	0	0
	Non-Agri. (employed)	0	0	0
Total Number		13	16	14

[1] The figures in the table are the number of male household heads.

Table 2 presents a summary of occupations of male household heads. The information is based on the questions on the primary occupation as well as the secondary occupation of each household heads in terms of time use during the last one year, i.e. from November 2006 to October 2007. As shown in Table 2, the occupations of male household heads are one of agricultural self-employment, employment in agricultural sector, non-agricultural self-employment, and employment in non-agricultural sector, or two of them. Although there are 5 other selections in the questionnaire: domestic work/helping household, student, retired, before schooling age, and not working due to chronically ill, none of them were chosen by male household heads. The results indicate that all the male household heads except one in site C are self-employed in agriculture as the primary occupation, and that 17 of them do not have any secondary occupation, while 21 of them are engaged in non-agricultural self-employment as a secondary occupation. As shown in Table 1 male household heads in site B are the least educated among the three sites, but Table 2 shows that the rate of engagement in non-agricultural self-employment is the highest in site B. It is because they are practicing lumbering thanks to relatively rich timber resources around site B. On the other hand, employment, in either in agricultural sector or non-agricultural sector, is not common among the male household heads in the study site.

In Table 3 female household heads (the number is only 5 as shown in Table 1) and the wives of male household heads are combined together, and their occupations are presented. They are based on the same information as in the case of male household heads. Table 3 indicates that all the females except for three in site C also mention agriculture as their primary occupation. As for their secondary occupation, "no secondary occupation" comes first then domestic work. Unlike the case of males, non-agricultural self-employment is not so common. Although the distinction between "no secondary occupation" and domestic work is not very clear, it is possible for some females to do little of domestic work since other females such as co-wives, sisters, children are available in the households. Finally, employment is rare among females just like in the case of male household heads.

Table 3 Occupations of Female Household Heads and Head's Wives (Nov. 2006 – Oct 2007)[1]

Primary Occupation	Secondary Occupation	Site A (Low)	Site B (Middle)	Site C (High)
Agriculture (self)	None	12	10	12
	Agriculture (employed)	0	0	0
	Non-Agri. (self)	2	3	4
	Non-Agri. (employed)	0	0	0
	Domestic Work	6	8	5
Domestic Work	None	0	0	0
	Agriculture (self)	0	0	2
	Agriculture (employed)	0	0	1
	Non-Agri. (employed)	0	0	0
	Domestic Work	0	0	0
Total Number		20	21	24

[1] The figures in the table are the number of female household heads and head's wives.

4. Time Allocation

Now the question is how a household allocates its time between sectors, i.e. agriculture and non-agriculture, as well as between periods, i.e. *ex ante* and *ex post*. In order to answer it, household time allocation pattern is calculated from the information obtained by the household weekly interview. The weekly interview asks a one-week recall on daily time use for 7 categories of activity (agriculture, non-agriculture, natural resource collection, grazing, domestic work, social activities, and education) of each household member including children. This question about time use does not distinguish between employment and self-employment in the case of agriculture and non-agriculture, and this report follows such categorization of activities. This cannot be a serious problem since employment is rare in the study site as shown in Tables 2 and 3. Moreover, the weekly interview has another set of questions about the type of work done, which enables us to make a distinction between employment and self-employment although this report does not do it.

Table 4 presents average time allocated to 6 categories of activity for the 16 sample households in site C. Due to time constraints for preparing this report, only site C data are analyzed here. The following remarks on Table 4 need to be noted. First, it limits to adult household members, the definition of which is one whose age is above 12 as of October 2007 when the survey started. By this definition, adult household members include not only the head and its spouses, whose characteristics are summarized in Tables 1, 2, and 3, but also other adults living in the same household. Some of the adults are students and are going to school. Students above the age of 12 are counted as adults by the definition, but time spent for education (one of the 7 categories as given above) is not included in total work time. Consequently, Table 4 has only 6 categories of activity. As for time period, Table 4 divides one cropping season into three periods so that *ex ante* and *ex post* impact of weather shock can be distinguished. Period 1 is the beginning of 2007/08 cropping season, where ploughing and sowing are the main activities. Period 1 in Table 4 covers 4 weeks from the middle of November to the middle of December in 2007. Period 2 is a pre-harvest period, by which most cropping activities have been completed. Period 2 in Table 4 covers 4 weeks from the middle of February to the middle of March in 2008. Period 3 is the period of after-harvest. Period 3 in Table 4 covers 4 weeks from the middle of April to the middle of May in 2008. Then, for each period and for each household, average time allocated to each category of activity per day per adult is calculated. Finally, the average and the standard deviation of the household-level figures are obtained, and presented in Table 4. Because of some missing data, time allocation is obtained only for 10 households out of 16 in Period 1, and 14 households out of 16 in Periods 2 and 3.

Table 4 Household's Time Allocation among Various Activities (hours per day per adult)[1]

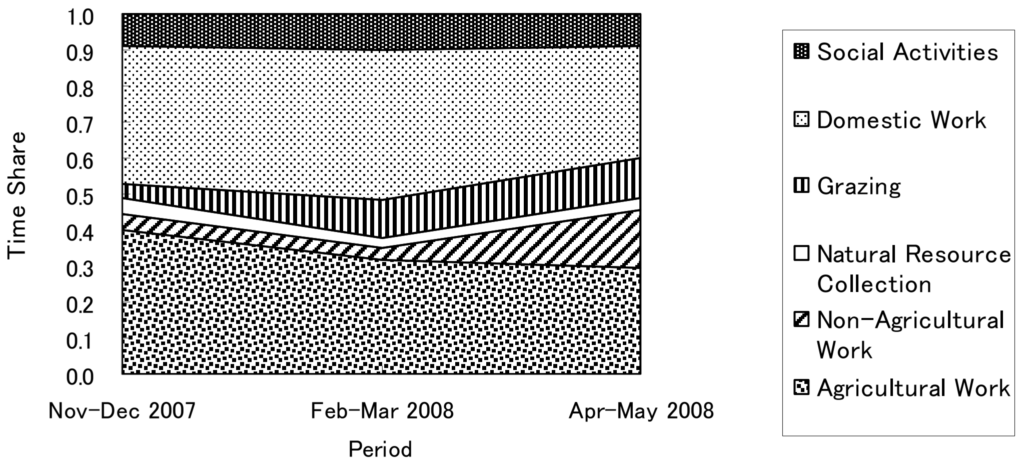
	Period 1 Nov-Dec 2007	Period 2 Feb-Mar 2008	Period 3 April-May 2008
Total Work Time	5.74 (1.41)	4.84 (1.77)	5.39 (1.55)
Agricultural Work	2.28 (0.78)[a]	1.53 (0.77)[a]	1.71 (1.09)
Non-agricultural Work[#]	0.26 (0.21)[a]	0.16 (0.13)[b]	0.88 (0.75)[a, b]
Natural Resource Collection	0.24 (0.16)	0.14 (0.15)	0.18 (0.24)
Grazing[#]	0.23 (0.23)	0.51 (0.49)	0.56 (0.74)
Domestic Work	2.20 (1.27)	2.02 (1.35)	1.62 (0.96)
Social Activities	0.51 (0.41)	0.47 (0.35)	0.48 (0.47)
Number of Households	10	14	14

[1] Standard deviations are in the parentheses.
[a] Two averages are different at the significance level of 5% by paired sample T-test.
[b] Two averages are different at the significance level of 1% by paired sample T-test.
[#] The variances of three periods are different at the significance level of 1% by Levene test.

With respect to household time allocation, the following points are salient in Table 4. First, as discussed with Tables 2 and 3, agricultural work uses most of the household work time, but domestic work is almost equally significant in terms of time allocation. Second, since natural resource collection, grazing, and social activities are not considered as occupations, they do not appear in Tables 2 and 3. But they are as important as non-agricultural work in terms of time allocation. Third, as expected, longer time is used for agricultural work in period 1 than other periods. Statistical tests show that difference in the amount of time spent for agriculture is significant between periods 1 and 2. In period 3 there is still agricultural work: some of the households continue harvesting and post-harvest processing, others work in gardens for vegetable production using residual moisture near streams. Fourth, also as expected, time allocation for non-agricultural work is much larger in period 3 than other periods. The difference is statistically significant between periods 1 and 3 as well as between periods 2 and 3. Fifth, time allocation for other activities also shows some tendency. For example, time used for natural resource collection is the largest in period 1; time spent for grazing is the smallest in period 1; and time for social activities does not change much over the periods. However, the differences in time use for natural resource collection and grazing are not statistically significant, as indicated in Table 4. Sixth, total working time is lower in period 2 where there is not much work for agriculture, although the difference is not statistically significant. If total time per day given to an adult household member is assumed to be 8 hours, the residual of working time can be considered as leisure. And hence, Table 4 indicates that household adult members tend to have more leisure in period 2 than other periods on average.

As discussed above, total working time is variable depending on the period. Hence, instead of absolute hours spent for each activity, Figure 1 shows time share of each activity in total working time. Figure 1 confirms that time share of agricultural work declines over the three periods, while that of non-agricultural work increases in period 3. Figure 1 also shows that time share of domestic work does not change in the first two periods but sharply reduces in period 3. Although this report does not provide rigorous analyses, Figure 1 seems to suggest that non-agricultural work and domestic work are competing for household time in period 3.

Fig. 1 Time Allocation during Cropping Season



Time allocation pattern differs in each period not only in terms of average time used for each activity but also in terms of variation of time use among sample households. As shown in Table 4, variances are significantly different in the case of non-agricultural work and grazing: variation among households in time use is much larger in period 3 than in other periods. These results can be graphically confirmed in Figures 2 and 3. Each line in the figures corresponds to a sample household. Figure 2 shows that some households do not seem to increase time allocated to non-agricultural work even in period 3, while the others increase it. In addition, several households sharply increase time allocation to non-agricultural work in period 3, which may create the huge variation in period 3 compared with other periods. This result may suggest that some (not all) households use non-agricultural work as a risk-coping strategy to respond to crop production shock. Figure 3 is for grazing. It shows that some households increase grazing time in period 3, while other households decrease it. Considering that grazing itself does not produce immediate revenue, incremental time allocation to grazing after harvest may not be a risk-coping behavior. The determinants of grazing time remain to be a topic of future research.

Fig. 2 Time Used for Non-Agricultural Work per Day per Adult

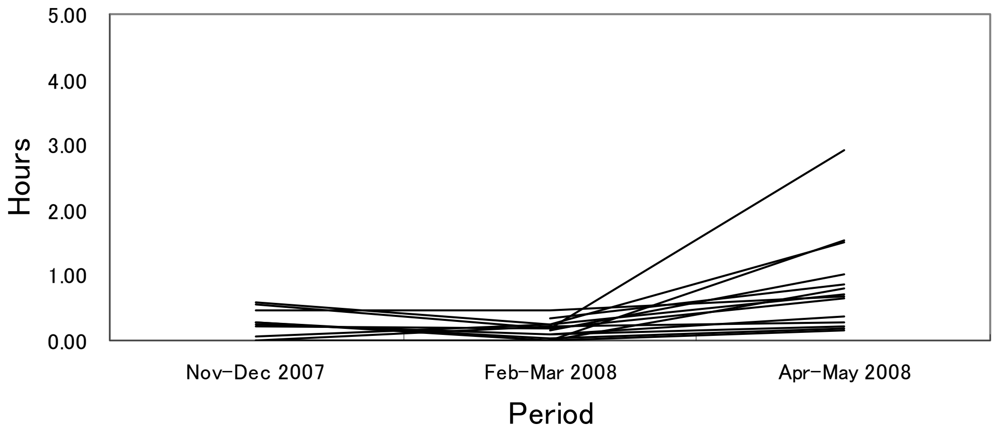
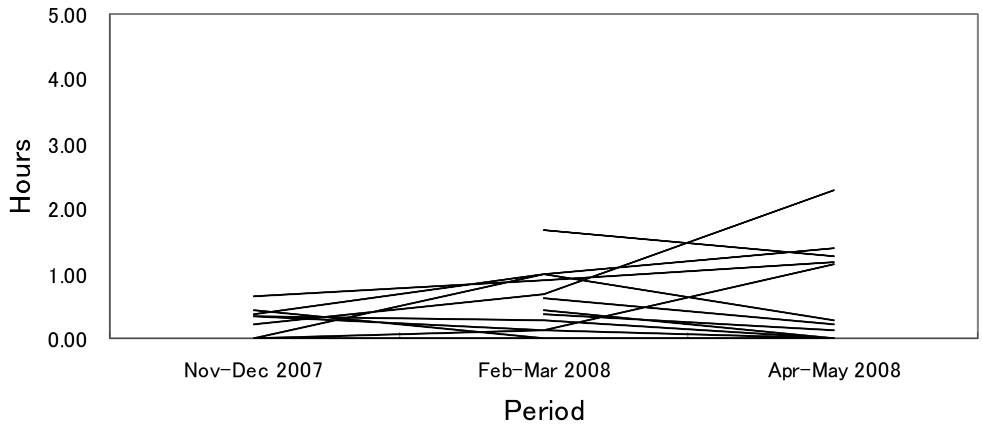


Fig. 3 Hours for Grazing per Day per Adult



Figures 4 and 5 are the case where the variances do not significantly differ over the three periods. Figure 4 shows time allocated to agricultural work, indicating that the majority of households reduce time used for agricultural work in period 2, which causes the significant smaller average hours in period 2 than in period 1 as shown in Table 4. Interestingly enough, in period 3, some households increase time allocation to agricultural work, while others decrease it. As a result, the standard deviation increases in period 3 (although statistically not significant), but the mean value in period 3 does not change significantly. Thus, Figure 4 implies that for some households agriculture in period 3 (i.e. vegetable production in gardens) may be an *ex post* risk coping strategy in the case of crop failure. However, it does not exclude the possibility that the practice of dry season agriculture is determined by other factors such as access to water sources than crop failure in the previous cropping season. Total working time shown in Figure 5, on the other hand, does not show any particular pattern of change over the three periods except for the slight decline in period 2, which is also observed in Table 4. However, looking at each line in Figure 4 reveals that some households increase total working time in period 3, while others decrease it. Thus, it is hypothesized that those who increase total working time in period 3, may be engaged in risk-coping activities, either agriculture or non-agriculture, while those who decrease total working time in period 3, do not necessarily have to conduct any coping in period 3 and hence enjoy leisure. Testing these hypotheses is out of the scope of this report and remains for future research.

Fig. 4 Time Used for Agricultural Work per Day per Adult

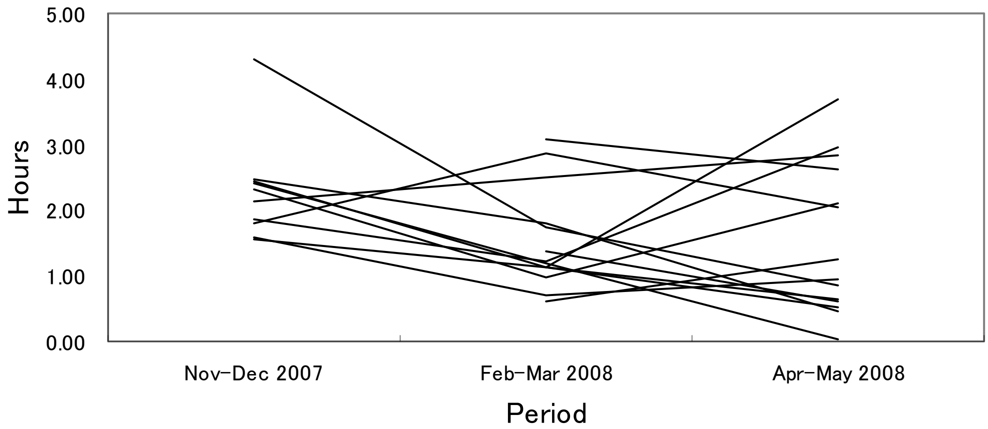
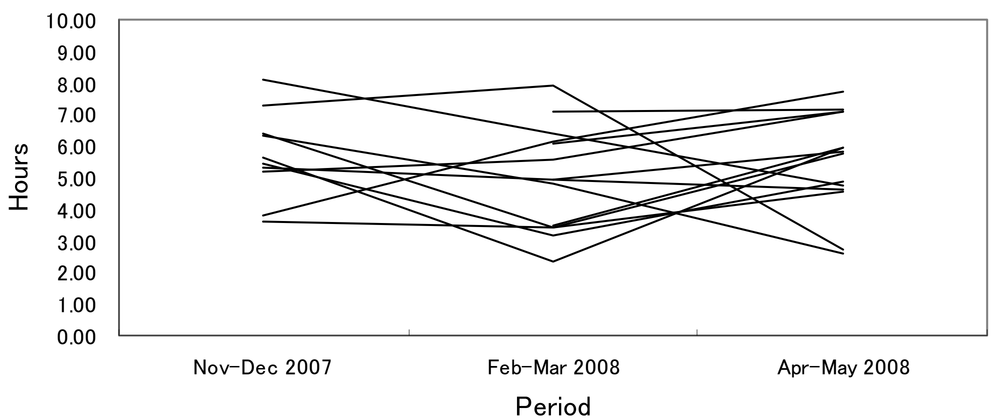


Fig. 5 Total Working Time per Day per Adult



5. Future Direction

Table 4 and Figure 1 in the previous section together indicate that agriculture is the single dominant economic activities during cropping season, while the significance of non-agricultural work increases after harvest. These results might suggest that non-agricultural work is an *ex post* risk coping strategy after having a shock in crop production. However, in order to conclude it, it is necessary to provide evidence that households having suffered a shock in crop production in periods 1 and 2 increase non-agricultural work in period 3. Moreover, it is necessary to separate *ex ante* risk management from *ex post* risk coping, because a household who is vulnerable to external shock such as drought may expect a shock and allocate more time to non-agricultural work as an *ex ante* strategy, which does not depend on crop production performance in previous periods.

The household survey of the Resilience Project Theme 2 makes it possible to investigate these points because it has data of daily precipitation recorded on each sample household's plot and because the survey will continue for at least three years to construct a panel dataset. The former feature of the household survey enables us to deal with rainfall as an idiosyncratic shock because observed rainfall level varies significantly even within a site. Thus, if incremental time allocation to non-agricultural work in period 3 depends on the plot-specific rainfall received in the field, such non-agricultural work can be considered to be an *ex post* coping. But as discussed, cross-sectional comparison using only one season data is not sufficient to separate *ex ante* risk management. With this regard, the latter feature of the household survey will help us to eliminate *ex ante* portion of non-agricultural work because it can be treated as a household fixed effect in panel data.

In this short report, labor supply as risk responses is the only concern. However, as stated in section 1, "resilience" requires consumption smoothing in variable environment. In this sense, it is necessary to test if such labor supply responses really smooth income and hence consumption. The household survey collects weekly information on household's income and consumption. Particularly, as consumption indicators, the survey asks not only the amount of food consumed, but also cash and in-kind expenditures in a week. Moreover, household members' body weight and fat thickness are measured every week. Such a rich dataset is being constructed and remains to be analyzed in future research.

6. Conclusions

Theme 2 of the RIHN's Resilience Project aims to provide the evidence of the household-level resilience and to examine its determinants based on household survey conducted in the Southern Province of Zambia. This report presents only the results of preliminary analyses of household survey data collected during the first cropping season of 2007/08, focusing on labor supply as risk responses. It is found that significantly longer time is used for agricultural work during planting period, while time used for non-agricultural work is significantly longer after harvest. Even in the after harvest period, some households do not increase time allocated to non-agricultural work, while the others increase it. As a result, the variance in time allocation to non-agricultural work is significantly larger after harvest than before harvest. These findings may suggest that some (not all) households use non-agricultural work as an *ex post* risk-coping strategy to respond to crop production shock in the previous cropping season. However, the findings are not sufficient to conclude it: it is necessary to separate *ex ante* portion of non-agricultural work from *ex post* portion of non-agricultural work, and to test if *ex post* non-agricultural work actually smoothes consumption. Such robust analyses remain for future studies. The on-going weekly interview of the household survey together with daily precipitation recorded at plot level as well as weekly body measurement of household members will constitute a rich dataset to investigate household-level resilience in variable environment.

References

Dercon, S. 2002. "Income Risk, Coping Strategies, and Safety Nets," *World Bank Research Observer*, Vol. 17, No. 2, pp. 141-166.

Dercon, S. (ed.), 2005. Insurance against Poverty. Oxford: Oxford University Press.

Dercon, S., J. Hoddinott, and T. Woldehanna, 2005. "Shocks and Consumption in 15 Ethiopian Villages, 1999-2004," *Journal of African Economies*, Vol. 14, No. 4, pp. 559-585.

Hoddinott, J. and S. Harrower, 2005. "Consumption Smoothing in the Zone Lacustre, Mali," *Journal of African Economies*, Vol. 14, No. 4, pp. 489-519.

Ito, T. and T. Kurosaki, 2006. Weather Risk and the Off-Farm Labor Supply of Agricultural Households in India, *Discussion Paper Series No.161*, Tokyo: Institute of Economic Research, Hitotsubashi University.

Rose, E., 2001. "Ex Ante and Ex Post Labor Supply Response to Risk in a Low Income Area." *Journal of Development Economics*, Vol. 64, No. 2, pp. 371-388.

Sakurai, T. 2006. "Role of Social Capital for Economic Development: Evidence and Issues," In: S. Yokoyama and T. Sakurai (eds.) *Potential of Social Capital for Community Development*, Tokyo: Asian Productivity Organization, pp. 217-235.

Sakurai, T. 2008a. "Asset Holdings of Rural Households in Southern Province, Zambia: A Report from Census in the Study Villages," *FY2007 FR1 Project Report*, pp. 59 (abstract).

Sakurai, T. 2008b. "Smallholders' Adaptability to Climate Change in Sub-Saharan Africa: Preliminary Investigation Based on Farm Household Survey in Zambia," *Wako Keizai*, Vol. 41, No. 1, pp. pp. 43-65 (in Japanese).

Growth and Nutritional Status of Children and Adults Living in Contrasting Ecological Zones in the Southern Province of Zambia

Taro Yamauchi
Graduate School of Health Sciences, Hokkaido University, Hokkaido, Japan

Abstract

Zambia has been facing erratic and poor distribution of rainfall in many parts of the country, particularly the low-veldt areas of the southern, western and north-western provinces. In October 2007, we started a longitudinal survey of growth and nutritional status, monitoring local people dwelling in five villages located in the Sinazongwe district in the southern province of Zambia, in order to examine the influence of decreased water and food availability caused by drought.

We report on the nutritional status of adults and children and growth status of children in the initial stages of a longitudinal survey of people living in three ecologically contrasting zones: the upper flat land zone on the plateau, the middle slope zone, and the lower flat land zone near Lake Kariba. More than 70 % of adults were classed as 'normal' in terms of their body mass index (BMI), which suggests that the nutritional status of adult subjects was generally good. Adults who live on the lower flat land were relatively taller and heavier than their counterparts living on the middle slopes and on the upper flat land. In contrast to the adults, the growth and nutritional status of children were poor. Compared with US reference data, the height and weight of the children was approximately equal to or less than the 3rd percentile of the US population. Moreover, the nutritional status of children was worse than that of adults. Thirty-five percent of boys and 45 % of girls were classed as 'underweight'.

It is expected that with the increase in available data in the future, it will be necessary to adjust the figures reported here. In addition, when sufficient data has been obtained for each individual, it will be possible to conduct not only cross-sectional analyses, as in this report, but also longitudinal analyses. These will enable us to examine in more detail the influences of environmental change, particularly rainfall, on the growth and nutritional status of adults and children.

1. Introduction

Geographical variation in the amount of rainfall influences the quality and location of vegetation, and rain stimulates changes in livestock nutrition and productivity. In particular, drought causes water shortages and decreased availability of food, which affects the health and nutritional status of local residents. Thus it can be said that rainfall is indirectly linked to the health and nutritional status of the people.

Zambia has been facing erratic and poor distribution of rainfall in many parts of the country, particularly the low-veldt areas of the southern, western and north-western provinces

(Yamauchi 2007). In October 2007, we started a longitudinal survey of growth and nutritional status, monitoring local people dwelling in five villages located in the Sinazongwe district in the southern province of Zambia, in order to examine the influence of decreased water and food availability caused by drought (Yamauchi et al., 2008).

This report aims to examine the nutritional status of adults and the growth of children in the initial stages of the survey, as well as to compare the growth and nutritional status of subjects living in the three contrasting ecological zones.

2. Subjects and Methods

2.1 Village Location and Subject Households

The slope area around Lake Kariba can be divided into three ecological zones: the upper flat land zone on the plateau (‘Upper’), the middle slope zone (‘Middle’), and the lower flat land zone near Lake Kariba (‘Lower’) (Sakurai 2008). We chose five villages consisting of two villages (Sianemba and Siameja) from 'Lower', two villages (Chanzika and Kanego) from 'Middle' and one village (Siachaya) from 'Upper'. Forty-eight households were selected in total, 16 from each of the three zones (‘Lower’, ‘Middle’ and ‘Upper’): 4 in Sianemba, 12 in Siameja, 8 in Chanzika, 8 in Kanego and 16 in Siachaya.

In this article, adults are defined those older than 18 years and children as 18 years old or less. For children, those whose ages were not known were excluded from the analyses.

2.2 Anthropometric Measurements

The details of the anthropometric measurements are given elsewhere (Yamauchi et al., 2008). I explain them briefly here.

2.2.1. Height

Height was measured at monthly intervals. Height was measured to the nearest 1 mm using a wall mounted metal tape measure (200 cm in height), specially made by a local carpenter.

2.2.2. Weight

These measurements were done at weekly intervals. Body weight was measured to the nearest 0.1 kg using battery-operated digital scales. In this paper, we limit the report to height, weight and body mass index (BMI = weight (kg) / height $(m)^2$).

2.2.3. Determining the Nutritional Status of Adults and Children, and the Growth of Children

The adults' nutritional status was defined based on their BMI as 'underweight (BMI < 18.5)', 'normal (BMI = 18.5 - 25.0)' or 'overweight (BMI > 25.0)' (WHO, 2000). For children, the sex- and age-dependent BMI cut-offs proposed by the International Obesity Taskforce (IOTF, Cole et al., 2000, 2007) were used to classify each child as 'underweight', 'normal', or 'overweight' in the same way as the adults. Furthermore, the height and weight of the children were plotted on US reference growth data (percentile curves, Centers for Disease Control and Prevention (CDC) 2000).

2.2.4. Statistical Analyses

Sex difference was examined using the unpaired t-test, and regional differences were evaluated with analysis of variance with multiple comparisons (Tukey HSD test). All analyses were conducted with the JMP statistical package (SAS Institute, Cary, NC, USA) with statistical significance assigned at $P < 0.05$.

3. Results and Discussion

3.1. Sample Sizes for Anthropometric Measurements

The sample sizes for height, weight and BMI are shown separately for adults (Table 1A) and children (Table 1B). The sample sizes were almost balanced among the three ecological zones in both adults and children for both sexes. Adult sample size varied between 113 (for BMI) and 140 (for weight). The sample size was larger for children than for adults, even though those children whose ages were not known were excluded from the analysis. We expect to obtain more data in the future by improving the data input and obtaining more age information for the children.

Table 1A Sample size (adults > 18 years)

Sex	Zone	Age	Height	Weight	BMI
Men	Lower	17	15	20	15
	Middle	18	19	28	19
	Upper	20	21	21	20
	All	55	55	69	54
Women	Lower	21	20	22	18
	Middle	13	17	22	17
	Upper	25	25	27	24
	All	59	62	71	59
Total		114	117	140	113

Table 1B Sample size (children ≤ 18 years)

Sex	Zone	Age	Height	Weight	BMI
Boys	Lower	28	26	28	25
	Middle	28	26	28	26
	Upper	30	27	29	26
	All	86	79	85	77
Girls	Lower	26	26	26	26
	Middle	21	19	21	19
	Upper	30	27	30	27
	All	77	72	77	72
Total		163	151	162	149

3.2. Nutritional Status of Adults

Table 2 shows the mean and SD of height, weight and BMI of the adults by sex. The mean age was not significantly different between men and women. Significant sex differences were found in that men were significantly taller and heavier than women.

Table 2 Physical characteristics of adults

	Age (year)		Height (cm)		Weight (kg)		BMI	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Men	33.1	13.8	165.3	9.0	54.3	9.1	19.7	2.4
Women	35.6	13.2	156.7	5.5	51.5	7.5	20.9	2.9
P	NS		< 0.0001		0.0455		0.0183	

In contrast, the average BMI of women was higher than that of men. The mean BMI fell between 18.5 and 25.0 in both sexes, suggesting that the nutritional status of the adults was generally good. Individual BMI values revealed that 28 % of men and 15 % of women were classed as 'underweight (BMI < 18.5)' and no men and 7 % of women were classed as 'overweight (BMI > 25.0)'.

Regional differences in height, weight and BMI of the subjects were compared among the three zones (Fig. 1). Significant group differences were found in height and weight ($P < 0.05$ for both measurements). According to multiple comparison analysis, the lower zone women were significantly taller than the middle zone women ($P = 0.020$), and the lower zone men were significantly heavier than the upper zone men ($P = 0.024$). These results suggest that subjects living on the lower flat land had a larger physique than the other two groups. In contrast, no significant difference was observed in BMI among the three ecological groups. This might be due to the offset of height and weight in calculation of the BMI.

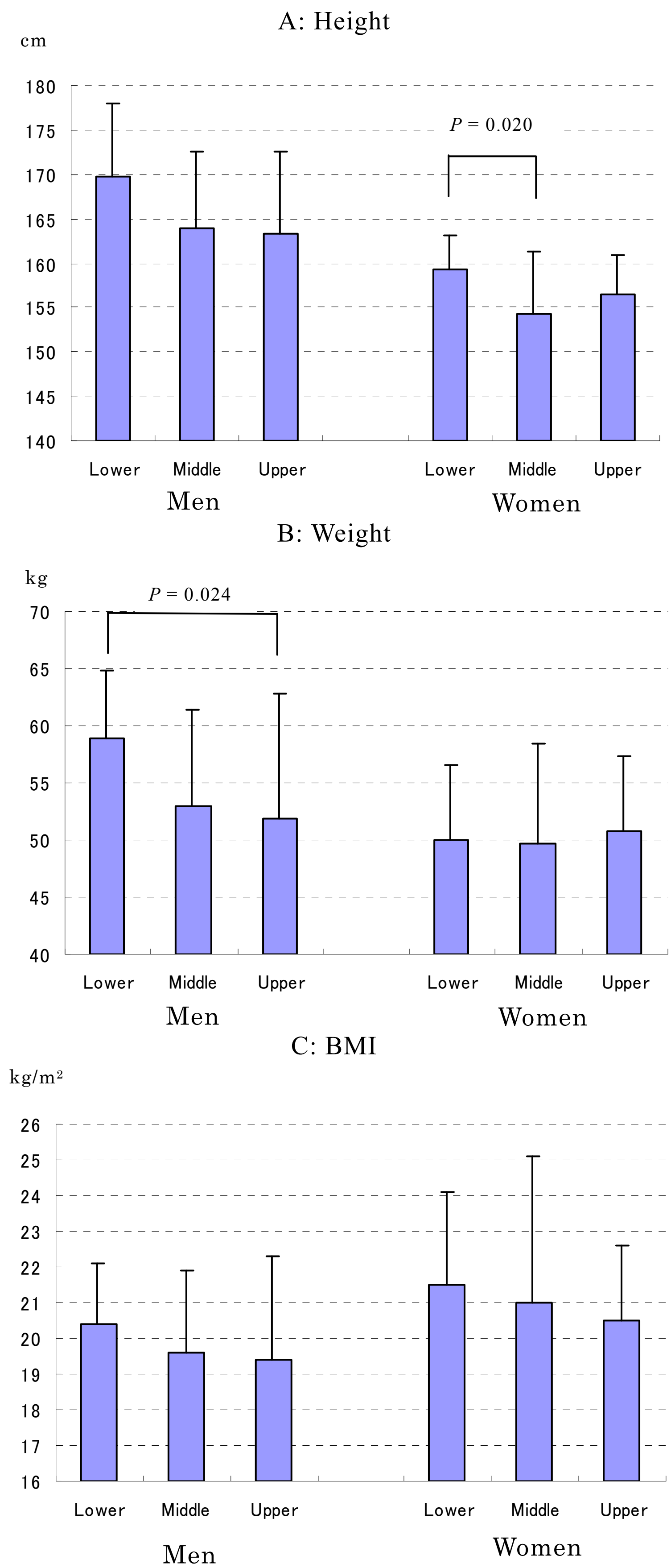


Fig. 1 Physical characteristics in the three ecological zones

3.3. Growth in Children

The heights and weights of different age groups and sexes are shown by sex in figures 2 (height) and 3 (weight). Five percentile curves for height (50th, 25th, 10th, 5th and 3rd), and four for weight (50th, 25th, 10th and 3rd), taken from US reference data (2000 CDC growth charts, Kuczmarski et al., 2002) were superimposed on the graphs. The smoothed curves from the Zambian data (broken lines) correspond to approximately the 3rd percentile of the US reference data for both height and weight in boys, and weight in girls, but the smoothed curve for height in girls was below the 3rd percentile of the US data (Fig. 2).

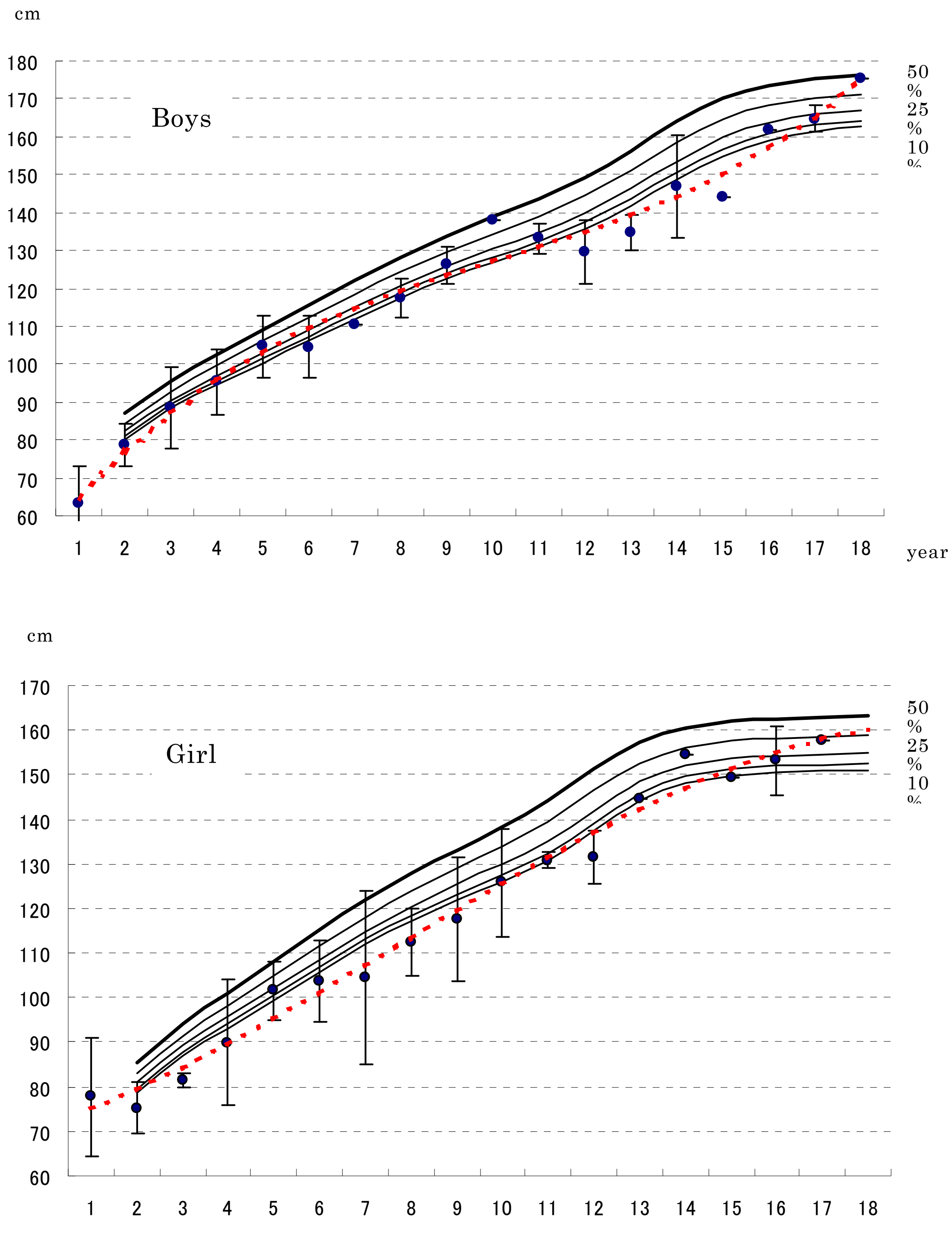


Fig. 2 Growth in height of boys and girls (mean and SD) compared with US reference percentiles

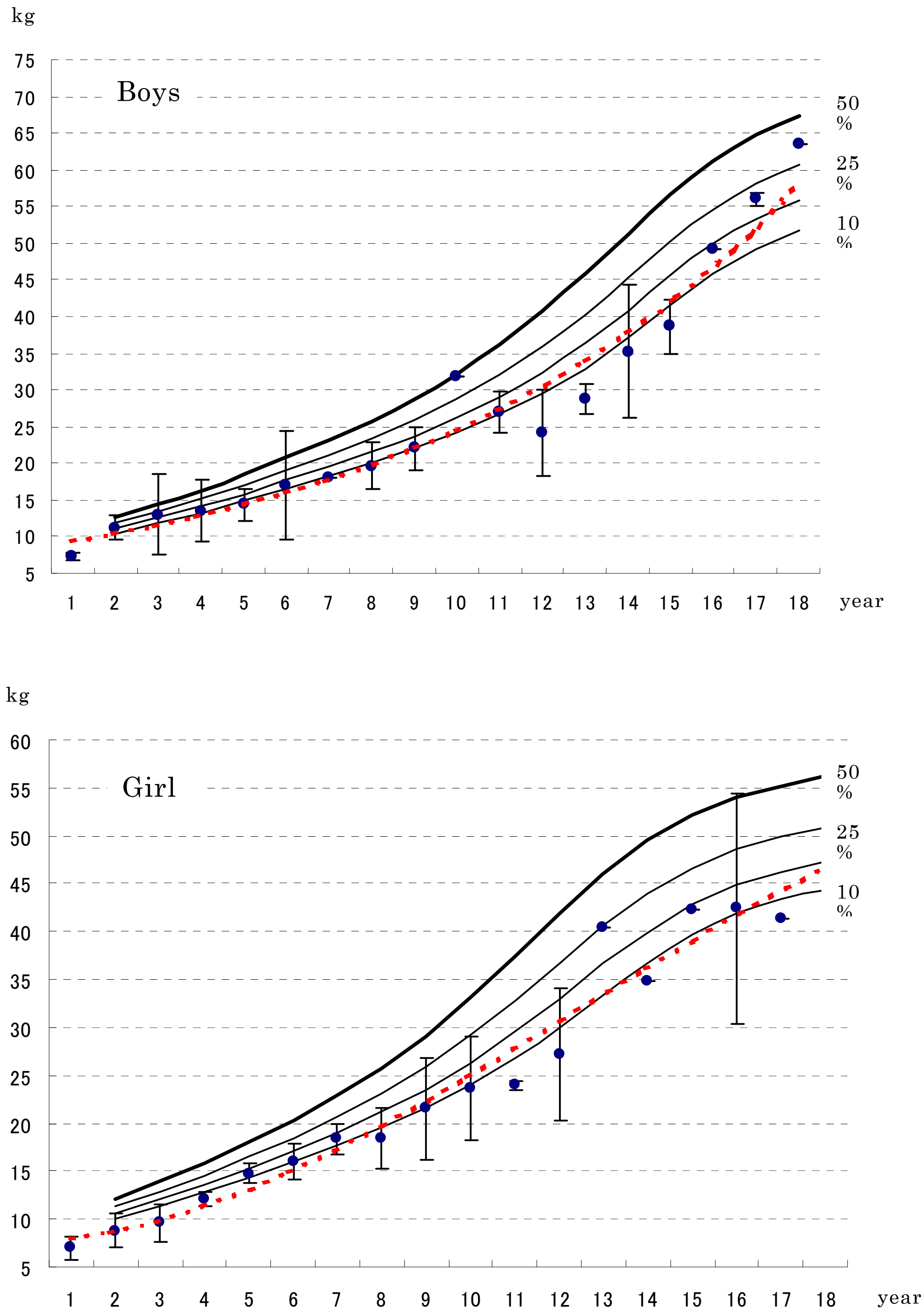


Fig. 3 Growth in weight of boys and girls (mean and SD) compared with US reference percentiles

Table 3 shows the nutritional status of children based on their BMI. Based on the age- and sex-dependent BMI cut-offs proposed by the IOTF (Cole et al., 2000, 2007), 35 % of boys and 45 % of girls were classed as 'underweight'. The results of both the growth curves and the BMI indicate that the nutritional status of children in this study was poor and that they might be suffering from low food availability and unfavorable environmental conditions.

Furthermore, the proportion of ‘underweight’ children was higher than in adults (28 % and 15 % in men and women, respectively), suggesting that under-nutrition was more severe in children than in adults.

Table 3 Nutritional status of children based on BMI (%)

	Underweight	Normal	Overweight	All
Boys	34.7	58.3	6.9	100.0
Girls	44.6	44.6	10.8	100.0

4. Summary and Future Perspective

Unfortunately, we have limited data at present, due to a delay in the input of data to computers in Zambia. In addition, the available data is not systematic and the sample size differs among the various anthropometric measurements (see Table 1A,B). Using these limited data, we report on the nutritional status of adults and children and the growth status of children in the initial stages of a longitudinal survey of people living in three ecologically contrasting zones in Zambia.

More than 70 % of adults were classed as 'normal' in terms of their BMI, which suggests that the nutritional status of adult subjects was generally good. Adults who live on the lower flat land were relatively taller and heavier than their counterparts living on the middle slopes and on the upper flat land. In contrast to the adults, the growth and nutritional status of children were poor. Compared with US reference data, the height and weight of the children was approximately equal to or less than the 3rd percentile of the US population. Moreover, the nutritional status of children was worse than that of adults. Thirty-five percent of boys and 45 % of girls were classed as 'underweight'.

It is expected that with the increase in available data in the future, it will be necessary to adjust the figures reported here. In addition, when sufficient data has been obtained for each individual, it will be possible to conduct not only cross-sectional analyses, as in this report, but also longitudinal analyses. These will enable us to examine in more detail the influences of environmental change, particularly rainfall, on the growth and nutritional status of adults and children. We are also conducting household interviews to obtain socio-economic information at the same time as obtaining the anthropometric measurements. We will be able to clarify individual households’ strategies to cope with future variation in rainfall, and analyze the socio-economic information together with the individual longitudinal data on growth and nutritional status.

References

Cole TJ, Bellizzi MC, Flegal KM, Dietz WH (2000) Establishing a standard definition for child overweight and obesity worldwide: international survey. *British Medical Journal* 320: 1240-1243.

Cole TJ, Flegal KM, Nicholls D, Jackson AA (2007) Body mass index cut offs to define thinness in children and adolescents: international survey. *British Medical Journal* 335: 194-202.

Kuczmarski RJ, Ogden CL, Guo SS, et al. (2002) 2000 CDC growth charts for the United States: methods and development. *Vital and Health Statistics*, Series 11, 246:1-190.

Sakurai T (2008) Asset holdings of rural households in southern province, Zambia: a report from census in the study villages. Vulnerability and Resilience of Social-Ecological Systems, FY2007 FR1 Project Report, 185-200.

World Health Organization (2000) Obesity: preventing and managing the global epidemic. Technical report series 894. Geneva: World Health Organization.

Yamauchi T (2007) Longitudinal monitoring survey on the growth and nutritional status of children in Zambia: Assessment of the impact of drought on the health and nutritional status of children. Vulnerability and Resilience of Social-Ecological Systems, FY2006 PR Project Report, 27-32.

Yamauchi T , Lekprichakul T, Sakurai T, Kanno H, Umetsu C, Sokotela S (2008) Training local health assistants for a community health survey in a developing country: longitudinal monitoring of the growth and nutrition of children in Zambia. *Journal of Higher Education and Lifelong Learning*, 16, in press.

Analysis of Meteorological Measurements Made Over the Rainy Season 2007/2008 in Sinazongwe District, Zambia.

Hiromitsu Kanno[1] and Tazu Saeki[2]

[1]National Agricultural Research Center for Tohoku Region, Morioka, Iwate, Japan

[2]National Institute for Environmental Studies, Tsukuba, Japan

Abstract

Local meteorological observations were made in the Sinazongwe District, Zambia, from September 2007. This study investigates the rainy season of 2007/2008, which was defined as occurring between early December and mid March. Daily precipitation data at three sites reveal distinct seasonal variations. The amount of precipitation amount was large at site B (mid elevation, 1586 mm) and site A (low elevation, 1600 mm), and lower at site C (high elevation, 1426 mm). There were precipitation peaks in the evenings at sites B and A, but this diurnal variation was indistinct at site C. Therefore, the differences in the amount of precipitation between site C and sites B and A may be produced by the evening rain.

The understanding of the local village people was that the amount of precipitation in the highlands is higher than in the lowlands. However, the observational data showed the opposite distribution. This difference between perception and observation may be due to higher land temperature and solar radiation in the lowlands than the highlands, causing faster evaporation of soil moisture in the lowlands.

Each site had large variations amongst the observation points. Differences between maximum and minimum precipitation were 176 mm at site C, 190 mm at site B and 140 mm at site A. The precipitation distribution at each site showed systematic patterns. At site C, points of low precipitation tended to concentrate towards the center of the village. At site B, the amount of precipitation was related to altitude. At site A, points of high precipitation tended to lie in the southwest. Seasonal cycles in precipitation were found to be closely connected with seasonal changes in surface meteorological parameters. Some parameters, including temperature, wind and solar radiation, showed differences between the three sites. The observations will continue in order to develop a better understanding of the climate of the research area.

1. Introduction

According to Lekprichakul (2006), there have been six droughts in Zambia over the past 18 years (1991/1992, 1994/1995, 1997/1998, 2000/2001 and 2004/2005), and agricultural products such as maize have suffered dry weather damage. On a broader scale, the semiarid regions of West Africa have also suffered major drought and famine twice since the 1970s. Famine occurred in the Sahel from 1972 to 1974 and from 1983 to 1985. Several researchers have sought to determine the mechanism of rainfall variability giving rise to famine conditions (Folland *et al.*, 1986; Fontaine and Janicot, 1996; Hastenrath, 1990; Lamb, 1983; Lamb and Peppler, 1992). Le

Barbe *et al.* (2002) recently investigated rainfall variability in West Africa using high-resolution data, presenting the spatial extent and structure of rainfall on intraseasonal and decadal time scales

The recent changing climate conditions attributed to global warming have heightened the importance of meteorological study in semiarid areas. In meteorological and agricultural studies, both accurate meteorological observations and comprehensive investigation of farming production are required, necessitating both simulation and fieldwork. However, in comparison with developed countries, the meteorological observation networks in developing countries typical of semi-arid regions are sparse and the range of observation parameters is limited. The deficiency in meteorological data is exacerbated by the difficulty in performing fieldwork in such countries.

This study aims to understand the meteorology in the Sinazongwe District, Zambia. A field program was undertaken and meteorological parameters were observed from September 2007. This study analyzes this meteorological data for the rainy season of 2007/2008.

Fig. 1: Photograph of the meteorological observation station at site C (Siachaya Village).

2. Meteorological Observation Methods

Two meteorological observation robots were installed at Siachaya Village (site C) and Sianemba Village (site A). Observations began in mid September, 2007. Figure 1 shows a photograph of the station at site C. Meteorological observations of air temperature, air pressure, relative humidity, solar radiation, precipitation, wind direction and wind speed were made at 30 minutes intervals and stored by a data logger. Wind direction was recorded as instantaneous values, whilst the other meteorological elements were recorded as 30 min means for the 30 minutes prior to data logging. The station was powered by a solar-charged battery and installed in a wide bare area in the center of the village. Problems at site C meant that the relative humidity data was observed only at site A over the study period. Equivalent potential temperature and absolute humidity were calculated from air temperature, relative humidity and air pressure.

A total of 38 rain gauges were installed at sites C, B and A, 16 at each site. Figure 2 shows a photograph of a rain gauge, which was fixed in the ground with metal pole and cement. Precipitation data were recorded at 30 minutes intervals and automatically stored in the data logger. This study uses hourly and daily means calculated from 30 minutes interval data.

3. Temporal Variation and Distribution of Precipitation

1) Temporal Variation in Precipitation

Figure 3 shows the daily mean and accumulated precipitation at site C from October 10, 2007, to April 30, 2008. Four observation points failed and were excluded from the statistical analysis. The total amount of precipitation in the rainy season of 2007/2008 was 1426 mm. First rain was observed on November 6, and then continuous rain occurred from December 4 onwards. At the end of December, high precipitation was observed and accumulated precipitation abruptly increased. From early January, the rain was continuous but the amount of daily precipitation tended to decrease. Precipitation was interrupted in the later half of February and then started again in early March. The rainy season ended on March 17.

Figure 4 shows daily mean and accumulated precipitation at site B. Three observation points were excluded from the analysis. The total amount of precipitation was 1586 mm, 160 mm more than site C. First rain was observed on November 6, and then continuous rain occurred from December 5. The time series of daily precipitation show similar variations to site C. The date of first continuous rain and the end of the rainy season on March 18 were both one day later than site C.

Figure 5 shows the daily mean and accumulated precipitations at site A. Five points were excluded from the analysis. The total amount of precipitation was 1600 mm, 174 mm more than site C. First rain was observed on November 6, and then continuous rain occurred from December 6. The time series of daily precipitation show similar variations to sites C and B, but the date of first continuous rain was two days later and the end of the rainy season one day later than site C.

Fig. 2: Photograph of a rain gauge used in this study. The data logger is installed inside the gauge.

Therefore, the precipitation at the three sites showed closely corresponding temporal variation and the rainy season in 2007/2008 can be defined as between December 4-6 and March 17-18. The total amount of precipitation at site C was 10 % less than at sites B and A.

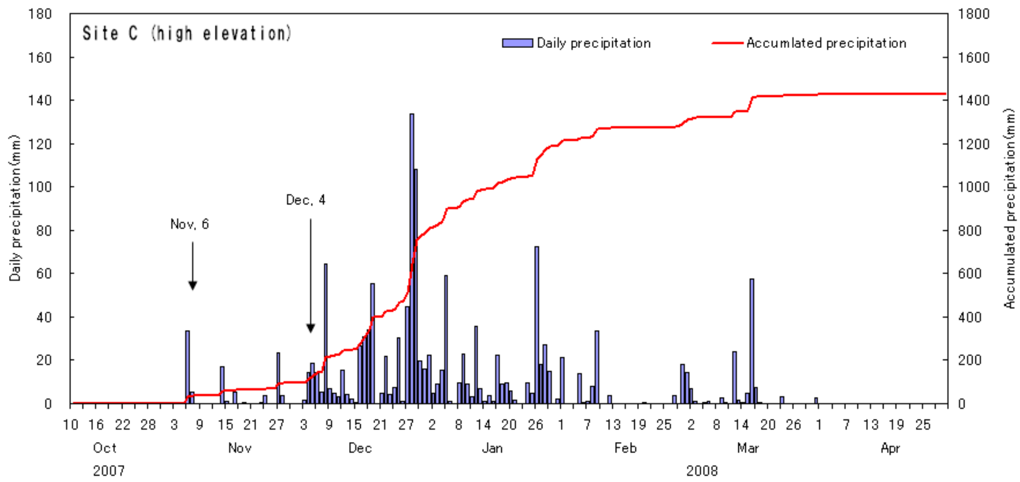


Fig. 3: Daily mean and accumulated precipitation at site C from October 10 2007 to April 30 2008. Precipitation was averaged over 12 data points.

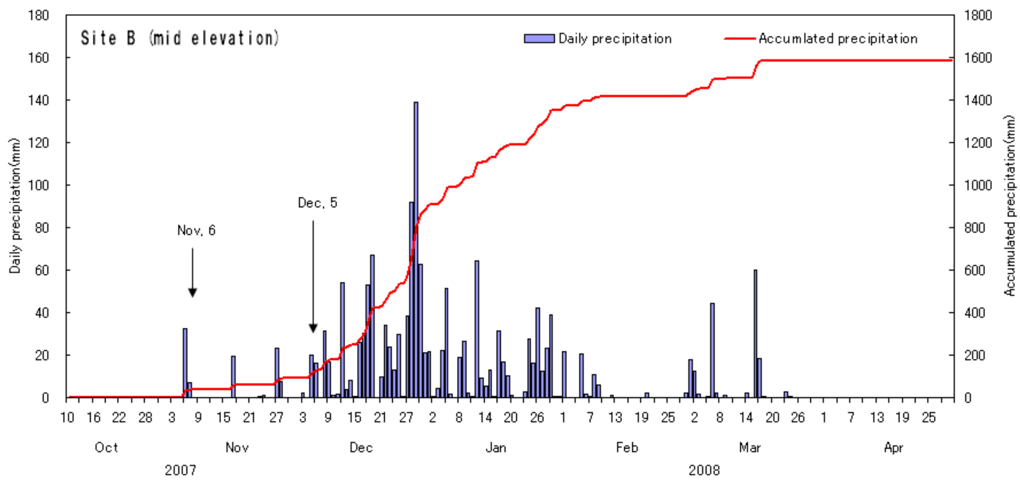


Fig. 4: Same as in Fig.3 except for site B. Precipitation was averaged over 13 data points.

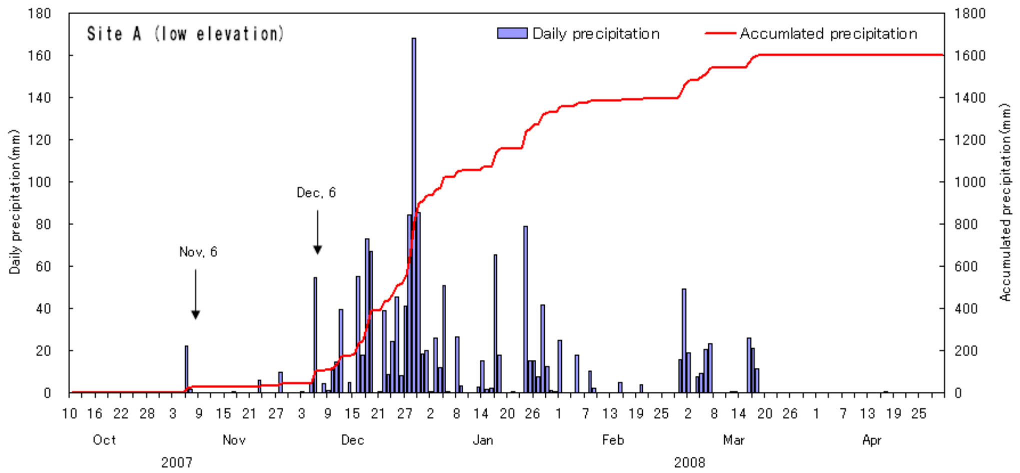


Fig. 5: Same as in Fig.3 except for site A. Precipitation was averaged over 11 data points.

2) Precipitation Distributions

Figures 6, 7 and 8 show the precipitation distributions at sites C, B and A, respectively. At site C, points of low precipitation (less than 1300 mm) tended to concentrate at the center of the village and points of high precipitation (more than 1300 mm) surrounded these. At Site B, points of high precipitation were located to the west, which is mountainous and high altitude, implying that precipitation distribution at this site may be related to altitude and the topography. At Site A, points of higher precipitation were located to the southwest. Site A is flat land along the river, so this distribution was not related to the topography. Other factors such as the route of cumulonimbus and showers may be responsible for this distribution at site A.

Figure 9 shows average, minimum and maximum precipitation and standard deviations at each site from October 10 2007 to April 30 2008. Since the number of precipitation points differs at each site, the standard deviations should be used as a rough estimate. Each site had large spatial variation between the observation points. The differences between maximum and minimum precipitation were 176 mm at site C, 190 mm at site B and 140 mm at site A. The standard deviations were small at site A and large at sites B and C, which may be due to the complicated topography at these sites.

Figures 10 and 11 show the relation between precipitation and altitude at the sites B and C. At site B, precipitation and altitude showed a clear correlation: higher elevation sites tended to have higher precipitation, and the correlation coefficient is 0.54. However, at site C, there was no correlation between elevation and precipitation. This is an important difference as the topography of both sites is mountainous, suggesting that another factor may be affecting the precipitation distribution at these two sites.

3) Hourly Variations of Precipitation

Figure 12 shows the hourly accumulated precipitation from October 10, 2007 to April 30, 2008 at each site. Distinct diurnal variations were present at site A with low precipitation between 03:00 and 05:00 and high precipitation between 16:00 and 18:00. These evening rain are most likely produced by convective rain. Site B showed similar diurnal variations in hourly precipitation to site A, but with high precipitation between 17:00 and 18:00, one hour shorter than site A.

On the other hand, diurnal variations were indistinct at site C and there was no precipitation peak in the evening. This may mean that the convective rain that produces high precipitation at sites B and A does not extend to the highlands. This leads to two hypotheses; 1) The lower total amount of precipitation at site C than at sites B and A may be due to the lack of high precipitation in the evening at site C, 2) The high evening rain may be the cause of the relation of precipitation distribution with topography at site B and lack of high evening rain may make such a relation ambiguous at site C

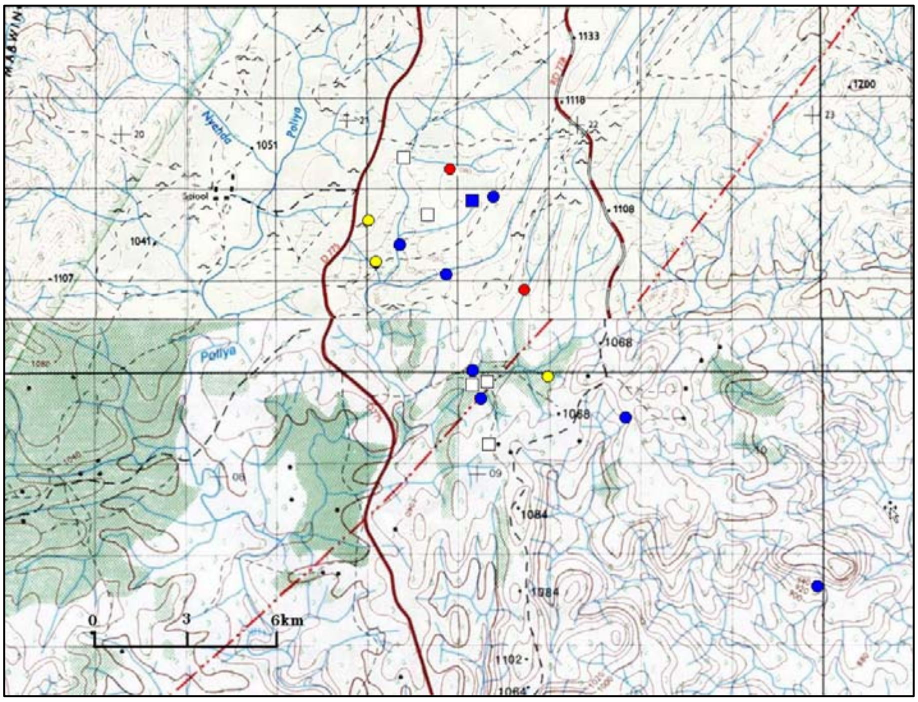


Fig. 6: Precipitation distribution at site C. Precipitation was summed for September 15 2007 to April 30 2008. Red marks indicate precipitation over 1500 mm, yellow marks over 1400 mm, blue marks over 1300mm and white marks indicate lack of data.

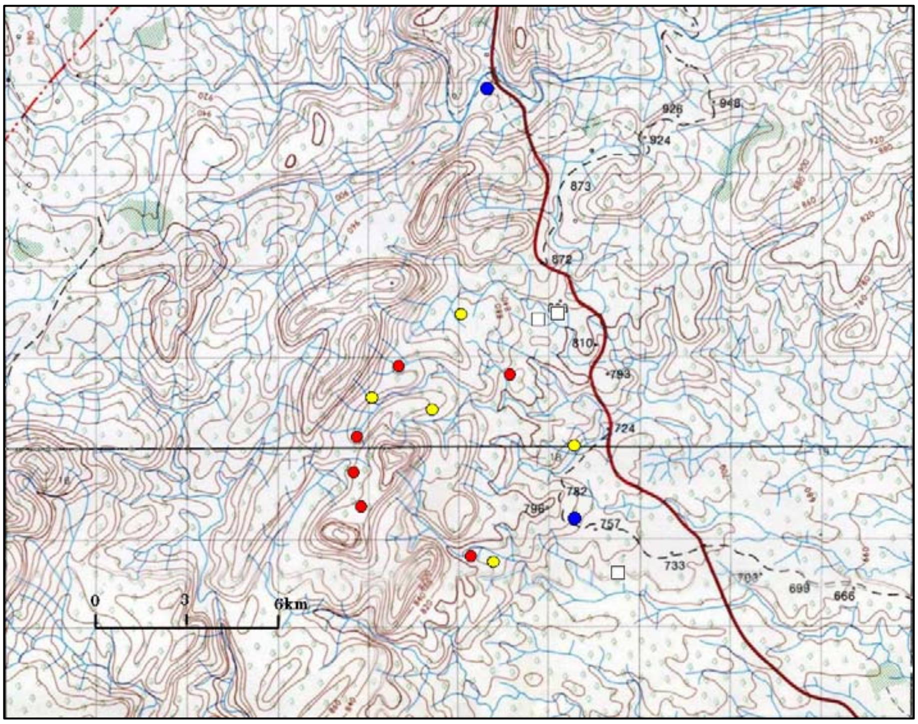


Fig. 7: Same as in Fig.6 except for site B. Red marks: precipitation over 1600 mm, yellow marks: over 1500 mm, blue marks: over 1400 mm.

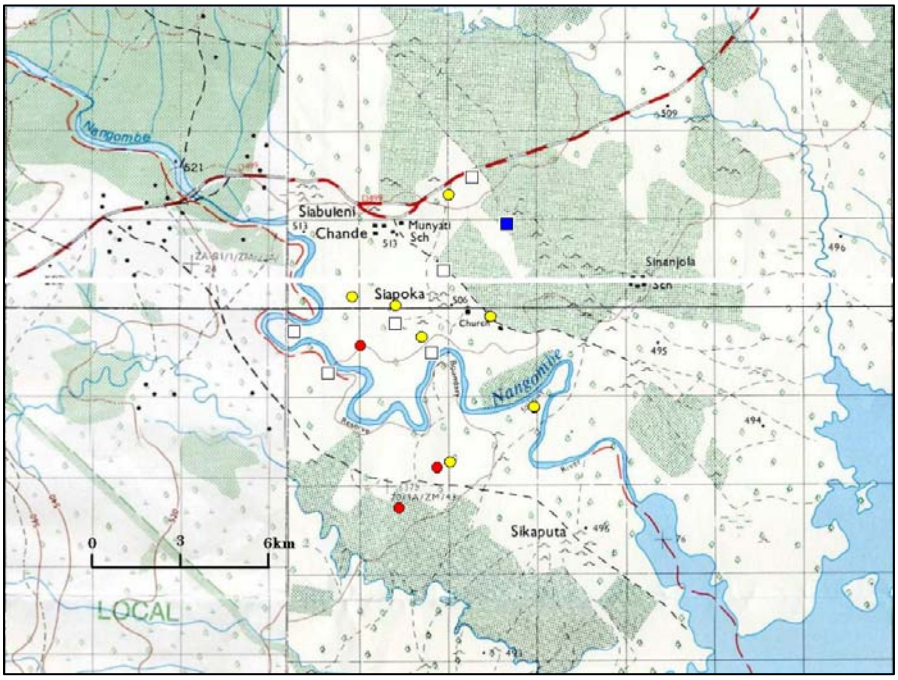


Fig.8 Same as in Fig.7 except for site A.

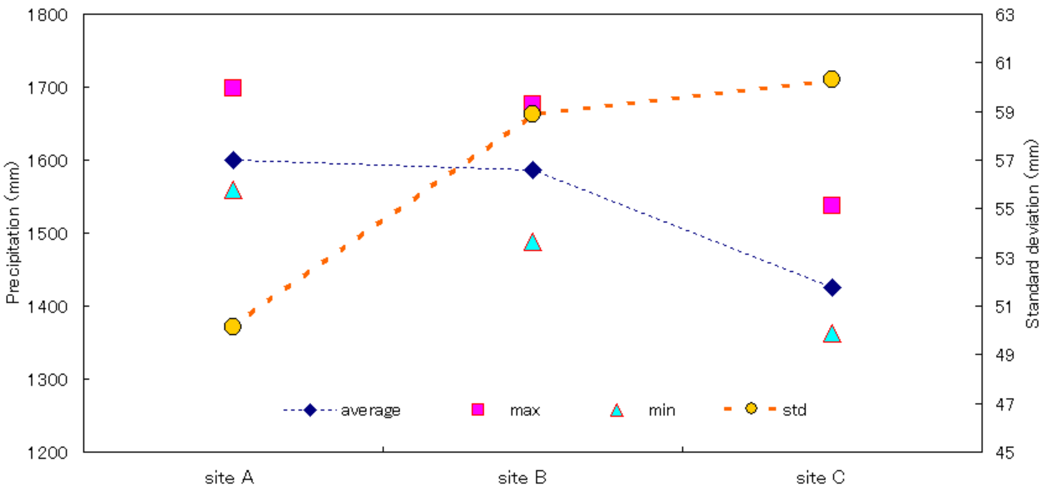


Fig. 9: Maximum, average and minimum precipitation and standard deviations at each site. Period was from October 10 2007 to

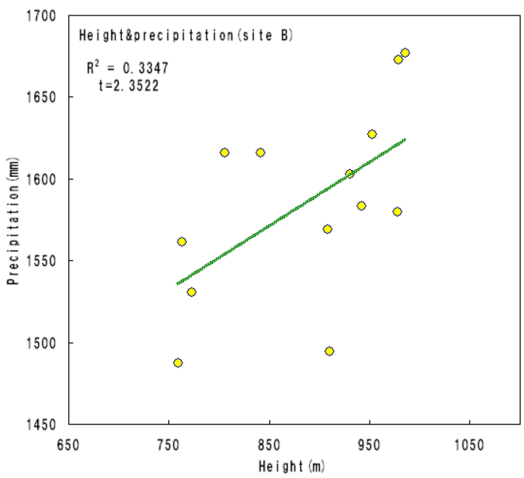


Fig. 10: Relation between precipitation and altitude at site B. The correlation coefficient is 0.54 and significance level is less than 0.05 %.

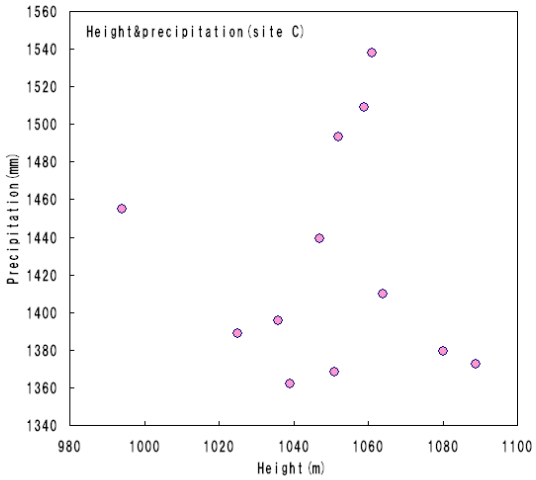


Fig. 11: Same as in Fig.10 except for site C. There is no significant correlation.

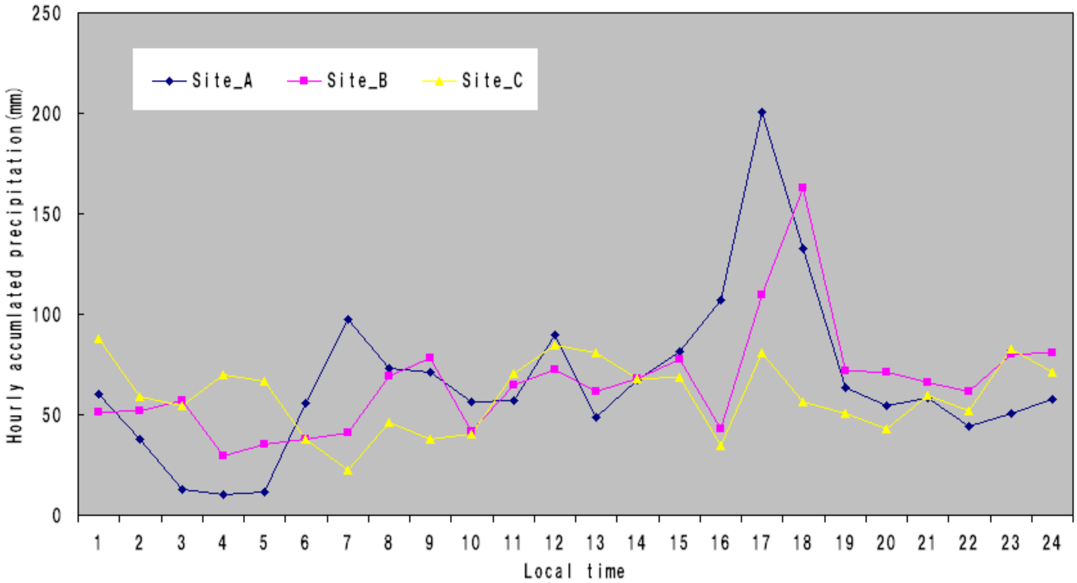


Fig. 12: Hourly accumulated precipitation from October 10 2007 to April 30 2008 at each site.

4. Meteorological Observation Station Data

In this section, daily and hourly variations of the meteorological parameters other than precipitation at sites C and A are discussed.

1) Temperature

Figures 13 and 14 show temporal variations in temperature at sites C and A from September 15, 2007, to April 30, 2008. At site C, the daily mean temperature was around 25 °C and the daily range was around 12 °C before the rainy season (Fig. 13). From the beginning of rainy season, both temperatures and the daily range decreased simultaneously until late January. Through February, both temperatures and the daily range rose again, but to less than before the rainy season. In March, temperatures decreased to around 20 °C on average with a maximum of 25 °C and a minimum of 15 °C.

At site A, the temporal variations in temperature were similar but with values about 5 °C larger than at site C (Fig.14). The maximum temperature occasionally reached around 40 °C before the rainy season.

Figure 15 shows the lapse rate of daily mean temperatures between sites C and A. Temperature lapse rate was calculated by using height difference between the sites (1090 m at Site C minus 515 m at Site A = 575 m). In October and April, the lapse rate was around 0.5 °C. This is almost the same as the moist adiabatic lapse rate at 0.5 °C, implying that stratification may be stable before and after the rainy season. During the rainy season, the lapse rate was around 0.8 °C and sometimes reached around 1.0 °C. Since the dry adiabatic lapse rate is about 1.0 °C, stratification was sometimes absolutely unstable and may produce unstable conditions through the rainy season.

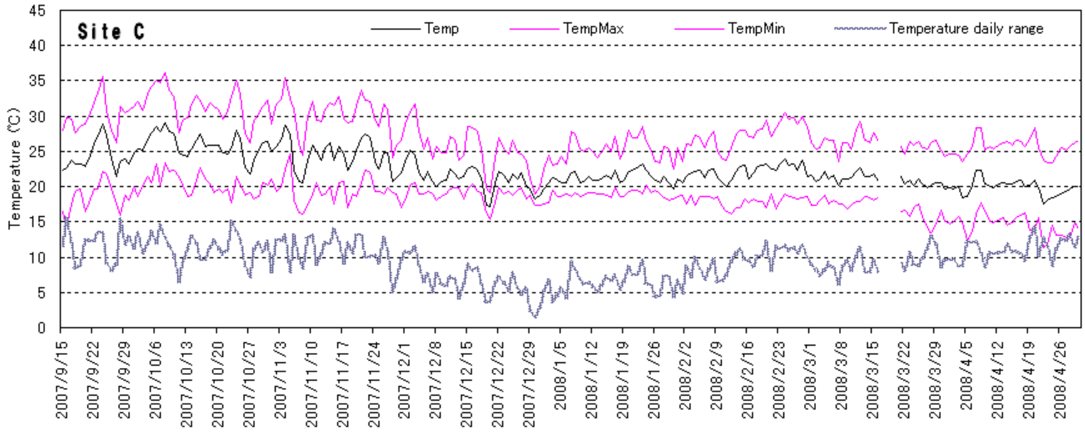


Fig. 13: Time series of maximum, average and minimum temperatures and the daily range at site C from September 15 2007 to April 30 2008.

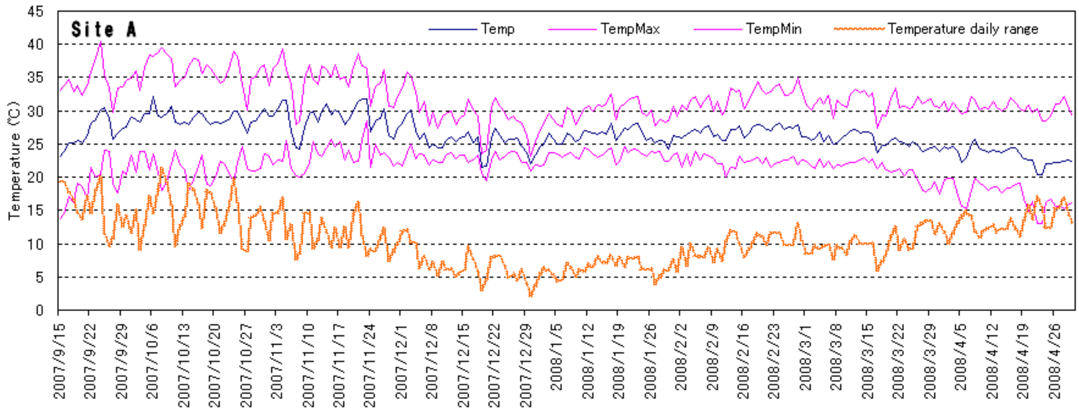


Fig.14 Same as in Fig.13 except for site A.

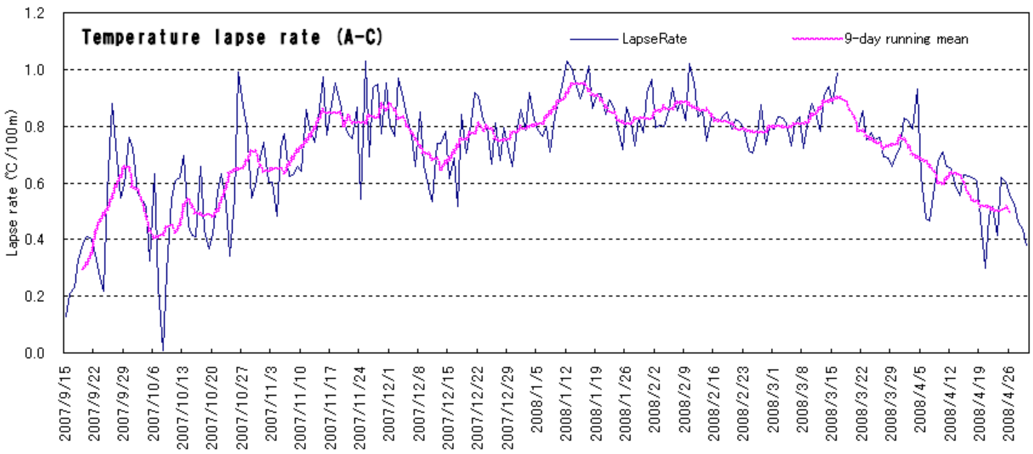


Fig. 15: Temperature lapse rate (℃/100 m) between sites A and C.

2) Wind

Figures 16 and 17 show hourly wind speed and direction at site C from September 15, 2007, to April 30, 2008. The wind speed was generally weak during the rainy season and relatively strong before the rainy season (Fig. 16). The average wind speed during the observation period was 1.5 ms^{-1}. Maximum wind speed was less than 5 ms^{-1} and not strong compared to mid-latitude areas. Wind direction was concentrated around 60 degrees (ENE) and 120 degrees (ESE) (Fig. 17). Figure 18 shows hourly mean wind speed and direction at site C. Distinct diurnal variations in wind speed were present. These were weak (1.0 ms^{-1}) from evening to morning (19:00 to 07:00) and strong (over 2.0 ms^{-1}) from 09:00 to 16:00. There were no distinct diurnal variations in wind direction.

Figures 19 and 20 show hourly wind speed and direction at site A. The wind speed had similar temporal variations to site C, but the average wind speed was lower at 1.3 ms^{-1} (Fig. 19). Wind direction concentrated around 120 degree (ESE) and 240 degree (WSW) (Fig. 20). The wind direction from the WSE is along a mountain ridge and the ESE wind direction is from Kariba Lake. Figure 21 shows hourly mean wind speed and direction at site A. Both wind speed and direction had clear diurnal variations: from 20:00 to 07:00, the wind speed was low and the wind direction was 120 degree (ESE) and from 09:00 to 18:00, the wind speed was over 1.5 ms^{-1} and the wind direction was around 240 degree (WSW). This means that at night, weak wind blows from Kariba Lake, and in the daytime, relatively stronger wind blows along the mountain ridge.

3) Solar Radiation

Figures 22 and 23 show daily solar radiation at sites C and A. At site C, daily solar radiation was around 25 MJ before the rainy season and then decreased to around 10 to 20 MJ until late January. In February, it rose to around 20 to 25 MJ and then decreased again in March. These changes were nearly simultaneous with the precipitation variations (see Fig. 3). After the rainy season, solar radiation gradually decreased, caused by seasonal change of solar altitude. At site A, the seasonal change in solar radiation was nearly the same as at site C, but the values in rainy season were higher than at site C (Fig. 23).

Figure 24 shows the time series of solar radiation at sites A and C and the difference between them. Both before and after the rainy season, solar radiation was generally higher at site C than at site A, but during the rainy season, values at site A were distinctly higher than at site C. In mid January, the difference reached over 10 MJ. These differences in solar radiation in the rainy season are likely produced by the distribution and height of clouds: during the rainy season, high altitude areas may be frequently covered by orographic clouds that block solar radiation.

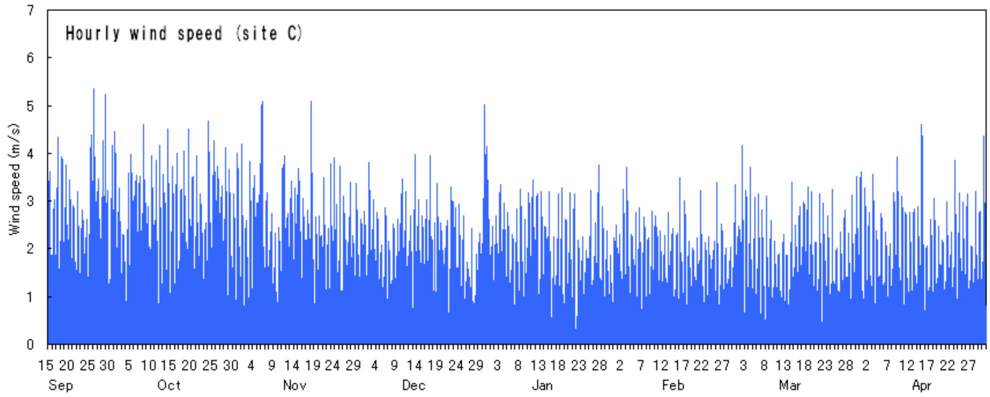


Fig. 16: Hourly wind speed (ms^{-1}) at site C from September 15 2007 to April 30 2008.

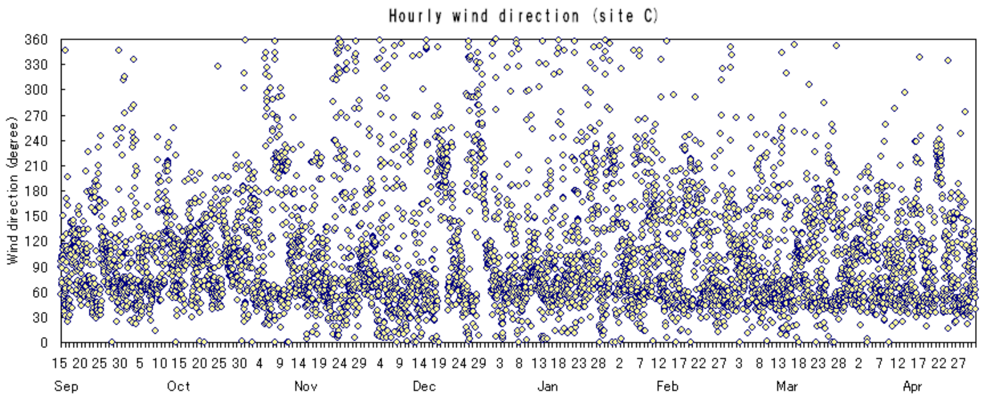


Fig. 17: Hourly wind direction (degree) at site C from September 15 2007 to April 30 2008.

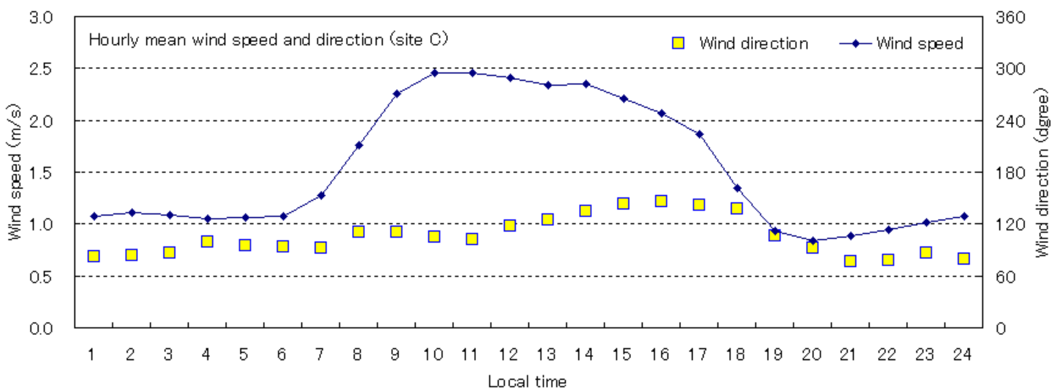


Fig. 18: Hourly mean wind speed and direction at site C. Values were averaged for each hour from September 15 2007 to April 30 2008.

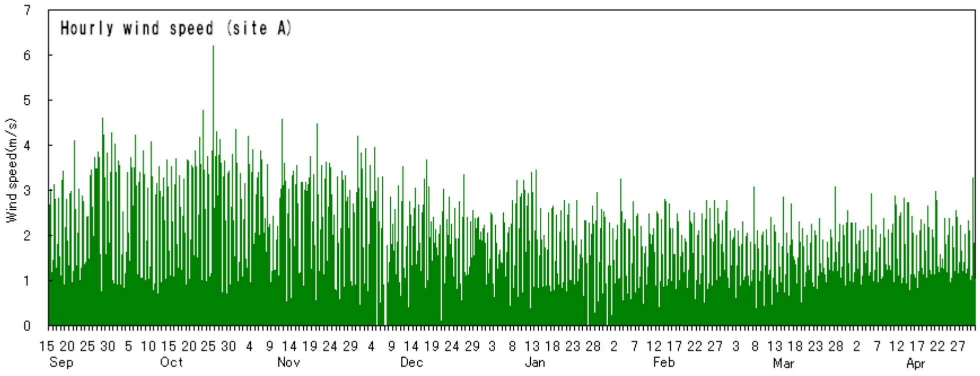


Fig.19 Same as in Fig.16 except for site A.

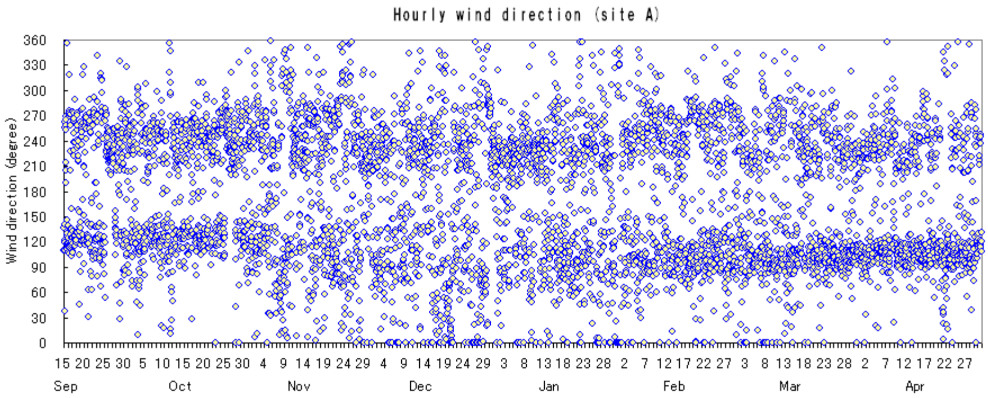


Fig.20 Same as in Fig.17 except for site A.

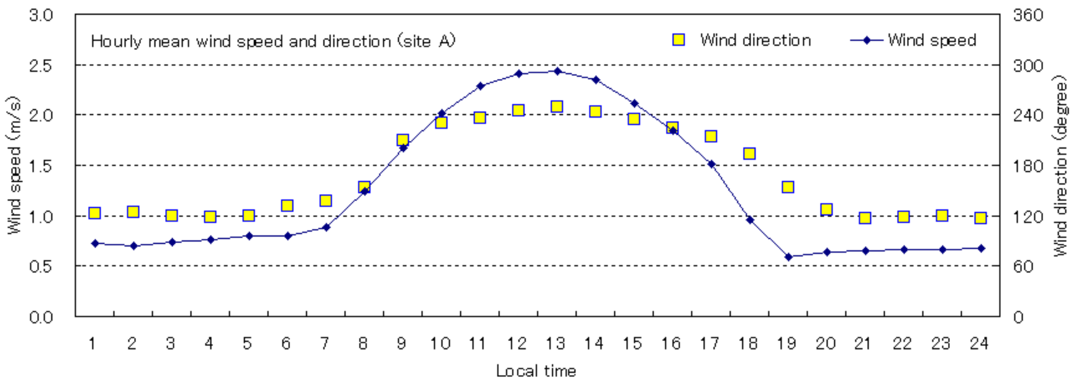


Fig.21 Same as in Fig.18 except for site A.

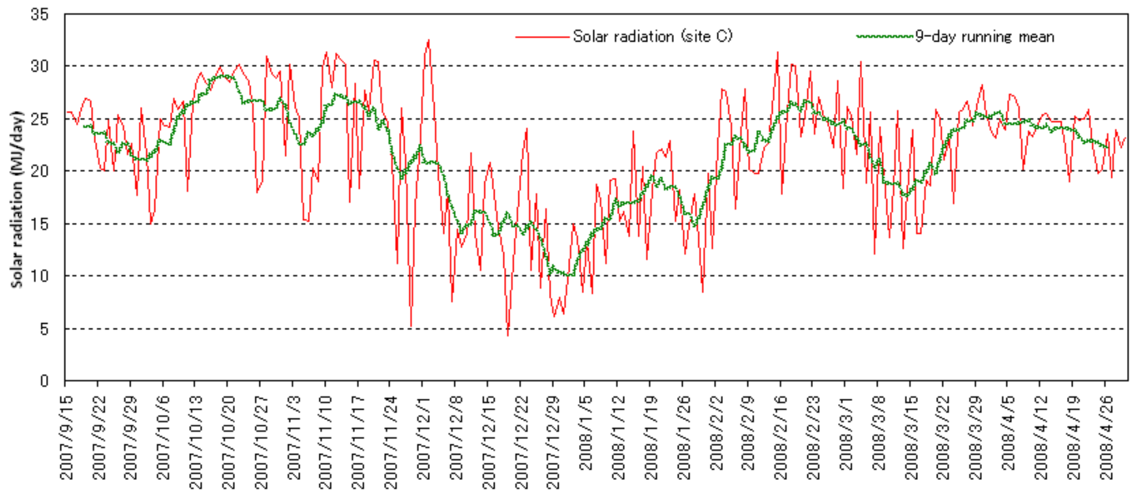


Fig. 22: Time series of daily solar radiation (MJ) at sites C. The nine day running mean is also shown.

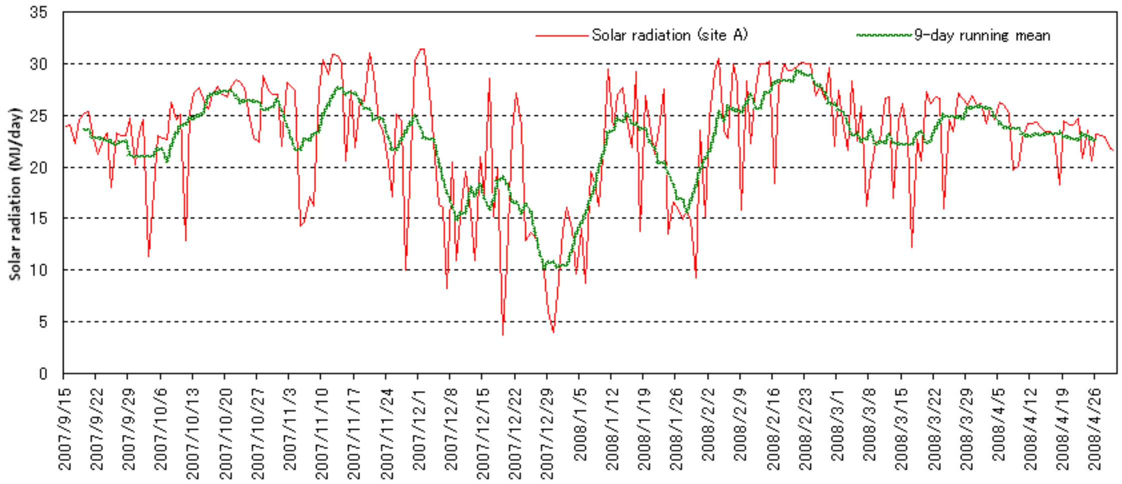


Fig.23 Same as in Fig.22 except for site A.

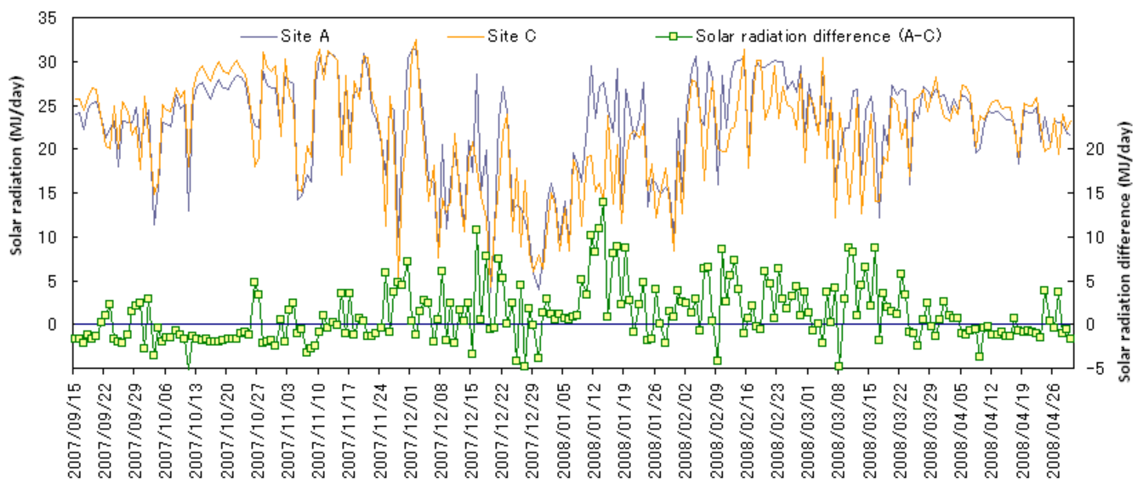


Fig. 24: Time series of solar radiation at sites A and C and the difference between sites.

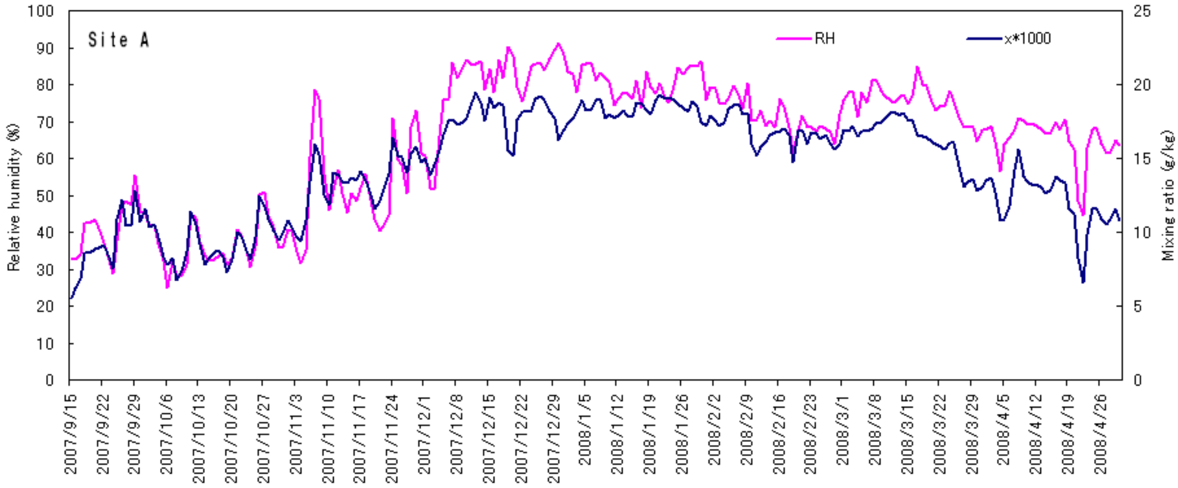


Fig. 25: Time series of relative humidity (%) and mixing ratio (g kg^{-1}) at site A.

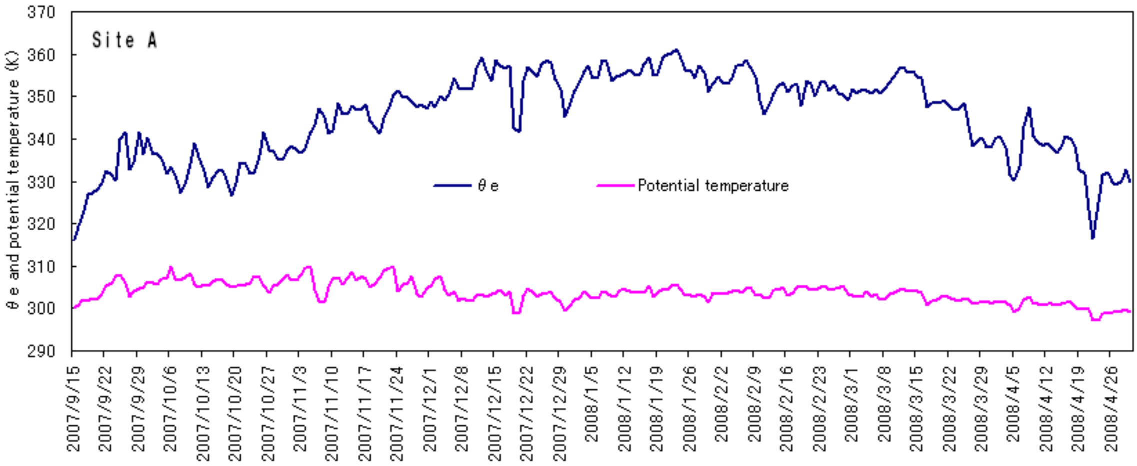


Fig. 26: Time series of equivalent potential temperature and potential temperature (K) at site A.

4) Humidity

Figure 25 shows the time series of relative humidity and mixing ratio at site A. Before the rainy season, relative humidity was about 30 to 40 %. It then rose abruptly with first rain on 6 November. The next abrupt rise was on December 5 with the start of continuous rain. During the rainy season, relative humidity was around 70 to 80 %. It decreased after the rainy season, but it did not return to the level observed before the rainy season. This was due to the temperature decrease after the rainy season.

Seasonal variation of the mixing ratio was similar to the relative humidity, however the values before and after the rainy season ware nearly the same. During the rainy season, the mixing ratio was stable around 16 to 19 g kg^{-1}. Since the seasonal change of mixing ratio was symmetrical from September to April, the amount of water in the air was the same before and after the rainy season.

5) Potential and Equivalent Potential Temperature

Figure 26 shows the temporal variation of potential and equivalent potential temperature at site A. Equivalent potential temperature showed a distinct seasonal change and potential temperature did not. Equivalent potential temperature can be used to define the air mass characteristics and vertical stability. In the continuing fieldwork, the rainy season relative humidity at site C will be observed and the equivalent potential temperature and mixing ratio at the two sites can be compared.

5. Discussion and Conclusion

Local meteorological observations were made at three research sites in the Sinazongwe District, Zambia from September 2007 onward. The rainy season of 2007/2008 was defined as occurring from early December to mid March. The amount of precipitation was lower at the high elevation site (site C) than the mid elevation (site B) and low elevation (site A) sites. There were precipitation peaks in the evening at sites B and A, but diurnal variation was indistinct at site C. The difference in the amount of precipitation between site C and sites B and A may be produced by this evening rain.

Each site had large spatial variations in precipitation between the observation points. The differences between maximum and minimum precipitation were 176 mm at site C, 190 mm at site B and 140 mm at site A. Also, precipitation distribution showed systematic patterns at each site. At site C, points with low precipitation tended to concentrate in the center of the village. At site B, precipitation was linearly related with altitude, and at site A, points with high precipitation tended to lie in the southwest.

The temporal variation in temperature showed a distinct seasonal change and temperatures were about 5 °C higher at site A than at site C. The lapse rate between the two sites was large during the rainy season, indicating that that the stratification around the research sites tended to be unstable at this time.

Wind speeds at the two sites were not strong compared to mid latitudes. There were distinct diurnal variations with wind speeds faster in the daytime and slower at nighttime. Wind direction at site A also had distinct diurnal variations, with the wind coming from the ESE (along a mountain ridge) in the daytime, and from the ESE (from Kariba Lake) at nighttime. At site C, diurnal variation in wind direction was not clear.

Solar radiation at sites C and A decreased during the rainy season and was higher at site A than at site C. Relative humidity and the mixing ratio showed distinct seasonal change simultaneous with precipitation, but relative humidity was not the same before and after the rainy season. The mixing ratio indicated that the amount of water in the air was the same before and after the rainy season. Equivalent potential temperature showed distinct seasonal variations at site A. Over the next rainy season, relative humidity data at site C will be measured, allowing analysis of differences in the air masses between the two sites.

The village people had the impression that the precipitation was higher at the highland site than at the lowland site (Kanno, 2008). However, the observational data showed the opposite tendency. Their false impression may be because at the lowland site, temperature and solar radiation were larger than the highland site, leading to greater evaporation of soil moisture.

The period of rainy season, the amount of precipitation and its distribution have been defined based on only one year of observations. The meteorological observations should be continued to better the understanding of the local meteorology.

References

Folland, C. K., T. N. Palmer, and D. E. Parker, 1986: Sahel rainfall and worldwide sea temperature 1901-1985. *Nature*, **320**, 602-607.

Fontaine, B., and S. Janicot, 1996: Sea surface temperature fields associated with West African rainfall anomaly types. *J. Climate*, **9**, 2935-2940.

Hastenrath, S., 1990: Decadal scale changes of the circulation in the tropical Atlantic sector associated with Sahel drought. Int. *J. Climatol.*, **20**, 459-472.

Kanno, H., 2008: Local climate and 'proverbs of weather forecast' in Sinazongwe. FY2007 FR1 Project Report, Research Institute for Humanity and Nature, 66-69.

Lamb, P. J., 1983: West African water variations between recent contrasting Sub Saharan droughts. *Tellus*, **35A**, 198-212.

Lamb, P. J., and R. A. Peppler, 1992: Further case studies of topical Atlantic surface atmospheric and oceanic patterns associated with sub-Saharan drought. *J. Climate*, **5**, 476-488.

Le Barbe, L., and T. Lebel, and D. Tapsoba, 2002: Rainfall variability in West Africa during the years 1950-90. *J. Climate*, **15**, 187-202.

Lekprichakul T., 2006: Impact of 2004/2005 Drought on Zambia's Agricultural Production: Preliminary Results. FY2006 PR Project Report, Research Institute for Humanity and Nature.

Introductory analysis of social vulnerability in rural Africa

Shuhei Shimada
Graduate school of Asian and African Area Studies, Kyoto University

Abstract

Because of multiplicity of meaning, the vulnerability theory has not been recognized useful in practical analysis. However, it is widely acknowledged that the term vulnerability will have fertile possibility in the areas of interdisciplinary research for poverty issue and agricultural sustainability in Africa. .

I reviewed some of works on vulnerability to turn up relevant definition of vulnerability in the context of African rural society. Then I tried to interpret the cause and process of increased vulnerability of some farmers seen in the field study in three African countries, Nigeria, Burkina-Faso and Zambia. The findings show that vulnerability of individuals, households and communities is intricately interrelated and interacted. Labor migration from Burkina-Faso to the southern countries, for example, that has helped to mitigate vulnerability of households in drought prone area was abruptly stopped by the expulsion of foreigners from Ivory Coast in 2000 by political reason. This has compelled expelled migrants more vulnerable and also their home society in Burkina-Faso.

To understand these complicated vulnerability, it is necessary to scrutinize the different reasons and processes of increased vulnerability by each actor; individual, household, and community. And then, we have to examine their complicated inter-relationship.

The original article is printed in E-Journal GEO vol.2 (2)available from
http://wwwsoc.nii.ac.jp/ajg/ejgeo/

Recent Changes in Small-scale Irrigation in Zambia: the Case of a Village in Chibombo District

Shiro Kodamaya
Graduate School of Social Sciences, Hitotsubashi University, Tokyo, Japan

Abstract

This paper aims to explore factors behind the development of small-scale irrigation in Zambia by tracing the experience of irrigation development among small-scale farmers in a village in central Zambia. The paper also seeks to contribute to a deeper understanding of the environmental implications of irrigation development.

Irrigation farming in the village studied began as traditional or informal irrigation, whereby vegetables were grown in dambo gardens with the use of bucket irrigation. By the early 1990s, vegetable production in dambo gardens had become an important source of income for many farmers in the village. The combination of rain-fed maize cultivation in upland fields and vegetable growing in dambo gardens provided farmers with relatively secure and diversified income sources. As economic declines and structural adjustment measures in the 1980s and 1990s adversely affected the livelihoods of urban dwellers, farming of the village came to be economically more attractive. Irrigated vegetable production in dambo gardens became more popular as an additional income generating activity after the mid-1990s when the agricultural marketing was liberalized. In the early 2000s, some farmers in the village shifted from bucket irrigation to treadle pump irrigation with the assistance of an NGO. The introduction of treadle pumps entailed new methods in irrigation agronomy such as the use of furrows and pipes, the cultivation of winter maize, and more intensive use of land. The second half of the 2000s is seeing another development in the use of irrigation technology, with some farmers introducing engine pumps and drip irrigation. As irrigation methods developed from bucket irrigation to treadle pump and engine pump irrigation, water consumption level of each farmer likely increased.

The typical farming system found in the study area, which comprises the two practices is an expression of farmer adaptations in the face of uncertainties both in rainfall and market conditions. Introduction of new irrigation practices by some farmers can be considered as an expansion of the dambo gardening component of the system.

The development interventions by NGOs played an important role in the adoption and diffusion of new irrigation technologies. Support from NGOs related to irrigation development placed greater emphasis on income generation and market sales. The villagers continuously invested in new agricultural management practices and land-care techniques. However, the investments and technology promoted are mainly associated with income-generating activities, which may undermine the capacity of ecosystems to produce services. The case of the village studied demonstrates that responses of the farmers were not necessarily unified, coordinated responses of the “community”. The responses to the new farming practices and NGO support

mainly occurred at the level of individual farmers and farmers groups. As irrigation methods shifted to those entailing more capital intensive technology such as engine pumps, farmers' responses to new opportunities depended increasingly on their resource or capital base including social capital.

The shift from bucket irrigation to treadle pump and engine pump irrigation in the area has likely had a substantial impact on the use of water resources, especially groundwater. Since there are no customary or formal regulations on the use of groundwater, current opportunistic use of groundwater for irrigation can result in overuse of groundwater and might cause its decrease and depletion. It is crucial to introduce some mechanism of control and management of water resources which enables the sustainable use of this important resource.

1. Introduction

To achieve greater utilization of irrigation in a sustainable and environmentally sound manner is a great challenge for African[1] countries. This paper aims to explore the factors behind the development of small-scale irrigation in Zambia by tracing the experience of irrigation development among small-scale farmers in a village in central Zambia. The paper also seeks to contribute to a deeper understanding of the environmental implications of irrigation development.

Given the importance of small-scale irrigation in Africa's development agenda, it is important to identify factors contributing to the development of small-scale irrigation in current African contexts. Scholars and development practitioners advocate irrigation as an important means to achieve increased agricultural production and food security in Africa. In a region where droughts are prevalent, irrigation could be a key factor in enhancing food security. In the publication *African Environment Outlook,* it is argued that rapidly increasing the area under irrigation, especially small-scale irrigation, will provide farmers with opportunities to raise output on a sustainable basis (UNEP 2006: 84-5). Irrigation (mainly small-scale) is advocated as an example of "sustainable intensification" of agriculture in southern Africa, where agricultural growth depends on intensification rather than extensification (FFSSA 2004: 68). Thus irrigation is considered to be "sustainable" and contribute to poverty reduction among small farmers.

While irrigation can enhance food production, there are also risks such as its inappropriate application and overexploitation of water resources (UNEP 2006: 92, 136). Resource utilization becomes unsustainable when open access occurs in combination with demographic and technological changes (Haller & Merten 2008). Small-scale irrigation and cultivation of wetlands, without proper resource management, can cause land degradation or resource depletion. It is important to examine irrigation development in actual practice situations in order to determine how it can be kept sustainable and environmentally sound.

The adoption of irrigation practices exemplifies the coping strategies of small farmers who adapt and respond to new opportunities and constraints. We should examine the development of small-scale irrigation in terms of small farmers' wider strategies. The coping strategies of

[1] Unless otherwise noted, "Africa" refers to Sub-Saharan Africa.

individuals are integrated components of a country's wider economic system (Campbell 1990 cited in Zamani et al. 2006). Coping strategies are altered as a result of the emergence of new opportunities caused by a complex interplay of economic, political, social, and environmental conditions.

One issue to be investigated is how the actions of communities concerning small-scale irrigation development lead to sustainable practices which entail the management of socio-ecological systems. Fabricius et al. 2007 developed categories of communities according to their adaptive capacity and their role in ecosystem management. Communities are termed "Coping Actors" if they deal with adversity through reactive coping strategies. "Adaptive Co-manager" communities take a longer-term perspective in dealing with threats, and their adaptive strategies focus on sustainable management (Fabricius et al. 2007). While it is widely acknowledged that the concept of "community" is fraught with problems (Blaikie 2006), a community must be examined by focusing on its multiple interests and actors (Agrawal & Gibson 1999). This is because communities are composed of subgroups and individuals with varying preferences for resource use and distribution. It must also be recognized that human responses occur across different scales and levels of organization, playing out in multiple, uncoordinated, improvisational theaters (Bohensky & Lynam 2005).

2. Policy and Legal Contexts in Zambia

2.1. Politico-economic Setting

Over the last four decades, Zambia's political economy has undergone five distinct policy regimes (Thurlow & Wobst 2004):

(1) The period of a market economy and multi-party political system from Independence in 1964 to the early 1970s.

(2) The period of a state-controlled economy and single-party political system from the early 1970s to the mid-1980s. The government embarked on economic reforms to strengthen state control over the economy. Major industrial companies were nationalized, including copper mines. World copper prices plummeted in 1975 and this was the beginning of a 25-year stagnation of the Zambian economy. The political system also shifted to a one-party state.

(3) The period of economic transition in the second half of the 1980s. The government attempted to carry out IMF-World Bank-sponsored structural adjustment programs but abandoned them following political unrest.

(4) The return to a multi-party political system and the introduction of neo-liberal policies in the 1990s. After the 1991 multi-party election of President Chiluba, the MMD (Movement for Multi-party Democracy) government came to power. The government implemented economic liberalization and de-regulation policies such as the privatization of state enterprises, liberalization of agricultural markets, and trade liberalization. Economic stagnation continued with the deterioration of formal sector employment due to the economic liberalization.

(5) The period since 2001 of the "New Deal" under President Mwanawasa's government.

Economic liberalization policies were partly modified with more emphasis on poverty reduction. The economy recovered and grew, thanks to growing copper production after privatization in 2000, higher copper prices since 2004, and debt cancellations in 2005.

2.2. Policy and Institutional Setting for Irrigation and Water Resource Development

Zambian government policies and development plans emphasize the exploitation of water resources for irrigation development so as to achieve food security and poverty reduction. To reduce food shortages caused by the dependence of agriculture on rainfall, the expansion of irrigation is considered an appropriate solution. The PRSP (Poverty Reduction Strategy Paper) of 2002-2004 states the expectation that the expansion of irrigation would not only improve food security, but would also help reduce poverty[2] (Zambia 2002: 91). The Fifth National Development Plan (FNDP) sets a target of doubling the acreage under irrigation to 200,000 ha by 2010 (Zambia 2006: 49).

Zambia's policies and plans for agriculture and irrigation also have stressed the importance of the exploitation of water resources and irrigation development based on the recognition that the country is well-endowed with water resources, and on the assumption that irrigation is a sustainable agricultural practice. The 2004-2015 National Agricultural Policy provides 19 sectoral strategies including the promotion of sustainable and environmentally sound agricultural practices and the promotion of irrigation development. The National Irrigation Plan (NIP), formulated in 2005, proposes a strategy for efficient and sustainable exploitation of water resources by promoting irrigation. As interventions to improve the policy and legal environment, the NIP proposes the reduction of costs for energy and irrigation equipment as well as improved incentives for investing in irrigation[3]. The NIP recognizes the environmental considerations surrounding irrigation, stating that irrigation interventions do tend to generate an environmental impact. However, it also states, "there are no major worries concerning the effect of irrigation to the environment." (Zambia 2005: 10)

Government and donor policies are based on the recognition that Zambia is well-endowed with land and water resources which have been underutilized. Zambia is the most surface and groundwater resource-rich country in southern Africa (FFSSA n.d.: 47). The total internal renewable water resources (IRWR) have been calculated at 80 cubic km, while the total water withdrawal in 1994 was 1.7 cubic km.[4] Agriculture accounted for 77% of the total withdrawal, where the use of water is primarily for irrigation (Earth Trends 2003). Zambia's water sector is

---

[2] The perception that poverty is caused by the dependence on rain-fed agriculture is shared by Zambia's major donors. For instance, a paper by a joint initiative of major donors on pro-poor growth contends that crop production was negatively affected by the severe droughts of 1992 and 1995 which explain much of the increase in poverty that occurred between 1991 and 1996 (Thurlow & Wobst 2004: 31-32).

[3] It is recommended that during the first 2-3 years of the NIP, duty and VAT on basic irrigation equipment be reduced, and customs and excise duty for irrigation equipment also be reduced.

[4] 80 cubic km of surface water was produced internally and groundwater recharge was 47 cubic km. Total IRWR is: surface water + groundwater – overlap. There were 80 cubic km of overlap. The data was for 1977 to 2001 (FAO AQUASTAT cited in Earth Trends 2003).

undergoing an institutional transition[5]. While in 1994 the government adopted the National Water Policy (under revision since 2005), the national water sector framework is based on the old Water Act (1949). Presently the planning of water resources is fragmented. Plans for the development of agriculture, industry, and energy are prepared without adequate recognition of their impacts on water resources (Sievers 2006).

As of the mid-2000s, the total irrigated area in Zambia was officially 100,000 ha. Several estimates of irrigated acreage have been made. According to the PRSP 2002-2004, less than 40,000 ha of land is currently irrigated, mostly by commercial farmers (Zambia 2002: 53). The Water Rights survey (1994) estimated the total irrigated area at 53,000 ha, out of which smallholder irrigation accounted for only 210 ha (cited in FFSSA n.d.). However, these estimates did not include informal or traditional irrigation by small farmers, and if this had been included, the contribution of smallholder irrigation would be substantial. According to the Food and Agriculture Organization (FAO) of the United Nations, about 100,000 ha were estimated to be under so-called traditional irrigation in 1992[6]. These wetlands and dambos[7] in traditional areas of land tenure have been used for rice, fruit, and vegetable production without government intervention.[8]

There have been several programs promoting small-scale irrigation that were supported by the government, non-governmental organizations (NGOs) and donors. NGOs have played a particularly important role in mobilizing traditional farmers and emergent farmers to adopt irrigation practices. The Co-operative League of the United States of America (CLUSA) implemented a small-scale irrigation program through several NGOs including Total Land Care (TLC), World Vision International, and CARE. TLC[9], in collaboration with CLUSA, implemented a US$650,000 treadle pump irrigation project among 350 small-scale farmers (Daka 2006: 21). One NGO called International Development Enterprises (IDE) has been involved in the promotion of treadle pump and low-cost irrigation kits. Under USAID-funded projects promoting the Initiative to End Hunger in Africa, IDE was heading a market-led water management technology project called Smallholder Market Creation (Daka 2006: 21, 24, 27). As is clearly shown in this project, irrigation development is often associated with the commercialization of agriculture.

The ecological conditions of dambos and other wetlands are susceptible to deterioration, and the utilization of these wetlands for cultivation and irrigation may cause land degradation and depletion of resources. In Zambia, although it is government policy to promote the sustainable utilization of wetlands, there are no specific state laws that control or regulate such practices

---

5 The author was not able to collect the latest information on the water sector. The paper is based on information from up to early 2006.

6 Daka 2006 also shows an FAO AQUASTAT estimate for 2003: 155,912 ha of land in Zambia is irrigated, out of which an area of 100,000 ha is dambos used by small-scale farmers to grow vegetables.

7 Dambos are low-lying, shallow wetlands. For an expanded definition and the types of dambos, see Shimada 1995: 3-4.

8 FAO webpage on Zambia: http://www.fao.org/docrep/V8260B/V8260B1s.htm

9 TLC is an international NGO based in Malawi, operating also in Zambia, Tanzania and Mozambique (Bayani 2008).

(Shimada 1995: 12).[10]

The water resource management sub-sector was in the process of reform in the early 2000s as some drawbacks had been identified, including: a poor water resource management, regulation and enforcement mechanism; and an inadequate institutional and legal framework (Zambia 2002: 94; Sievers 2006). Zambian water laws and policies exhibit pluralism (Chileshe et al. 2005); water rights follow a state law property rights system in urban areas whereas customary law is more prominent in rural areas. The Water Development Board under the Ministry of Energy and Water Development allocates water rights, although no water charges have been levied on any irrigation abstractions (Daka 2006: 24). The Water Board coordinates water rights at the national level, especially for large-scale users such as commercial farmers (Chileshe et al. 2005). The water rights provided in state laws do not apply to customary laws. Traditional authorities (chiefs and headmen) are not involved in water resource management at the national level. Local communities on their traditional land have their own rules and perceptions of water rights, which are closely related to their land tenure system.

3. Development of Small-scale Irrigation in a Village in Central Zambia

3.1. Agriculture in "Village C" in the 1990s

The study area is a village in Chibombo District of Zambia's Central Province[11]. The village studied (hereafter called "Village C") was established in the mid-1970s. The land where the village is located was previously covered with forest, and the area was gradually cleared for villages as people migrated in and settled in the area. Village C had around 120 households by the mid-1990s. It is located close to the tarmac road connecting Lusaka and Kabwe. The location of the village is good in terms of the accessibility of major urban centers; it is about 90 km from Lusaka, 40 km from Kabwe, and about 260 km from the Copperbelt towns. The agriculture of the village has benefited from its good location and the accessibility to urban markets, which is one of the factors enhancing the commercialization of agriculture. The village is located in a Trust Land area, where customary law, including a communal land tenure system, is predominant.

Maize continues to be the most important cash crop as well as food crop for the majority of small farmers in Zambia. In Central Province as well as in Southern and Eastern Provinces, maize and other major crops are cultivated using ox-drawn ploughs. In maize farming, access to suitable land, ox-drawn implements, cattle and inputs such as fertilizer are important. While maize is an important crop in Village C, vegetable production is another of their main farming activities. The area around the village is abundant in dambos, which are utilized by farmers for crop production. Many of the village's farmers practice both upland maize cultivation and dambo gardening. In the

[10] The FNDP has set out nine agricultural sector programs including the Irrigation Development and Support Program, which involves six strategies including: facilitating the establishment of water rights that are supportive of sustainable agricultural development; and promoting the sustainable utilization of wetlands and dambos (Zambia 2006:50).

[11] A team of several researchers including the author has conducted research on the village since the early 1990s. See Shimada 1995.

early 1990s when we first conducted field research in the village, around half of the farmers in the village utilized dambos for vegetable production[12]. However, the size of the dambo gardens was limited; the average size of dambo gardens per household was only 0.5 ha (Shimada 1995: 33; Shimada 2007: 65). This was about one tenth the size of the upland fields. Most of the crops including maize were cultivated in the upland fields during the rainy season, while vegetables such as tomatoes, watermelons, and rapeseed were cultivated in both the upland fields and the dambo gardens[13]. The fact that vegetable production is a mainstay economic activity in Village C implies the importance of water resources, as vegetables are water-intensive crops. By the early 1990s in Village C, dambo land was not common-access but was allocated by the village headman in the same way as upland fields. Dambo land is allocated as an extension of upland allotments, with the rule that the "owner" of an upland allotment can extend his/her farmland borders toward the center of the stream or dambo (Shimada 1995: 31).

The combination of rain-fed upland cultivation and irrigated dambo gardening provides farmers with security against drought damages. The two farming activities are complementary in two respects. First, dambo gardening is a dry-season activity that does not compete for labor and land with upland farming and other activities. Second, the two activities are interconnected in such a way that the revenues from vegetable sales are used for purchasing maize production inputs for the rainy season.

However, rain-fed maize farming and vegetable growing each face a different set of climate uncertainties (related to environmental shocks) and market uncertainties (related to market and policy shocks). While rain-fed maize farming is susceptible to rainfall fluctuations, farmers could expect a certain amount of income from maize production based on fixed input and output prices during the period of state-controlled maize markets prior to the mid-1990s. Even after the liberalization of maize marketing system, the maize price fluctuations are more predictable than those of vegetables. In contrast, while vegetable production on dambo land is more drought-resistant than upland cultivation, farmers are faced with volatile prices at vegetable markets as they fall under the private markets system. This makes revenues realized from vegetable growing less predictable. Since vegetables are perishable, and given the lack of cold storage facilities, vegetable growers face the risk of being forced to sell their produce at giveaway prices or otherwise see their crops rotting away in their gardens.

The irrigation method most farmers practiced in the 1990s was bucket irrigation, which requires manual labor. Dambos possess seepage zones from which the capillary rise of moisture is exploited to grow crops without requiring much water control (Daka 2006: 11). In some areas on the fringes of a dambo, supplementary irrigation water is supplied to crops. Since the groundwater table is shallow in dambo lands, it is easy to dig shallow wells from which farmers can draw water

---

[12] Hanzawa's survey of 76 households in 1993 shows the magnitude of vegetable production in the village. In the 1992/93 season, 52 of the households interviewed had sold their tomato harvests from upland fields, and 41 households had done so from dambo crops (Hanzawa 1995).

[13] The acreage under cultivation for tomatoes and rapeseed accounted for 94% of the total dambo gardens in one of the village's dambos in 1992 (Shimada 1995: 33). Shimada measured the land size in 1992 and 1993, and found that 16 households managed crops in one dambo.

using buckets.

While protracted economic declines and structural adjustment measures in the 1980s and 1990s adversely affected income and employment for urban dwellers, farming in rural areas with access to markets was less severely affected, thus opening up prospects for better livelihoods in rural areas compared with urban areas. Zambia experienced several rounds of drought in the 1980s and 1990s, which impacted negatively on maize production in many parts of the country (Thurlow & Wobst 2004: 31-32; Kajoba 2007: 87). This made dambo irrigation farming particularly attractive. Under such circumstances, the population of Village C increased rapidly during the 1980s and the first half of the 1990s as people migrated into the village[14]. As a result of the population growth and increased commercialization of agricultural production, growing land use pressures and consequent land scarcity were beginning to be felt by the mid-1990s. Available land became so scarce that there were some cases of disputes over land between villagers as well as with neighboring villages (Kajoba 1995; Kodamaya 1995).

3.2. Effects of Liberalization of Agricultural Markets in the Mid-1990s

The deregulation of agricultural marketing system in the mid-1990s adversely affected small-scale farmers. The liberalization of maize marketing system resulted in price fluctuations and the deterioration of terms of trade for farmers. While input and output prices had been fixed annually during the state-controlled period, after the deregulation the prices fluctuated seasonally and annually. Since maize in Zambia is produced under rain-fed conditions, maize prices fluctuate seasonally according to domestic supplies[15]. After the liberalization that removed fertilizer subsidies, fertilizer prices increased more than maize prices did, so the terms of trade for farmers deteriorated[16]. In addition, fertilizer was not easily available in many rural areas in the years following the liberalization of markets. Maize price fluctuations and deteriorated terms of trade adversely affected maize production for the majority of small-scale farmers. Meanwhile, the devastation of livestock by cattle disease outbreaks exacerbated the situation, as the loss of cattle adversely affected ox-plough cultivation practices (Kajoba 2007). This led many farming households to pursue additional income-generating activities such as charcoal burning, petty trade in agricultural produce, fish trade, and running small shops[17]. Vegetable production in dambo

---

[14] A relative rise in agricultural employment occurred due to the high proportion of young people in the rural population, as well as the slowdown in rural-to-urban migration as economic conditions deteriorated in the 1980s and 1990s (FFSSA n.d.: 30). See Haller & Merten 2008 for the similar factors at work behind the in-migration of seasonal commercial fishermen to the fisheries in Kafue Flats, which attracted people who sought alternative income-generating activities.

[15] Seasonal maize prices normally reach their peak during the months of February, March and April (just before the harvest). The prices decline between April and June (just after the harvest), and thereafter prices rise again gradually.

[16] In fact, the government continued to be involved in fertilizer distribution through several programs including the Fertilizer Credit Program which was implemented by Food Reserve Agency from 1998. The government reintroduced fertilizer subsidies in 2002 through the Fertilizer Support Program.

[17] Similar responses were common both within and outside Zambia. UNEP 2006 reports that as a response to the poor performance of the formal sector, the diversification and intensification of

gardens also expanded in Village C as farmers sought an additional source of income.

Forest clearing was another important local event related to the environment that was occurring in the mid-1990s. On its eastern side, Village C borders a National Forest Reserve that was effectively protected by the government until the mid-1990s when people from some adjacent local communities, including some from Village C, migrated and settled in the Reserve. About 15 out of 120 households of Village C moved into the forest between 1995 and 1997. By the early 2000s, most of the land in the forest had been cleared for farming. Most of the people who shifted from the village to the forest cleared large tracts of land where they cultivated a large hectarage of maize and grazed a large herd of cattle. Factors behind the migratory event included social tensions between villagers that culminated in the departure of some villagers, many of whom were also motivated by the desire to have a larger land area to cultivate and graze. The event is an illustrative case of "extensification" of farming instead of the preferable "sustainable intensification." The population of the village, which had grown rapidly until the mid-1990s, ceased to increase and became stagnant.

3.3. Development of New Irrigation: Introduction of Treadle Pumps in 2001

Irrigation farming in Village C entered a new stage with the start of a new millennium. In 2001, an NGO called Total Land Care (TLC) came to the village and introduced a new irrigation method utilizing treadle pumps (Shimada 2007). TLC promoted the Vifor (Village Irrigation and Forestry) program and encouraged farmers in the village to form a group to collectively practice new irrigation methods. The organization extended micro-credit for the farmer group to buy treadle pumps, and trained them in irrigation agronomy and treadle pump operation and maintenance. The farmers participating in the Vifor group were required to establish a small land plot for gravity irrigation with furrows and ridges. The land plots were irrigated with water abstracted by treadle pump from a shallow well. FAO's AQUASTAT 2003 estimated that more than 5,000 treadle pumps were in use in Zambia to irrigate a total area of more than 1,200 ha (Daka 2006: 6). A treadle pump has the limited capacity of abstracting water from a depth of up to 8 meters. For this reason, its application is common in dambos where water tables are shallow.

An important note on irrigation and the environment must be added in relation to TLC's development intervention. As the name Vifor (Village Irrigation and Forestry) suggests, TLC was attempting to promote not only irrigation but also social forestry, as it had been doing in Malawi where the organization is based (Bayani 2008)[18]. However, as far as the project in Village C and TLC's activities elsewhere in Zambia in the early 2000s were concerned, the focus was on irrigation rather than on forestry[19]. Except a few farmers practicing agroforestry and conservation

---

informal sector activities occurred, many of which were based on natural resources and may have detrimental impacts on the environment (UNEP 2006: 16).

[18] In Malawi, TLC is also promoting the use of manure and agroforestry. TLC follows the policy that those benefiting from TLC's irrigation program must plant at least 100 trees along a stream bank (Bayani 2008).

[19] References to TLC are made on several pages of Daka 2006, but without any associated mentions of forestry or agro-forestry activities.

farming, other members perceived the project as specifically promoting treadle pump irrigation. The period when treadle pumps were being introduced by TLC also saw actors outside the village promoting other new agricultural practices. One of these was conservation farming promoted by the Conservation Farming Unit of the Zambia National Farmers Union (ZNFU), whereby some farmers in the village introduced these practices, mainly in their upland fields.

The irrigation project of 2001 entailed several new elements. First, it involved a technological development in terms of the shift from bucket irrigation to pump irrigation. A treadle pump can abstract a larger amount of water in a shorter time and can irrigate a larger hectarage of land. It is also so simple to use that it can even be operated by children.

Second, the irrigation project included the establishment of specific small-sized land plots (15m by 30m) for gravity irrigation, which entailed a more intensive use of the land (Shimada 2007)[20]. However, it is not clear whether the intensive use of small plots for irrigation also implied more efficient use of water compared with traditional dambo cultivation. There were also implications for farmers' requirement of cattle and ox-drawn implements because the cultivation of small irrigation plots does not depend on ox-ploughing.

Third, the crops recommended by TLC included not only vegetables but also maize, the staple crop. Before the Vifor project, few farmers grew irrigated maize during the dry season. Since the introduction of the project, some farmers have practiced "winter maize" cultivation with irrigation. This was in line with the new situation under the liberalized agricultural market and the government policy encouraging farmers to grow winter maize. Winter maize is planted around May and harvested around October and November when maize can fetch higher prices.

It is difficult to quantitatively estimate the impact of treadle pumps on water demand because it depends on several factors; in addition to the abstraction capacity of a treadle pump, the calculation must include evaporation rates, the type of crops irrigated (their water intensity and evaporation rates), irrigation methods (considering their water use efficiency or irrigation efficiency), and acreage under irrigation. Although the introduction of treadle pumps can increase water demand, the associated introduction of a new irrigation agronomy and diversification of crops irrigated can also affect the water demand. In addition, such an increase in the total water demand could have been small, because the number of farmers who adopted the use of a treadle pump[21] was small and the size of the land irrigated by each farmer was also small.

Since TLC and Vifor were instrumental in introducing the new irrigation project, farmers' access to new technology and financial resources depended on their membership in the Vifor group. Again, to be entitled to subsidized fertilizer under the government's Fertilizer Support Program, farmers were required to organize themselves into a co-operative[22], thus effectively encouraging

---

[20] This can be compared with the average size of a dambo garden in 1992, which was 0.4 ha per household (Shimada 1995: 33; Shimada 2007).

[21] This was due to the cost of the pump. In 2001, a treadle pump cost 480,000 kwacha (US$133) (Shimada 2007). In 2008, a treadle pump set (including the treadle pump, outlet pipes, inlet pipes and a foot valve) cost 570,000 kwacha (US$162).

[22] The Cooperative Societies Act no.20 of 1998 provides the legal framework for co-operatives in Zambia.

farmers to do so. In Village C, 21 farmers formed the J.C. Irrigation and Savings Club in 2001 to have access to government-subsidized fertilizer (Shimada 2007)[23].

3.4. Introduction of Engine Pumps

Another development in irrigation methods in Village C occurred around 2005. A growing number of farmers began to purchase engine pumps. By 2008, about a dozen farmers in the village were practicing irrigation farming using engine pumps. In fact, many of the engine pump owners were those who had bought treadle pumps in 2001[24]. In other words, there was a shift from treadle pumps to engine pumps among those farmers who practiced pump irrigation. One farmer bought an engine pump for 1.25 million kwacha (or US$350) in 2007[25].

Another development in irrigation was the introduction of drip irrigation. Two organizations called IDE and Cropserve held a training course on drip irrigation in March 2008, and subsequently some farmers in the village were introducing drip irrigation[26]. In 2008, a drip irrigation kit cost 230,000 kwacha (or US$66). A drum is installed at an elevation of 2 to 3 m above ground to provide a low-pressure head that is sufficient to operate micro-tube drippers. Water is pumped from the source to the reservoir, and the micro-tubes emit water drop by drop onto the root zone surrounding the crops.

In 2007, another group of farmers practicing irrigation organized themselves into a co-operative called M. Vegetable Growers[27]. M. Vegetable Growers had 35 members and spanned 4 villages including Village C. The co-operative was assisted by the Rural Prosperity Initiative (RPI) of IDE. M. Vegetable Growers and two other co-operatives were organized into the IDE-RPI Zone 2 in June 2008.

Some changes in the economic and policy environments helped with the diffusion of engine pumps in the village, including economic liberalization policies, the reduction of duties on irrigation equipment, and the recovery of the Zambian economy. With the trade liberalization in the first half of the 1990s, imported goods became more easily available. The Zambian economy, after 25 years of stagnation and contraction, recorded 8 consecutive years of growth since 1999. The economic recovery was accelerated by the rapid expansion of copper exports, which jumped from US$365 million in 1998 to US$3.084 billion in 2006 (IMF 2006; IMF 2008). The expansion of exports has resulted in an appreciation of the Zambian currency, from 4779 kwacha per US dollar in 2004 to 3603 in 2006. The reduction of duty, VAT, and customs as recommended in the National Irrigation Plan in 2005 has also helped to reduce the cost of irrigation equipment. These changes

---

[23] J.C. are the initials of a former village headman's name. Before this Club, two co-operatives were formed in the area in 1998 and 1999 to gain access to Fertilizer Credit Program.

[24] This shift does not seem to be unique to Village C farmers; farmers in the other groups trained by TLC were reported to be investing in motorized-pump irrigation systems following their use of treadle pump irrigation (Daka 2006 : 22).

[25] Engine pumps were not entirely new to the village. A few farmers had bought engine pumps in 1992 and 1993 but they resold them after a few years.

[26] IDE is a US-based NGO and Cropserve is a private company. IDE trains farmers and links farmers with service providers.

[27] M. stands for the area's name.

resulted in imported engine pumps coming within the financial reach of more small-scale farmers[28].

However, it is also a fact that only a fraction of the farmers in the village can afford engine pumps. An engine pump costs two and half times more than a treadle pump. In addition to their initial cost, engine pumps require much greater maintenance costs, including fuel, than do treadle pumps. Consequently, the number of households who can afford an engine pump is likely to be small.

One factor that encouraged farmers to adopt engine pumps was an increased demand for water. As some households wanted to expand their irrigation farming, they were faced with the limited abstraction capacity of a treadle pump. A treadle pump also depends on the availability of labor, which can be a constraint on expanded irrigation farming. A treadle pump can be operated by children, who in fact were an important source of labor, but they were not available during the school terms.

One of the impacts of the introduction of engine pumps was the extension of irrigation to upland fields. Whereas a treadle pump is restricted to the irrigation of dambo lands due to its limited capacity, an engine pump can be used to irrigate even upland plots. According to our informants in the village, the irrigation of upland plots began two years ago and has been expanding since then.

A related impact of engine pumps is the effect on water consumption and its distribution among water users. An engine pump is more powerful than a treadle pump and this can result in increased water consumption. However, as already noted, it is difficult to estimate changes in water consumption because it depends on many factors. While the introduction of engine pumps and the concomitant extension of the irrigated area into upland fields can cause increased water consumption, the adoption of drip irrigation, originally developed as a water-saving practice, works as a counterbalance by contributing to water savings (Smil 2000). Since the number of farmers practicing irrigation with engine pumps is small, and since they are likely to consume a much larger amount of water than those without engine pumps, then the amount of water consumed will be disproportionately concentrated among a small number of farmers[29].

While the introduction of engine pumps is likely to result in increased water demand among those farmers, the total water demand of the village may not see a marked increase due to the stagnant growth of the village population since the mid-1990s (in contrast to its rapid population growth in the first half of the 1990s). The stagnant population trends were caused by a combination of several local and national factors[30].

---

[28] Another noticeable change associated with export expansions and kwacha appreciation is the rapid increase in automobile imports.

[29] Since the water for the villagers' domestic use is also drawn from wells, this may lead to competition for water between irrigation and domestic use.

[30] Local factors include (as described above): the out-migration of some households to the neighboring forest reserve in the mid-1990s; and the moving out of some people from the village due to social tensions. National factors include: the recovery of the Zambian economy since 2000, which brought some improvements in employment and income in urban areas.

The issue of the amount of water use and its distribution among users is related to the control and collective management of water resources. Access to land including dambos, which falls under the communal land tenure system, is controlled by chiefs and village headmen. However, a villager can dig a well on his/her allocated land without seeking the permission or consent of a chief, headman, or other villagers. While there are some farming groups and co-operatives in the area, they mainly have the purpose of gaining access to subsidized fertilizer and other state and NGO support; there are no groups operating as a water-users association. Thus there is no mechanism of collective control or management of groundwater abstracted from wells, and consequently water resources can be over-used in de facto open-access situations. As far as surface water such as streams is concerned, there are some customary controls. According to our informants in the village, there is an acknowledgment that "streams are communal and there are no boundaries for streams [it means that unlike lands streams are not allocated to individuals]," and as such there is some control of the use of stream water. When a farmer wants to build an earthen dam on a stream, he/she is required to gain the consent of farmers who live along that stream.

4. Discussion and Conclusion

In this paper, we traced the development of small-scale irrigation based on the experiences of one village in central Zambia. Irrigation farming in the village began as traditional or informal irrigation, whereby vegetables were grown in dambo gardens with the use of bucket irrigation. By the early 1990s, vegetable production in dambo gardens had become an important source of income for many farmers in the village. The combination of rain-fed maize cultivation in upland fields and vegetable growing in dambo gardens provided farmers with relatively secure and diversified income sources. As economic declines and structural adjustment measures in the 1980s and 1990s adversely affected the livelihoods of urban dwellers, farming in this village, with its water resources, came to be economically more attractive. Irrigated vegetable production in dambo gardens became more popular as an additional or alternative income generating activity after the mid-1990s when the agricultural market was liberalized. In the early 2000s, some farmers in the village shifted from bucket irrigation to treadle pump irrigation with the assistance of a non-governmental organization. The introduction of treadle pumps entailed new methods in irrigation agronomy such as the use of furrows and pipes, the cultivation of winter maize, and more intensive use of the land. The second half of the 2000s is seeing another development in the use of irrigation technology, with some farmers introducing engine pumps and drip irrigation. As irrigation methods developed from bucket irrigation to treadle pump and engine pump irrigation, the water consumption level of each farmer likely increased.

The development of irrigation farming in Village C illustrates a type of coping strategy used by farmers to respond and adapt to new opportunities and constraints. Opportunities and farmer responses in the village must be seen against the backdrop of economic, geographical and environmental conditions. The typical farming system found in the study area, which comprises the two practices of rain-fed maize cultivation and irrigated dambo gardening, is an expression of farming adaptations in the face of uncertainties both in rainfall and market conditions. The introduction of new irrigation practices by some farmers can be considered an expansion of the dambo gardening component of the system. Those farmers using new irrigation methods retain the two farming practices so as to be adaptive to different sets of opportunities and risks.

The development interventions of NGOs played an important role in the adoption and diffusion of treadle pumps and drip irrigation. Support from NGOs related to irrigation development placed greater emphasis on poverty reduction, income generation, and market sales than on environmental and ecological aspects. One of the two NGOs involved in promoting small-scale irrigation in the village emphasized linking farmers with the market, while the other was perceived by farmers to stress irrigation despite its usual inclusive focus on both irrigation and forestry. Although irrigation farming in the research site has developed without stimulation by any specific government support programs, the government contributed to the policy setting, facilitating the exploitation of water resources for irrigation without paying due attention to environmental considerations including regulations on the use of wetlands and water resources.

Economic and geographical conditions also played a part in the farmers' opportunities and responses. This can be illustrated by comparing the study area with other areas. When compared with Gwembe Valley in Southern Province, it is evident that the area where our case study village is situated has much more favorable conditions. Farmers in the study site have easy access to markets for selling their produce, whereas Gwembe people cannot count on the availability of markets. The former can invest in irrigation equipment while expecting a good return, whereas for the latter people, agricultural investment is a gamble in which the odds are too high due to climatic uncertainties and unpredictable government and donor policies (Cliggett et al. 2007).

It is quite clear that the farmers in the village studied are not "Powerless Spectators," but either "Coping Actors" or "Adaptive Co-managers" as described in Fabricius' categories of communities. The villagers continuously invested in new agricultural management practices and land-care techniques. Knowledge networks enabled the villagers to co-opt new technology from outsiders (Fabricius et al. 2007). However, the investments and technology promoted are mainly associated with income-generating activities, which may allow the damaging of ecosystems and thus undermine their capacity to generate services. Although some farmers introduced conservation farming methods which were promoted by a non-government organization, the village lacks systematic efforts to invest in the long-term management of ecosystem services or to take appropriate action for long-term sustainability. It seems that the dambos of the village are opportunistically used without any plan for maintaining their capacity to generate services.

The case of the village studied demonstrates that the farmers' responses were not necessarily unified, coordinated responses of the "community" (in this case, the village). The responses to the new farming practices and NGO support mainly occurred at the level of individual farmers and farmer groups. Treadle pumps, drip irrigation, and conservation farming were respectively introduced by different farmer groups, with some of their members overlapping and including farmers from neighboring villages, while engine pumps were introduced by individual farmers. In addition to these farmer groups, several other groups were formed to gain access to government-subsidized fertilizer. Their strategy is to continue the type of farming predominant in the 1980s, that is, rain-fed maize farming dependent on government-subsidized fertilizer, and this is quite different from the strategy of pursuing the introduction of new irrigation technology. However, it is important not to polarize this distinction, because many farmers combine upland maize cultivation and dambo gardening, and the two strategies coexist at the individual farmer level, with some differences in emphasis. The out-migration of some villagers to the neighboring forest reserve in the mid-1990s demonstrates how individuals and subgroups in the community had different preferences for resource use with various responses to opportunities and constraints.

Farmers' responses to new opportunities are not only conditioned by the configuration of those opportunities but also constrained by the farmers' assets or capital. As irrigation methods shifted to those entailing more capital-intensive technology such as engine pumps, farmers' responses to new opportunities depended increasingly on their resource or capital base including social capital[31]. Whereas any farmer with access to dambo land and labor can undertake traditional irrigation practices, only those farmers with sufficient financial resources can afford the initial investment and maintenance outlays of new irrigation methods. Since membership in farmer groups is required in order to be entitled to support from NGOs and the state, social capital might play a role in the access to new irrigation technology and subsidized inputs. One probable consequence of this situation is a widening gap between those who have sufficient resources to respond to new opportunities and those without. In other words, irrigation development has benefited a small proportion of farmers, while the majority of the village population has been excluded from the benefits of the new technology. However, even those farmers who are wealthy enough to invest in expanded crop production and new irrigation technology are facing a risk because they are more dependent on private markets, making them vulnerable to market price fluctuations[32].

Although it is difficult to quantitatively estimate the impact of pump irrigation on water demand because of many factors affecting water use, the shift from bucket irrigation to treadle pump and engine pump irrigation in the area has likely had a substantial impact on the use of water resources, especially groundwater. Since there are no customary or formal regulations or control of the use of groundwater, current opportunistic use of groundwater for irrigation agriculture can result in the overuse of groundwater and might cause its decrease and depletion. Zambia, in terms of a national total, is well-endowed with water resources, both surface water and groundwater, and there are many prospects for exploiting this abundant irrigation potential. However, the water resource endowment varies from area to area and water resources in particular local areas can be much scarcer than the national total figures suggest[33]. As irrigation farming provides small-scale

[31] However, intensive irrigation farming on small plots depends less on cattle and ox-drawn implements, which are important capital for upland cultivation and traditional dambo gardening.

[32] See Liverman's studies for information on the vulnerability of the production of fruit and vegetable crops for export markets to both price fluctuations and climate change (cited in O'Brien & Leichenko 2000).

[33] PRSP 2002-2004 points out that there are significant variations [in the available water resources] across the country, and there is a strong seasonal distribution leading to water deficits in certain localities. Competition for available water resources is expected to increase (Zambia 2002:

farmers with an important source of income as well as security against damages from rainfall fluctuations, it is crucial to introduce some mechanism of control and management of water resources which enables the sustainable use of this important resource. Last, we must add that if one looks at the distribution of water consumption at the national level, it has remained highly skewed with a large proportion of water resources being consumed by commercial farms for irrigation and for industrial use such as by mining companies, while water use by small farmers for irrigation is just emerging. Under these circumstances, control or regulation of water resources should not be imposed on small-scale farmers in a top-down manner. Instead, it should be managed in a participatory way based on the idea that natural resources are most effectively managed when responsibility is shared with democratic local institutions[34].

References:

Agrawal, A. and Gibson, C. 1999 "Enchantment and Disenchantment: the Role of Community in Natural Resource Conservation", *World Development*, vol. 27, no.4: 629-649.

Bayani, E.K. 2008 "Malawi's Initiatives in Responses to Climate Change" *LEISA Magazine* 24 (4) December 2008: 34-5.

Benson, Todd 2004 "Africa's Food and Nutrition Security Situation", 2020 Discussion Paper 37, International Food Policy Research Institute.

Blaikie, P. 2006 "Is Small Really Beautiful? Community-based Natural Resource Management in Malawi and Botswana," *World Development* vol.34, no.11, pp.1942-1957.

Bohensky, E. and Lynam, T. 2005 "Evaluating Responses in Complex Adaptive Systems: Insights on Water Management from the Southern African Millennium Ecosystem Assessment (SAfMA)", *Ecology and Society*, vol. 10, no.1

Chileshe, P., Trottier, J. & Wilson, L. 2005 "Translation of Water Rights and Water Management in Zambia", Paper presented at International Workshop on 'African Water Laws: Plural Legislative Frameworks for Rural Water Management in Africa', January 2005, Johannesburg.

Cliggett, L., Colson, E., Hay, R., Scudder, T. & Unruh, J. 2007 "Chronic Uncertainty and Momentary Opportunity: A half century of adaptation among Zambia's Gwembe Tonga", *Human Ecology*, 35

Daka, A.E. 2006 "Experiences with Micro Agricultural Water Management Technologies: Zambia" (Report submitted to the International Water Management Institute, Southern Africa Sub-regional Office)
http://sarpn.org.za/documents/d0002066/Zambia_AWM_Report.pdf (accessed December 2008)

---

91).

[34] One issue relating to water resource management under the Community-based Natural Resource Management regime is that the boundaries of natural resources such as watersheds may bear no resemblance to community boundaries. One approach is to encourage the formation of appropriate federations and networks (Blaikie 2006: 1944; Ribot 2002: 14-5).

Earth Trends 2003 "Water Resources and Freshwater Ecosystems – Zambia"

Fabricius, C., Folke, C., Cundill, G. and Schultz, L. 2007 "Powerless Spectators, Coping Actors, and Adaptive Co-managers: a Synthesis of the Role of Communities in Ecosystem Management", *Ecology and Society,* vol. 12, no.1

FFSSA 2004 "Achieving Food Security in Southern Africa: Policy Issues and Options", FFSSA Synthesis Paper, Forum for Food Security in Southern Africa. http://www/odi/org/uk/food-security-forum

FFSSA n.d. "Zambia Food Security Issues Paper", Forum for Food Security in Southern Africa

Haller, T. & Merten, S. 2008 "'We are Zambians – Don't Tell Us How to Fish!' Institutional Change, Power Relations and Conflicts in the Kafue Flats Fisheries in Zambia" *Human Ecology*, no.36: 699-715

Hanzawa, K. 1995 "Agricultural Production and Economic Activity in Chinena Village: Economical Significance of Dambo Use", in Shimada ed. 1995.

IMF 2006 "Zambia: Selected Issues and Statistical Appendix" (IMF Country Report no.06/118),

IMF 2008 "Zambia: Statistical Appendix" (IMF Country Report no.08/30), January 2008.

Kajoba, G.M. 1995 "Changing Perceptions on Agricultural Land Tenure under Commercialization among Small-scale Farmers: the Case of Chinena Village in Chibombo District (Kabwe Rural), Central Zambia" in Shimada ed. 1995.

Kajoba, G.M. 2007 "Vulnerability and Resilience of Rural Society in Zambia: From the Viewpoint of Land Tenure and Food Security" in Vulnerability and Resilience of Social-Ecological Systems: Annual Project Report, RIHN.

Kodamaya, S. 1995 "Migration, Population Growth and Ethnic Diversity of a Village in Central Zambia", *Hitotsubashi Journal of Social Studies*, vol.27, no.2.

O'Brien K.L & Leichenko, R. M. 2000 "Double Exposure: assessing the impacts of climate change within the context of economic globalization", *Global Environmental Change*, no. 10: 221-232.

Ribot, J.C. 2002 *Democratic Decentralization of Natural Resources: Institutionalizing Popular Participation*, World Resources Institute.

Sanginga, P.C., Kamugisha, R.N. and Martin, A.M. 2007 "The Dynamics of Social Capital and Conflict Management in Multiple Resource Regimes: A Case of the Southwestern Highlands of Uganda", *Ecology and Society*, vol. 12, no. 1

Shimada, S. ed. 1995 *Agricultural Production and Environmental Change of Dambo*. Tohoku University/ University of Zambia

Shimada, S. 2007 *Gendai Africa Nouson (Rural Transition in Modern Africa: Challenge of Area Study to Read Change),* Kokon-Shoin, Tokyo. (in Japanese)

Sievers, P. 2006 "Zambia Water Sector: Challenges for Integrated Water Resources Management in Zambia", paper presented at Danida Water Sector Seminar, January 2006, Accra Ghana

Smil, V. 2000 *Feeding the World: a Challenge for the Twenty-first Century*. Massachusetts Institute of Technology.

Thurlow, J. and Wobst, P. 2004 "The Road to Pro-Poor Growth in Zambia: Past Lessons and Future

Challenges", Operationalising Pro-Poor Growth: A Country Case Study on Zambia, A joint initiative of AFD, BMZ, DFID, and the World Bank

UNEP (United Nations Environment Programme) 2006 *Africa Environment Outlook 2: Our Environment, Our Wealth*. UNEP, Nairobi.

Zamani, Gh. H., Gorgievski-Duijvesteijn, M.J. & Zarafshani, M. 2006 "Coping with Drought: Towards a Multilevel Understanding Based on Conservation of Resources Theory", *Human Ecology* 34.

Zambia 2002 Ministry of Finance and National Planning, *Zambia Poverty Reduction Strategy Paper 2002-2004*. Lusaka.

Zambia 2004 Ministry of Agriculture and Co-operatives, *National Agricultural Policy 2004-2015*. Lusaka

Zambia 2005 Ministry of Agriculture and Co-operatives, *National Irrigation Plan (NIP)*. Lusaka.

Zambia 2006 *Fifth National Development Plan 2006-2010*. Lusaka

The Cattle-raising among the Gwembe Tonga in the Southern Province, Zambia: Research Report in 2008

Masahiro Okamoto
Research Institute for Humanity and Nature

Abstract

A field research was conducted from November to December, 2008 in Sinazongwe District, Southern Province, and Lusaka in Zambia. The purpose of the research is to understand how the cattle-rearing is conducted among the Gwembe Tonga people in Southern Province. The revealed issues by the field research are as follows;

1) It was after forced migration of the Gwembe Tonga by constructing the Kariba Dam in 1950s, that they started to raise the cattle actively. Before that, they used to keep goats instead of cattle, because there was the effect of tsetse flies.
2) The shifting from raising goats to cattle is directly linked to the change of bride wealth. That is to say, bride wealth was mainly paid by goats and cash before 1950's; it is paid by cattle and cash after 1950's as the case may be together with goats.
3) The most important usage of the cattle is for plowing. However the number of oxens is in shortage in most households. Therefore it is popular to use cows for plowing.
4) The grazing area and feed for cattle change seasonally. Cattle graze in the bush around the villages mainly. During the dry season, they feed harvested maize stem and leguminous trees, *Acacia albida*, which are kept in the maize field for the purpose of feeding and for manuaring.
5) Feeding damage by cattle and goats is common. As a result, people make the fences around fields with the branch of echinate, *Acacia albida*.
6) Herdboys must attend to grayzing to avoid the invension of cattle and goats to the field during the rainy season. It is the regulation established by each village.
7) It is very rare to slaughter cattle for food except the case of funeral. If people need cash, they sell cattle to acquaintance or buyers from Lusaka. To slaughter goats for food is common.
8) Usually cattle are owned by individuals. However the cattle gifted as bright wealth are shared by the members of matrilineage. These cattle are called "*ngombe lya mukowa* ". They are used, when the need arises by members of matrilineage.

Human Networks in Southern Province, Zambia: An Overview

Yudai Ishimoto
Research Institute for Humanity and Nature, Kyoto, Japan

Abstract

The objective of this study was to clarify quotidian human networks of Tonga people living in Southern Province, Zambia, which is located in the semi-arid tropics (SAT) of an unstable ecological environment. The construction and reconstruction of these everyday human networks are discussed in this paper.

Human networks observed in research sites were kin networks, neighborhood networks, religious networks, scholastic networks, recreation networks, and networks in activities earning income.

The formation of human networks is divided into construction of new networks and reconstruction of existing networks. Opportunities of the former are migration, marriage, school attendance, and job gain. Examples of the latter are marriage, migration, divorce, graduation, resignation of job, change of church affiliation, and separation of new villages from old villages. In this paper, I focused on marriage as related to the construction and reconstruction of family networks and discussed the formation of human networks. It was evident in the study area that there were many marriages between members of neighboring villages, and a high percentage of marriages were between members of the same old neighborhoods of origin.

1. Introduction

Human networks, as represented in Fig. 1, are constructed in daily life. Some networks are utilized to solve ecological and social problems. Therefore, human networks are one component of resilience in social systems.

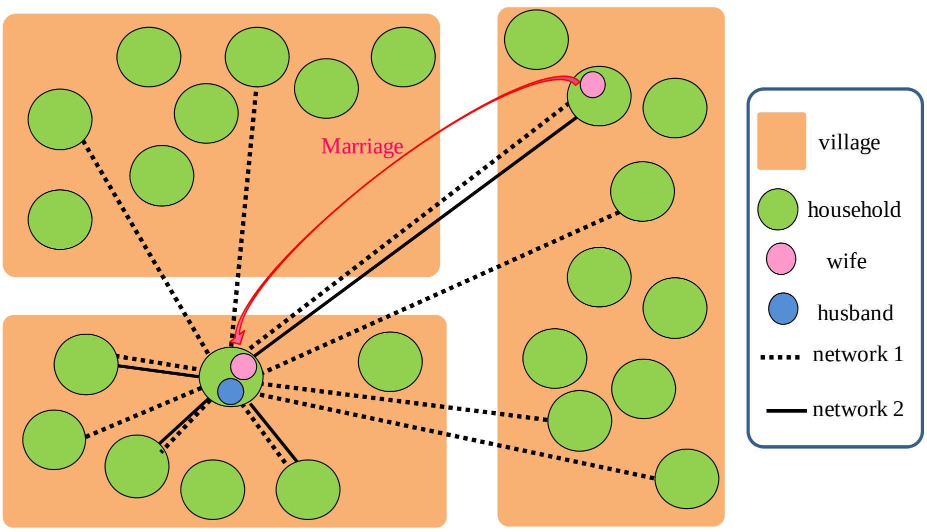


Fig. 1 Schematic Diagram of Human Network
* In this figure, there are networks between households.
Individuals and communities have networks as well.

Networks are chosen according to circumstances; the same ones are not always utilized to solve problems. Accordingly, to begin with, it is important to consider the entire picture rather than discuss networks in specific emergencies. The objective of this study was to clarify quotidian human networks of Tonga people living in the Southern Province of Zambia, which is located in the semi-arid tropics (SAT) of an unstable ecological environment. I studied the construction and reconstruction of these quotidian human networks.

In this study, "human networks" refers to both the structure of connections between people and the flow of things and actions in these connections; I discuss the former in this paper.

2. Research Outline

Research sites were located in lower flat land "Site A", middle slope "Site B", and upper flat land "Site C" at Sinazongwe area, Southern Province in Zambia. On every site, most of the residents were Tonga people. Fig. 2 indicates the locations of research villages. Red points show villages researched by other project members, and blue points show research villages added by the author. At Site A, I chose two villages of lakeside area, five villages of middle area and five villages of mountainside area, paying attention to differences in ecological environments.

The research period was from 20 June to 29 October 2008. The end of June was after harvest; the end of October was just before the start of rainy season. Research methods were direct observation and interview using a questionnaire. Research topics included kinds of human networks, features of each network, and marriage and birthplaces.

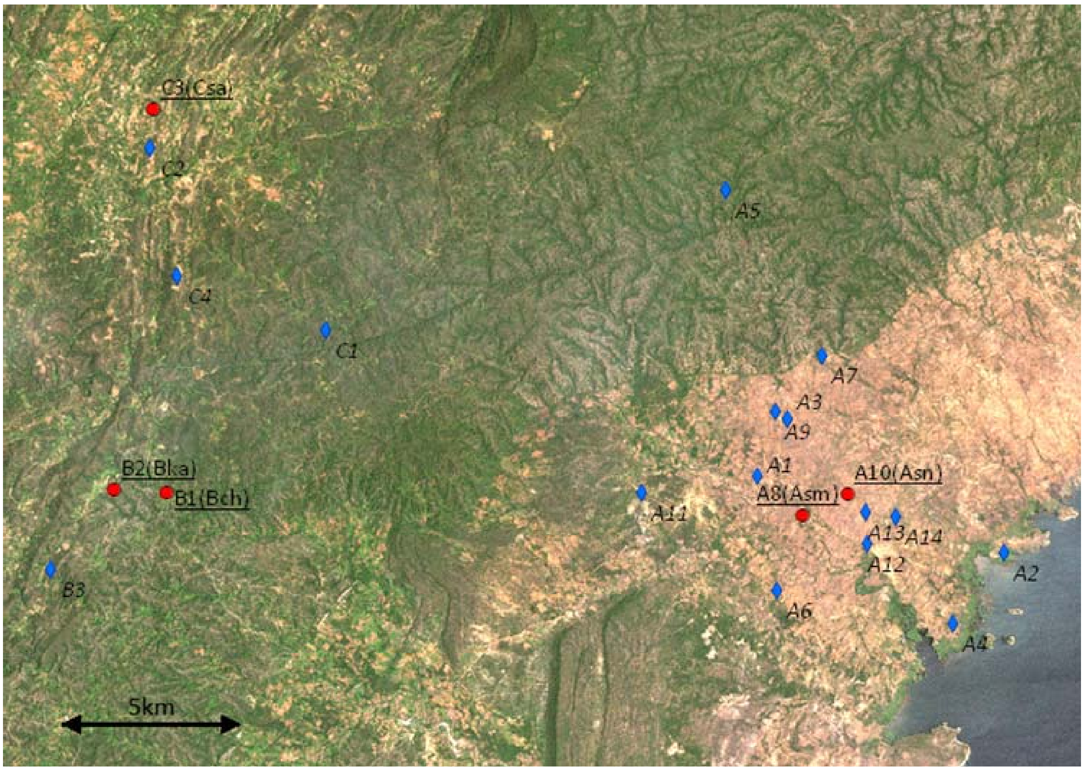


Fig. 2 Location of Research Villages

*1See table 1 for names of research villages.
*2 Drawn by Megumi YAMASHITA

Table 1　Names of Villages

	Name of village	Research village		Name of village	Research village		Name of village	Research village
A1	Chande	●	A18	Kalangwa		A35	Sianyuka	
A2	Chilele	●	A19	Kaluli		A36	Siapoke	
A3	Chizu	●	A20	Kasanse		A37	Siazwela	
A4	Mambova	●	A21	Makula		A38	Sikaputa	
A5	Maunga	●	A22	Malede		A39	Simagwali	
A6	Nagombe	●	A23	Manyonga		A40	Sinachilundu	
A7	Nchete	●	A24	Mukalanga		A41	Sinagainbi	
A8:Asm	Siameja	●	A25	Munyati		A42	Sinalulongwe	
A9	Siamvwem	●	A26	Mutwamasiku		A43	Tobonte	
A10:Asn	Sianemba	●	A27	Muvwali		A44	Lusinga	
A11	Siansima A	●	A28	Muzanbalika		B1:Bch	Chanzika	●
A12	Siansima B	●	A29	Siamufunde		B2:Bka	Kanego	●
A13	Simwela	●	A30	Siamunyembe		B3	Siajanba	●
A14	Sinanjola	●	A31	Siamutuna		C1	Mubanga	●
A15	Bbune		A32	Sianchinda		C2	Mwemba	●
A16	Chagobola		A33	Siangwinda		C3:Csa	Siachaya	●
A17	Chimkobo		A34	Siankwazi		C4	Siamusana	●

3. Overview of Human Networks

Human networks observed at research sites were kin networks, neighborhood networks, religious networks, scholastic networks, networks in recreation, and networks in activities earning income.

3-1. Family Networks

The following is a description of the members of kinship groups in the Tonga people. I focus on marriage as a case study of a family network in chapter four.

The Tonga people were divided into Valley Tonga and Plateau Tonga (Fig. 3). Most people at Sites A and B belonged to Valley Tonga, and people at Site C belonged to Plateau Tonga.

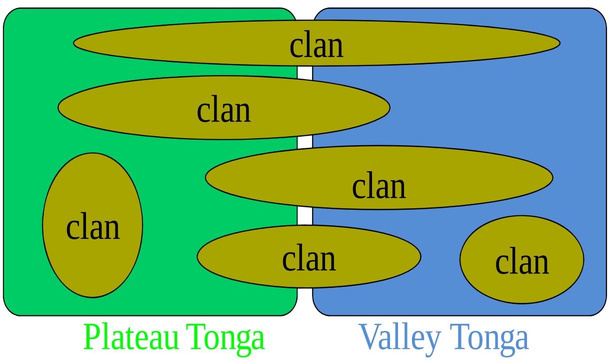


Fig. 3 Sub-Group of Tonga People

There were clans called "*mukowa*" which were smaller groups of Tonga than either Valley or Plateau Tonga. The clans had names of animals like cattle "*muwiinde*", baboon "*muchinba*", goat "*mulea*", zebra "*mugonka*", dog "*mukuli*", crocodile

“*muetwa*”, and rabbit “*musanje*”*;* there were also names related to plants like seed of pumpkin or “*mutanga*”. Many clans belonged to both Valley and Plateau Tonga. Members of the same clan had uncles and nephews among men of different generations and brothers among coeval men.
Regarding the institution of marriage in Tonga, people practiced polygyny and patrilocality. Children used the father’s name as their surname, and they succeeded their mother’s “*mukowa*”. Children inherited land from their father typically; however, it was possible to inherit land from their father’s side and mother’s side in the case of a land shortage.

3-2. Neighborhood Networks

Construction of Kariba Dam caused forced migration and remigration; it changed neighborhood networks. In this study, I focused on village organization or typical neighborhood networks. I discuss first the members of villages at research sites, and second the features regarding establishment of villages on each site.

The members of villages were mixed with people of more than one *mukowa* or clan with village members being autonomous units. Unused land belonged to the villages, and the headmen and committees of villages were allowed to use it. Members of villages dealt cooperatively with work projects like road maintenance and were recipients of aid programs such as food aid.

Regarding the establishment of villages, as can be seen in Fig. 4, new villages increased rapidly on Site A after construction of Kariba Dam in 1957, and new ones also increased on Sites B and C subsequently. The establishment year in Fig. 4 was the year in which the traditional chiefs gave villages headmanship; however, it may be that people started to live there before the establishment year. In Fig. 4, no information is shown regarding non-research villages because I could not acquire enough information about these villages.

People were forced to migrate from the valley area at the moment of dam construction, and they built a lot of new villages on Site A. The villages, which were located close together before migration, still belonged to old neighborhood groups like *Chilonga, Dangwe, Landani,* and *Njola*. The villages which developed before dam construction had the original name *Buleya*. But some villages were established after dam construction. A6 of Fig. 4 was separated from A8, A40 was separated from A1.

Fig. 5 is separated by color for each old neighborhood group in villages on Site A. Names of villages are put in position of latitude and longitude by headman or vice headman. In Fig. 5 it is apparent that villages of *Buleya* were grouped along the Nagombe River and that villages of other groups were established around them; in particular, the villages of *Chilonga* and *Landani* were scattered similarly.

On Site B, there was a lot of unused land. When the condition of the land worsened in new villages on Site A, many people continued to remigrate to Site B. New villages consisted of people who came from several villages.

On Site C, some villages were built before the construction of Kariba Dam. When land conditions deteriorated in the new villages on Site A, many people remigrated to Site C.

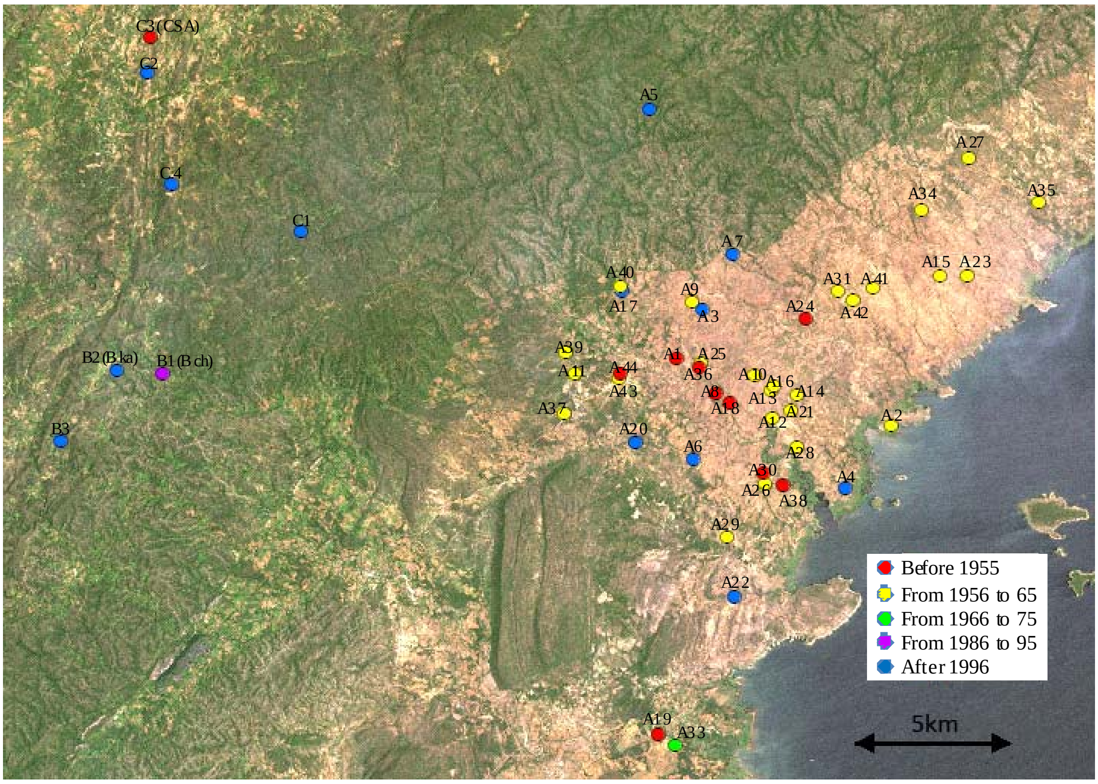


Fig. 4 Establishment of Villages

*1 See table 1 for names of research villages.

*2 Drawn by Megumi YAMASHITA

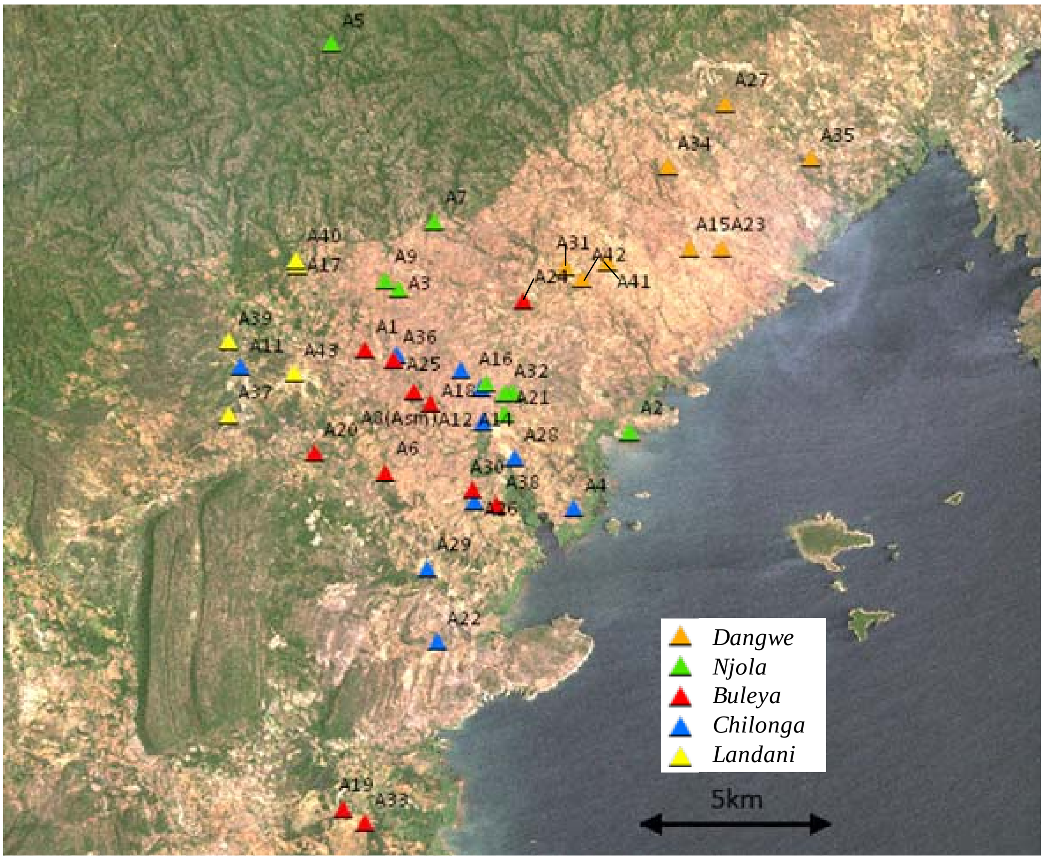


Fig. 5 Old Neighborhood Groups of Villages

*1 See table 1 for names of research villages.

*2 Drawn by Megumi YAMASHITA

3-3. Religious Networks

In the research area, most people were Christians. There were multiple sects of churches in this area, including Pentecostal, Seventh-Day Adventist, the United Church of Zambia, and the New Apostolic Church. Churches were built not only in towns but also in villages. Some villages had no church and others had churches of different sects, as seen in Fig. 6. People went to church in order to pray, typically on the weekend, although some did not go to church. Those who attended chose their own sect from the several ones available and did not necessarily attend the nearest church. In most couples, both went to the same church. Church provided not only a place to pray but also a place to acquire medical treatment and education in a big town.

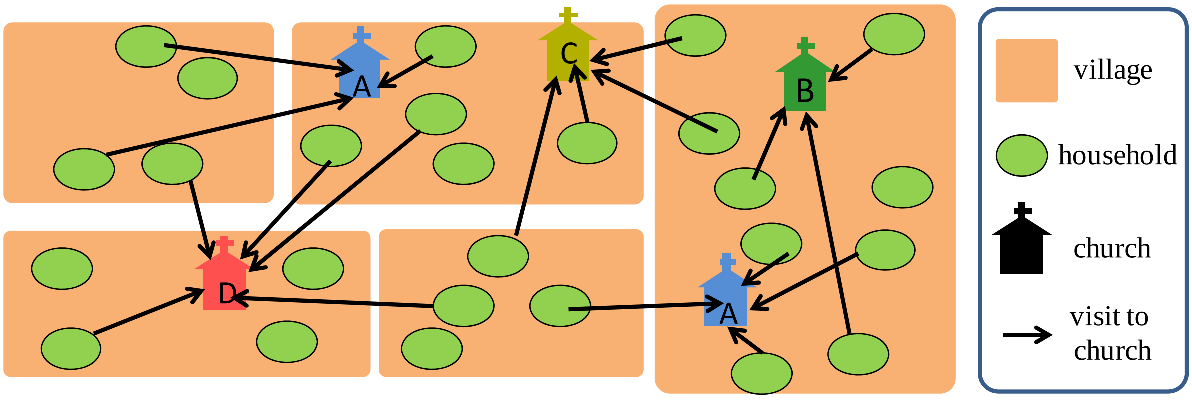


Fig. 6 Visits to Church by Residents

Each church sect organized 2 or 3 big meetings each year. For example, the New Apostolic Church organized meetings for Good Friday in April and Harvest in August, in which members of every branch participated (Fig. 7). The church also organized meetings of comity in October, which members of branches in some districts attended. There were other small meetings like music festivals as well (Fig. 8). People deepened their relationships with church members through the practicing of hymns, having meals and sharing lodging during these meetings.

Fig. 7 Preaching in Congregation

Fig. 8 Church choir singing

3-4. Scholastic Networks

There was a basic school serving several villages, providing pupils with friends outside their own villages (Fig. 9). Not only pupils, but also their parents acquired new relationships. Parents, especially those in the areas of community schools managed by themselves and not government, developed strong relationships with each other. There were very few high schools, and most students stayed in dormitories. An example of such a high school was in Maamba, Sinazongwe District. Given these circumstances, students in high school made many friends from a larger area than did pupils at basic schools.

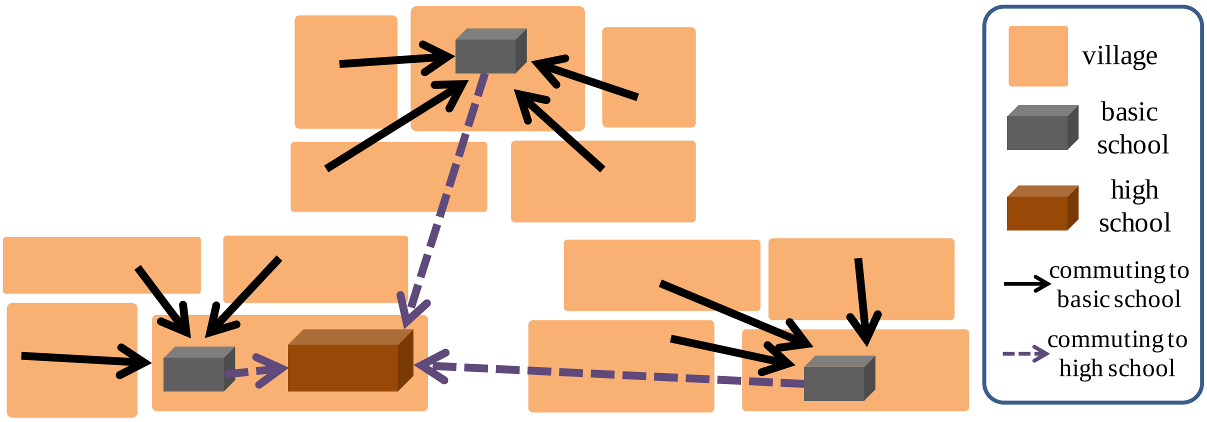


Fig. 9 Commuting Area of School

3-5. Networks in Recreation

The recreation of playing football is discussed because it involved not only players but other people as well. During dry season, there was a football tournament in Sinazongwe district, and all villages organized their own teams to participate. From the end of April, after harvest, to September, about 10 teams from each zone played in a round robin tournament. From October to November, before the start of rainy season, the top two of approximately 20 zones played in a knock-out round for the championship.

Not only players but also supporters went to away matches; consequently, players and supporters had good relationships. At the same time, they built intimacy with members of away teams, with whom they had matches many times.

3-6. Networks in Income Earning Activities

Networks in activities earning income were formed through being employed by companies, as well as through labor migration and other commercial activities.

Companies operating in research areas included agricultural companies, companies selling small fish or *Kapenta*, road construction companies, and mining companies. Labor migration was practiced in cities of Southern Province like Livingstone and Choma, the capital Lusaka, and cities of Copperbelt Province. Commercial activities in research areas included selling products such as cotton, okra, and fish to buyers; vegetables, fish, and forest products, for example, were sold in local markets. Store management and truck transport were also commercial businesses in the areas.

4. Formation of Human Networks

The formation of human networks can be divided into construction of new networks and reconstruction of existing networks. Examples of the former include marriage, school attendance, and job obtainment, as well as migration that results in getting new neighbors. Examples of the latter are divorce, graduation, resignation from a job, change of church affiliation and separation of new villages from old villages, as well as migration, which can change relationships with people around an old residence. Marriage could be included in the latter rather than the former in cases where the two people had been relatives before marriage, thus reconstructing an existing network. In this paper, I focus on marriage and its connection with the construction and reconstruction of kin networks, and discuss the formation of human networks.

4-1. Catalyst for Marriage and How Couples Met

I interviewed all couples in every village about the catalyst for marriage and how they met. The most common answers were that they met as relatives, neighbors, schoolmates and church mates before marriage. Other answers were that they met at markets, football grounds and traditional dances. People formed networks of affinal relationships through use of networks as discussed in chapter 3. In the following, I will analyze results of these interviews in detail.

4-2. Formation of Networks Throughout Marriage

I investigated marriages to explore how people formed the structure of human networks throughout their marriages. I analyzed each birthplace of husband and wife related to proximity between residence and birthplace, as well as their relationships with old neighborhood groups. In this report, I chose *Buleya* villages as villages started before migration, and *Chilonga* villages as villages formed through forced migration. *Buleya* villages chosen were Siameja, Nagombe and Chande; *Chilonga* villages chosen were Sianemba, Mambova and Siansima A.

In Fig. 10, I analyzed the degree of proximity between research villages and birthplaces of couples. In Fig. 10-1, I compared whether couples were born in villages of Site A or other areas. In the figure, the village of Site A represents the birthplaces of both husband and wife being located in Site A. Other area represents the birthplace of husband or wife being located in other areas. Percentages in Village of Site A were from 57% to 80%. In Fig. 10-2, I detailed degree of proximity between residence and birthplace when both birthplaces of the couple were located in Site A. In this figure, RN means that the birthplace of husband or wife was located in a research village or in the next village; NBO means that the birthplace was located two villages away, and OSA means that the birthplace was located at another village in Site A. The rates of birthplaces of couples that were RN were from 44% to 77%. The rate of birthplaces of couples that were RN and NBO were from 52% to 84%. It became evident that in the villages analyzed, there were many marriages between members of vicinal villages.

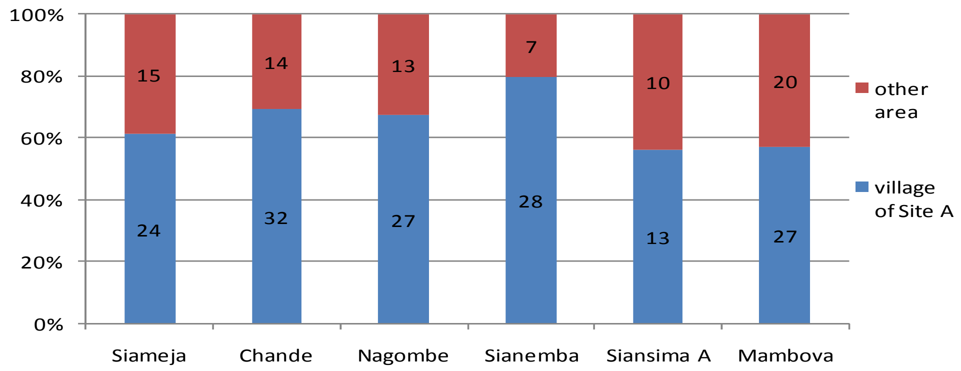


Fig. 10-1 Comparison of Birth Place; Site A or Other Area

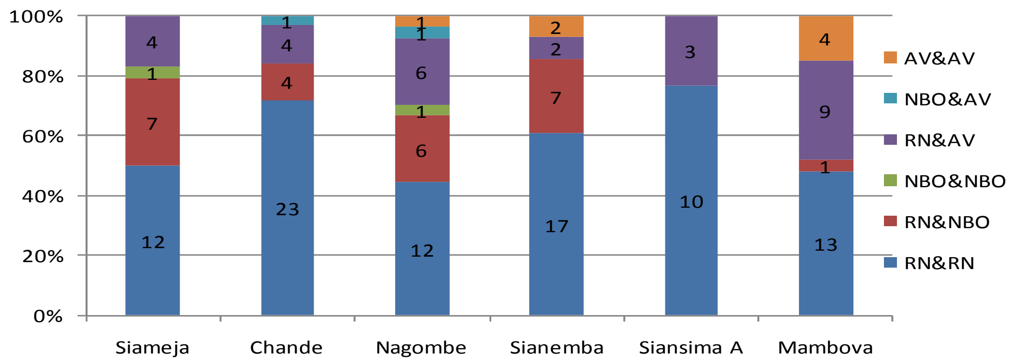


Fig. 10-2 Degree of Proximity between Residence and Birth Place in Site A

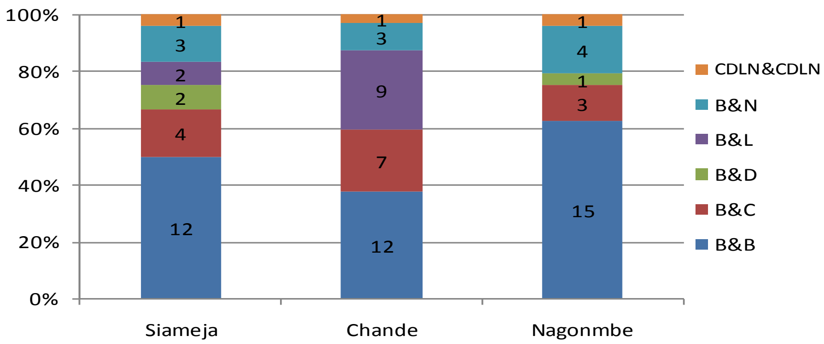


Fig. 11-1 Comparison about Old Neighborhood Groups of Villages Where Couples living in Villages of *Bulea* were Born in

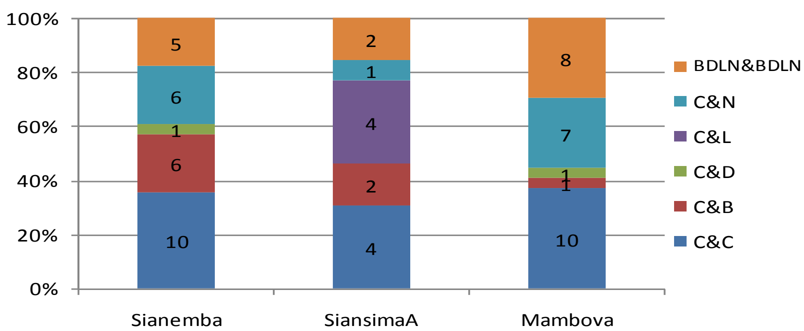


Fig. 11-2 Comparison about Old Neighborhood Groups of Villages Where Couples living in Villages of *Chilonga* were Born in

In Fig. 11, I compared which old neighborhood groups husband and wife belonged to when both members of the couple had been born in Site A. In these Figures, B was *Buleya*, C was *Chilonga*, D was *Dangwe*, L was *Landani*, N was *Njola*, and a combination of letters in the figure indicates the couple was from that pair of native groups. Fig. 11-1 indicates that couples born in *Buleya* occupied 38% to 56% of villages of *Buleya*. Fig. 11-2 indicates that couples from *Chilonga* occupied 31% to 37% of villages of *Chilonga*. From these figures, it is apparent that couples who had resided in the same original old neighborhood groups made up the highest percentage of couples in villages analyzed.

Conceptual Approach for Data Integration of Social-Ecological Change and Human Activities toward Community Resilience

- from Southern Province Collaborative Research -

Mitsunori Yoshimura[1], Yudai Ishimoto[2], Chieko Umetsu[2], Masahiro Okamoto[2], Hitoshi Shinjo[3], Ueru Tanaka[4], Keiichiro Matsumura[5], Hidetoshi Miyazaki[2], Megumi Yamashita[6]

[1]Remote Sensing Technology Center of Japan, [2]Research Institute for Humanity and Nature,

[3]Graduate School of Agriculture, Kyoto University

[4]Graduate School of Global Environmental Studies, Kyoto University,

[5]Graduate School of Human and Environmental Studies, Kyoto University,

[6]Survey College of Kinki, Japan

Abstract

The aim of this study is to clarify the relationships between social-ecological vulnerability, resilience and human activities from a multi-disciplinary point of view. Accordingly, this paper describes a conceptual approach to data integration for social-ecological change and human activities toward community resilience using multi-disciplinary data.

1. Introduction

In this study, we attempt to clarify the relationships between social-ecological vulnerability, resilience and human activities from a multi-disciplinary point of view. We adopt the multi-spatial and multi-temporal approaches to achieve this purpose. The multi-spatial approach refers to recognizing phenomena on land surfaces from different spatial scales, while the multi-temporal approach refers to summarizing epoch-making events according to the respective time period. Until last year, we independently gathered multi-temporal and spatial data based on each research team members' interests. In particular, this year we established intensive research sites in the southern province of Zambia, and they are now ready to begin data integration for social-ecological vulnerability and resilience. This paper describes a conceptual approach for such data integration of social-ecological change and human activities toward community resilience.

2. Phenomena and Scaling

Earth surface phenomena begin from one point and enlarge to cover wide areas. The scaling properties of earth surface variables should be known and should guide the analysis of satellite and GIS data. Although the identified scale data of satellite imagery is relatively well-specified compared with other types of geographic data, it may still lack precision because such data depends on a complex generalization process applied by the analyst. When satellite sensors detect phenomena, they should appear homogeneous on the imagery of some spatial scales but heterogeneous on that of different spatial scales. On the other hand, the extrapolation of point phenomena and model estimates to large areas remain a major problem in geographic analysis, and continued research is needed to identify appropriate sampling and scaling strategies for sparse ground phenomena, especially in the context of regional and global assessments. It seems difficult to introduce the relationships among various times and scale dependent on phenomena, because those relationships change due to both spatial and time scales. Furthermore, it is necessary to integrate variable information from isolated studies as GIS attribute data and also to establish logistic concepts for data integration.

3. Concept of Resilience Based on Social-Ecological Environments and Human Activities

Human activities are affected by both social and ecological environments. Conversely, human activities themselves affect both social and ecological environments. Thus there is a cross-interaction among them. We depict this relationship in Figure 1.

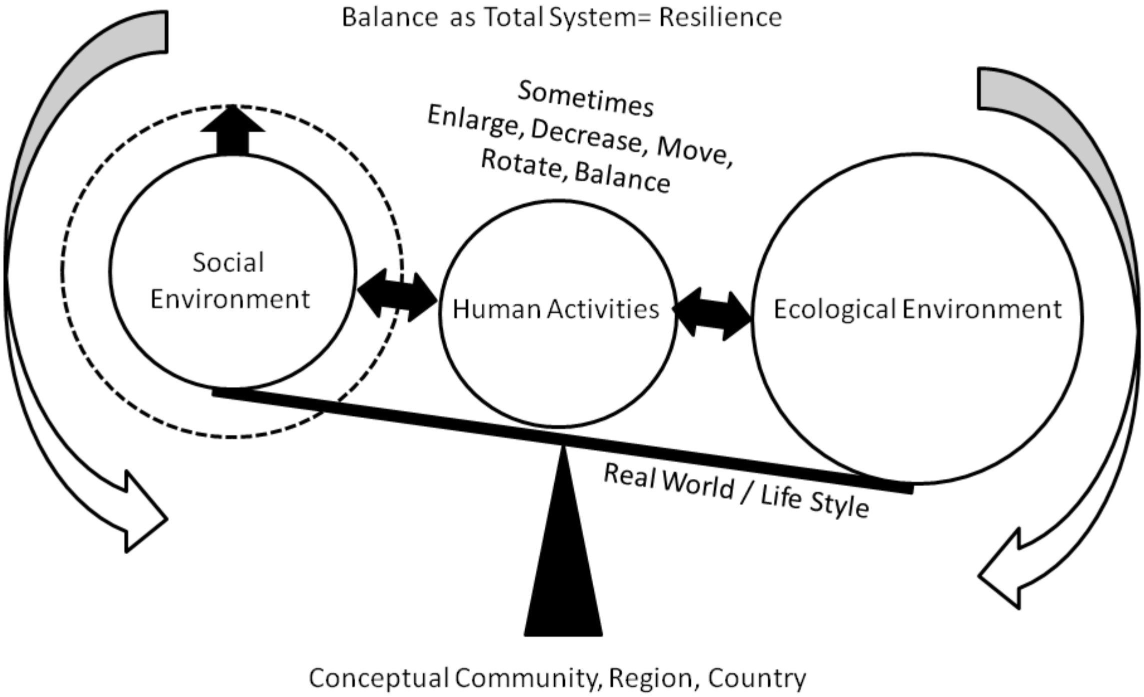


Figure 1 Concept of Resilience Based on the Social Environment, Ecological Environment, Human Activities and Their Surroundings

In Figure 1, the seesaw "bar" expresses the real world, or human lifestyle. The social environment, ecological environment and human activities are the three components of this system. When the system is stable, it is said to be in a resilient condition. Each component will enlarge, decrease, move, and rotate independently in response to shocks or other influences from outside the system, shown by arrows in the figure. Real social and ecological environments exist along the length of the bar, sometimes being stable, while at other times becoming unstable. Unstableness is caused by unbalances among these three factors along the bar or by forces outside of the system, as shown by the arrows in the figure. In this system, the components interact with each other without overlapping. However, any possible overlapping within this system should be defined. We assume that the minimum unit of this system is the community.

4. Social-Ecological Data Gathering and Their Cross Relationships

The most serious environmental problems in Africa are the pressures of large populations and the aggravation of ecosystems caused by excessive land use. Most of the cultivation crops in semi-arid tropic (SAT) areas already struggle under severe environmental conditions, and therefore many cannot survive when desiccation and high temperatures advance. After the 1960s, drought disasters caused by chronic desiccation occurred in many African countries, causing a large decrease in viable cultivation crops. The prolonged drought caused serious food shortages, starvation and other serious social problems in Africa. These frequent drought disasters after the 1960s occurred at the same time as the first world oil crisis. Together, these two historical events had negative influences on the economies and political environments of African countries. Furthermore, subsequent years have seen annual decreases in total precipitation, with famine becoming a chronic, serious problem in many countries, causing some to become food aid recipients. Furthermore, the protracted famine has fueled social unrest, and some African governments have even been overturned.

To prove the concept of resilience based on social-ecological environments and human activities, multi-disciplinary field data must be gathered and verified. For this purpose we set up three intensive research sites, Site-A, Site-B and Site-C, in the Sinazongwe district of the southern province of Zambia to conduct collaborative research on the resilience level of communities. Figure 2 shows the geographical distribution of the three intensive research sites. Lake Kariba can be seen in the lower right part of the figure. Site-A is located on the lower terrace, Site-B the middle escarpment, and Site-C the upper terrace.

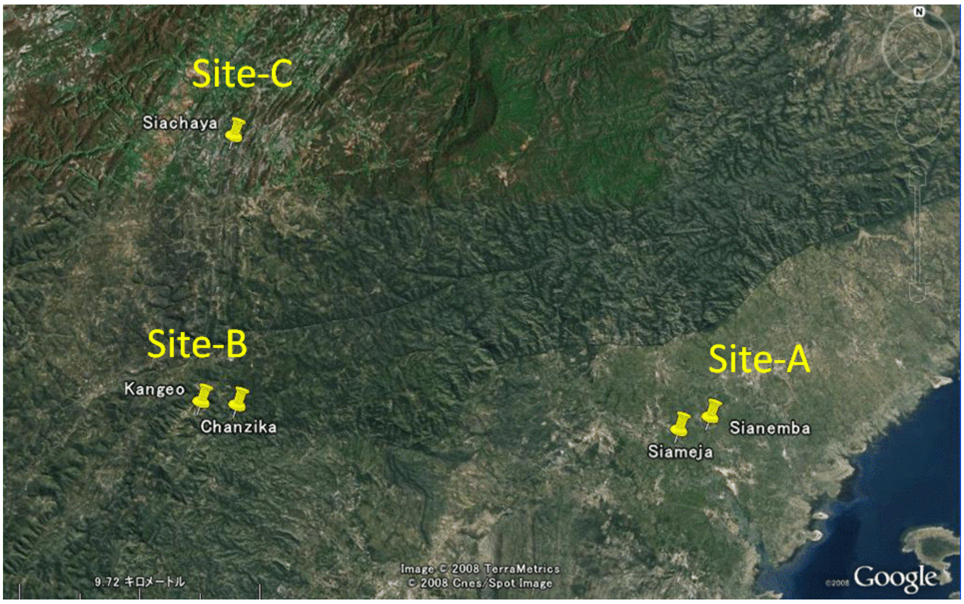


Figure 2 Intensive Research Site Distribution

The three sites were selected based on the terrain, location and level of community diversity. Collaborative field investigations at each of these sites are still being conducted.

Figure 3 illustrates the cross relationships among the various types of gathered social-ecological data. We assume that people are vulnerable against climate change and food security. The blight blue boxes with red letters represent the impact factors on human resilience. The gray boxes with black letters are the products of community activities. The white boxes represent various community events and acts. The arrows illustrate cross-effect streams; for example, climate change in the form of changing amounts of solar radiation can cause increases or decreases in precipitation. Increased precipitation can cause flooding, while decreases can cause drought. The government and international society, on the other hand, are triggers for social changes. Cash, crops and land are the results of human activities for livelihood. As the figure illustrates, in reality all of these factors affect each other either directly or indirectly.

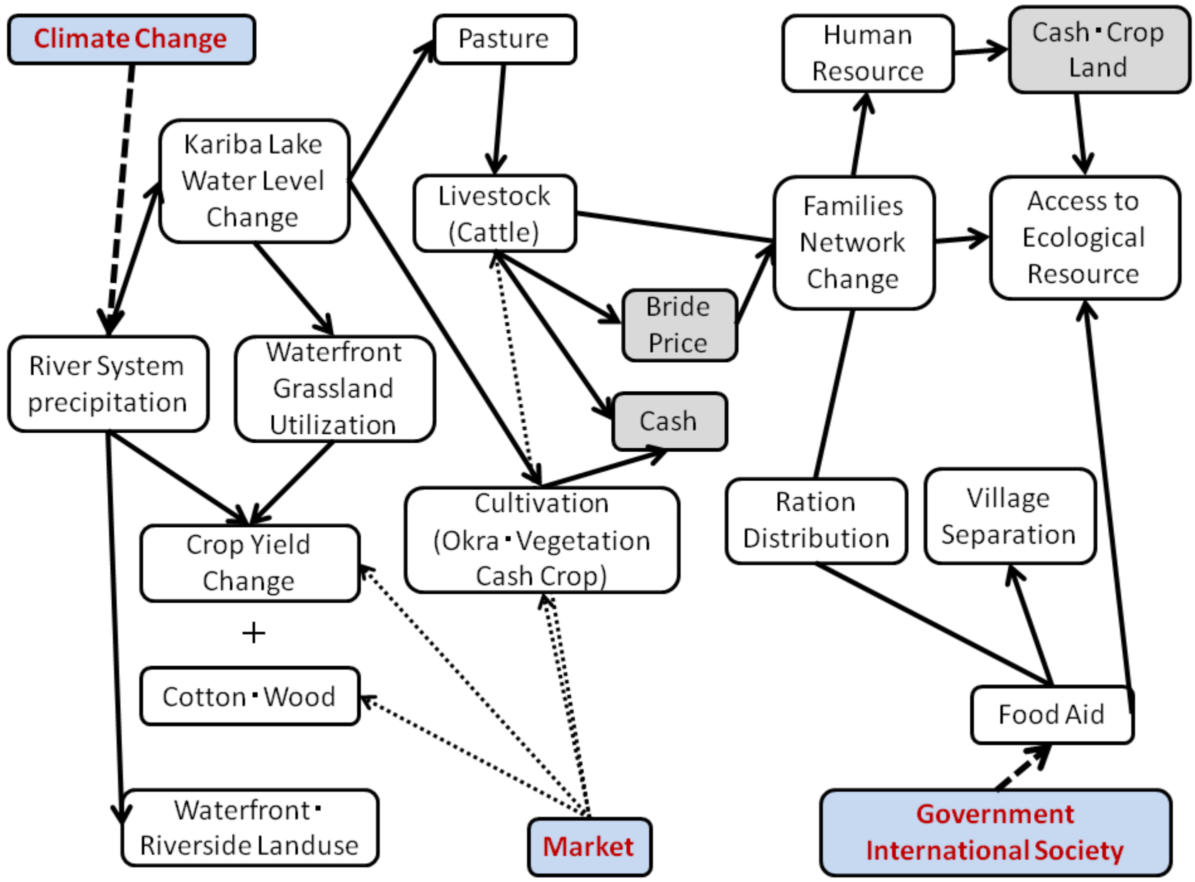


Figure 3 Social-Ecological Data and their Cross Relationships

In Figure 3, ecological environmental change caused by climate change on the left side and social environmental change as the result of the activities of government and international society on the right side are the two main driving forces of this system. The ecological environment is connected to the social environment by cash-product exchange, in which the key issue is the market. Furthermore, local institutions and customs can also be considered in this system, as can immigration and its related effects. In particular, immigration is an important issue to this region because when the Kariba dam was constructed in the 1950s, the government forced the local native tribes to emigrate from the Zambezi valley to the upper regions.

5. Future Research Directions toward Community Resilience

Resilience based on social and ecological environments and human activities, as illustrated above in Figure 1, is the conceptual framework by which we investigate community resilience. The data gathered heretofore and their cross-relationships (shown in Figure 2) comprise the primary results of our field investigations. However, the interpretation of these primary results is complicated, and thus we must make efforts to further organize this data to gain a better understanding of resilience at the community level. We did, however, gain an increased understanding of coping behavior in response to vulnerability: people develop several networks that act as safety nets to survive against any possible shocks to their environment.

As for future research, we are currently investigating the following research topics in corroboration with other multi-disciplinary research scientists.

1) Land acquisition, inheritance and strategies
2) Agriculture and livelihood activities
3) Immigration, food security and village separation
4) Pastures, livestock and treatment
5) Family networks, marriage and coping behavior in response to social vulnerability
6) Geographic conditions and coping behavior in response to ecological vulnerability
7) Coping behavior related to resilience

We are still in need of collaborators with different professional backgrounds, and it is necessary to discuss community resilience in more detail while also expanding the scope of the research from community level resilience to include both regional and country-level considerations.

Accumulating Multi-spatial and Temporal Data to Understand People's Livelihoods at the Village Level

Megumi Yamashita[1] and Hidetoshi Miyazaki[2]
[1]Survey College of Kinki, Osaka, Japan
[2]Research Institute of Humanity and Nature, Kyoto, Japan

Abstract

We aim to use a multi-spatial and temporal approach to trace people's livelihoods from a village to a regional level. For this, we accumulated various spatial data and considered the seasonal and inter-annual changes. The principal data was from satellite images, aerial photographs and a crop allocation map determined by field investigation. Our concept of a multi-spatial and temporal approach was used to integrate the various kinds of data.

1. Introduction

Land surface conditions such as vegetation cover and land-use/cover are reflections of the natural environment and of human society. Thus monitoring land surface changes is crucial for understanding the vulnerability and resilience of social-ecological systems. Spatial and temporal scales are important factors for monitoring land surface conditions. For example, changes of vegetation cover on a country scale generally depend on differences in the seasonal climate pattern. Changes of vegetation and land cover on a regional scale are caused by the consequences of environmental variability and human activities under the conditions of the climate local and the relevant agricultural system. For this, remotely sensed satellite images and aerial photographs are powerful tools to monitor the land surface conditions across a wide area. However, to understand the phenomenon shown on such momentary images, field investigations and a consideration of temporal events are indispensable.

This report describes the practicability of integrating multi-spatial and temporal data of satellite images, aerial photographs and the results of field investigation to understand people's livelihood at a village level.

2. Multi-Spatial Scales for Understanding Livelihood

Figure 1 shows our concept of multi-spatial scales to understand people's livelihood, with a specially focus on farming, at the village level. The crop field distribution from household activities illustrates the village; this can be seen at the largest spatial scale of a few kilometers square. This scale equates to the field investigations of each household's activity. The gathering together of villages forms a community, which has a larger area. This scale of a 5-10 kilometers square is almost the same as aerial photographs or magnified satellite images that have a 15-30m pixel size. Furthermore, the gathering together of communities then demonstrates the region. Land surface conditions at a regional scale can be shown in the satellite images such as those in the

Landsat series.

Here, we regard the middle scale in figure 1 as the common one for the integration of various kinds of data. The crop field distributions generated by the field investigations are scaled up to the common scale, and, as much as possible, the land surface conditions shown in the satellite imageries are scaled down to the common scale. In this way, the satellite imageries can be linked to the results of the field investigation.

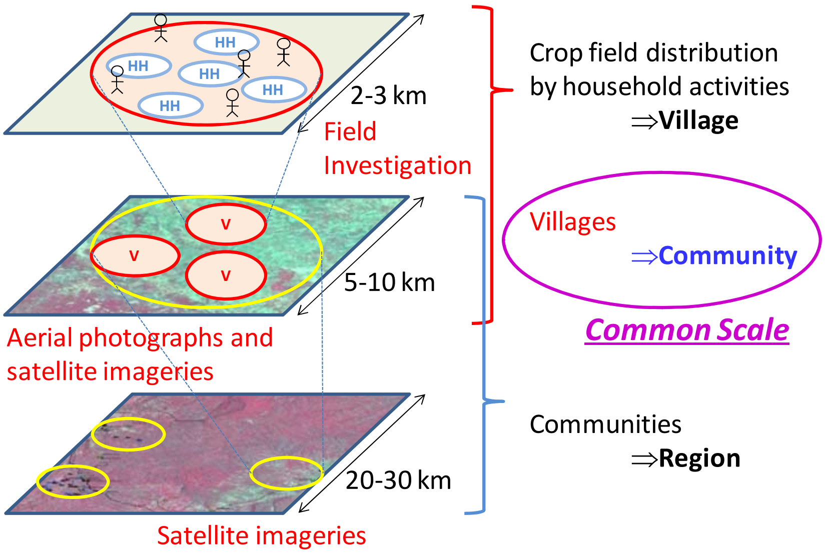


Figure 1. Concept of multi-spatial scales for understanding village livelihoods

3. Multi-temporal Understanding of the Land-use Strategy

The land surface shows various conditions that accord with seasonal and inter-annual changes. Figure 2 shows the concept of the multi-temporal understanding of a land-use strategy at the village level.

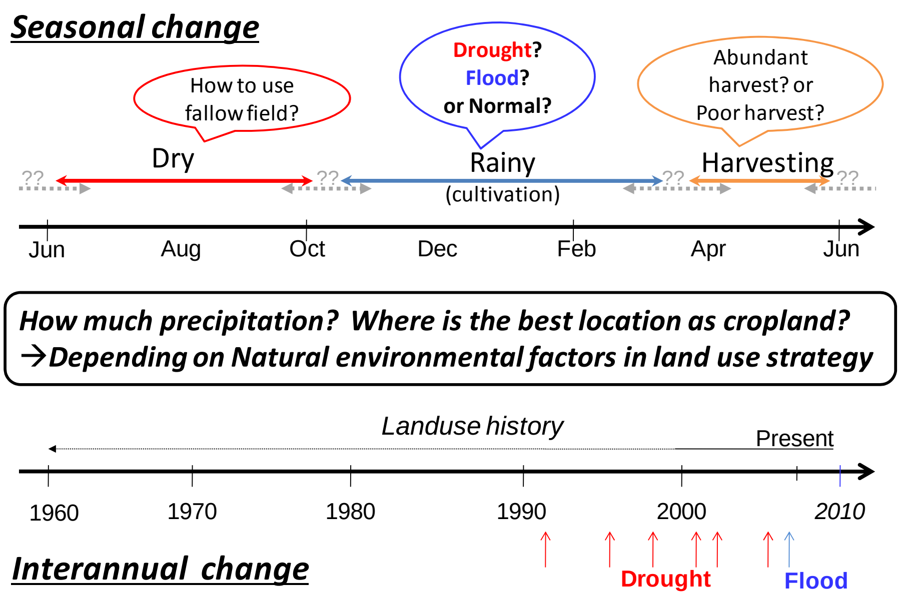


Figure 2. Concept of a multi-temporal understanding of land-use strategies at the village level

Seasonal changes are essentially caused by the climate. In this study area, a year can generally be divided into dry, rainy and harvesting seasons from the point of view of the crop calendar. However, the change point between seasons is unclear by year. Precipitation is an important factor when deciding the annual crop plan. Therefore, when farmers choose the best location for a particular crop field they consider features of the terrain such as in a valley or on a ridge. The land-use strategy of each household is influenced by natural environmental factors.

Inter-annual changes depend on the land-use history that can corresponded to various events such as the construction of the Kariba dam, migration, population increases, and the annual land-use strategy that accords with climate variations.

As for seasonal data, since 2007 we have carried out field investigations, and we obtained Landsat/ETM and Terra/ASTER satellite images from after 2001. The inter-annual data consists of aerial photographs and satellite images inform the 1970s, 80s, 90s, and 2000s.

4. Field Investigations for Crop Allocation Mapping

The crop field distribution at the village level for one year shows household's activities related to people's livelihoods. In this study, the crop allocation map was generated to understand people's livelihoods from year to year. The study area for the crop allocation mapping is shown in figure 3. Sites A, B and C are located in the lower terrace, middle escarpment and upper terrace, respectively, in the Sinazongwe district, Southern province. This is the common study area for this research project; thus many rain-gauges were installed at Sites A, B and C by the Theme-II group.

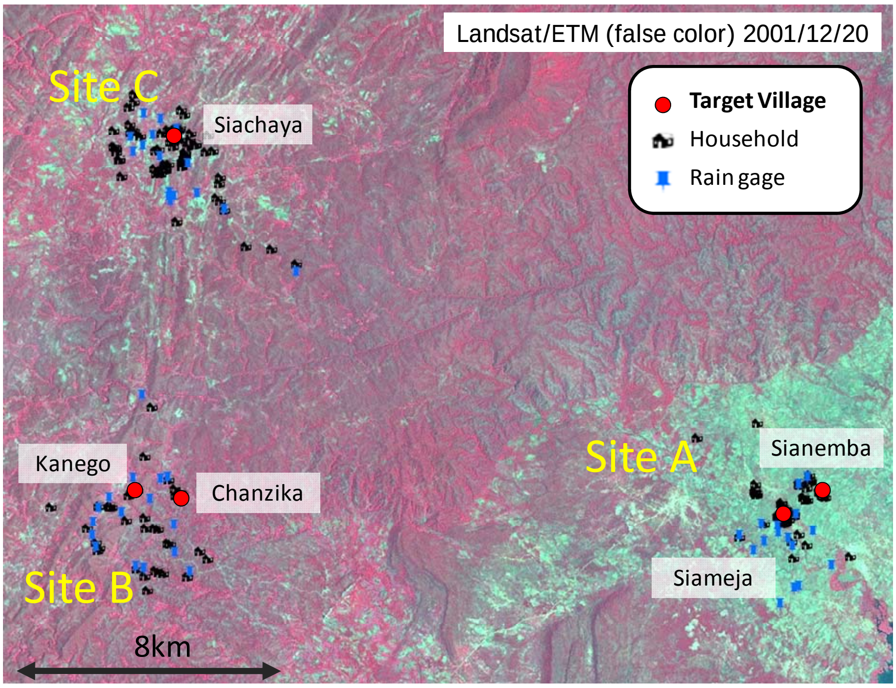


Figure 3. The study area for the field investigation

Field investigations for crop allocation mapping were carried out for 221 households in the Sianemba, Sianemeja (Site A), Kanego, Chanzika (Site B) and Siachaya (Site C) villages during the rainy season of 2007/2008 and the dry season of 2008.

To build up the crop allocation map, we used a portable GPS to measure boundaries at a sub-field level that recognized different crops at Sites A, B and C. We also carried out interviews about field names, topography, soil name, crops, cultivated varieties and kinds of fertilizer with all households to understand their coping strategies related to climate variations. Table 1 sets out the classification code and its description as attribute information to the crop allocation map, which shows the crop field boundaries and the attribute information in the GIS data format.

Table 1. The classification code and its description about crop field

Code	Discription about crop field
RCo	Rainy season /Cowpea
RC	Rainy season /Cotton
RFm	Rainy season/ Finger Millet
RGn	Rainy season/ Groundnut
RG	Rainy season/ Garden
RM	Rainy season/ Maize
RO	Rainy season/ Other
RP	Rainy season/ Pearl millet
RSf	Rainy season/ Sunflower
RSo	Rainy season/ Sorghum
RS	Rainy season/ Sweet Potato
D	Damaged fields by water
DB	Dry season/ Banana
DC	Dry season/ Cotton
DG	Dry season/ Garden
DM	Dry season/ Maize
DO	Dry season/ Other
DSu	Dry season/ suger cane
DS	Dry season/ Sweet Potato
RFa	Fallow
RF	Rental Field

The crop field distribution at Site B (Middle escarpment) as a sample of the field investigations is shown in figure 4 with an overlay of the Landsat/ETM (Pansharpened false image) observed on 20 December 2001. The boundaries of the crop fields during the rainy season in 2007/2008 and the dry season in 2008 are shown in blue and yellow lines, respectively. The red lines show fields damaged by water from a flood in December 2007. The purple lines show fallow fields and a rental field from another village. From looking at the crop allocation map overlain to Landsat/ETM, the accuracy of the positioning of each crop field location can be seen as adequate.

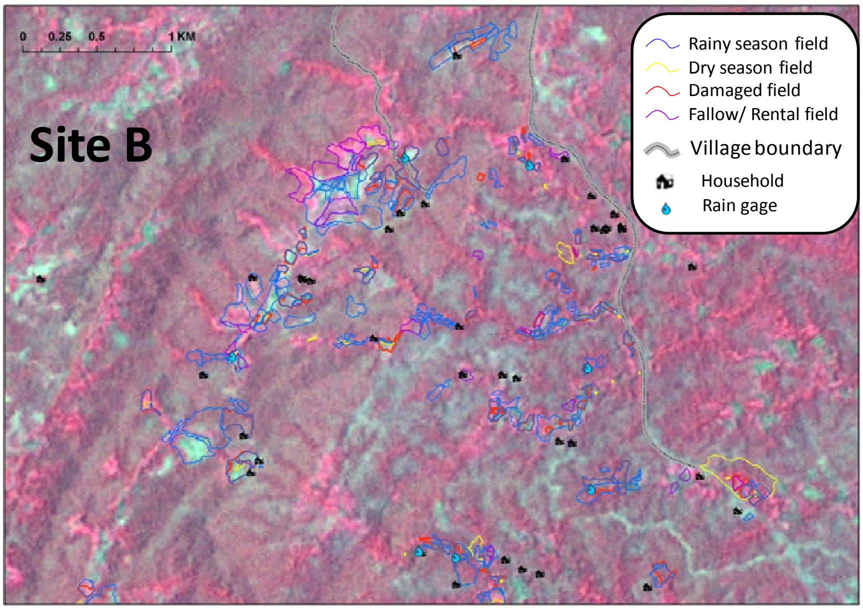


Figure 4. Crop field distribution at Site B during rainy and dry seasons

Figure 5 shows the crop allocation map for Site A. The code in the map legend corresponds to that of table 1. It can be seen that maize and cotton fields dominate.

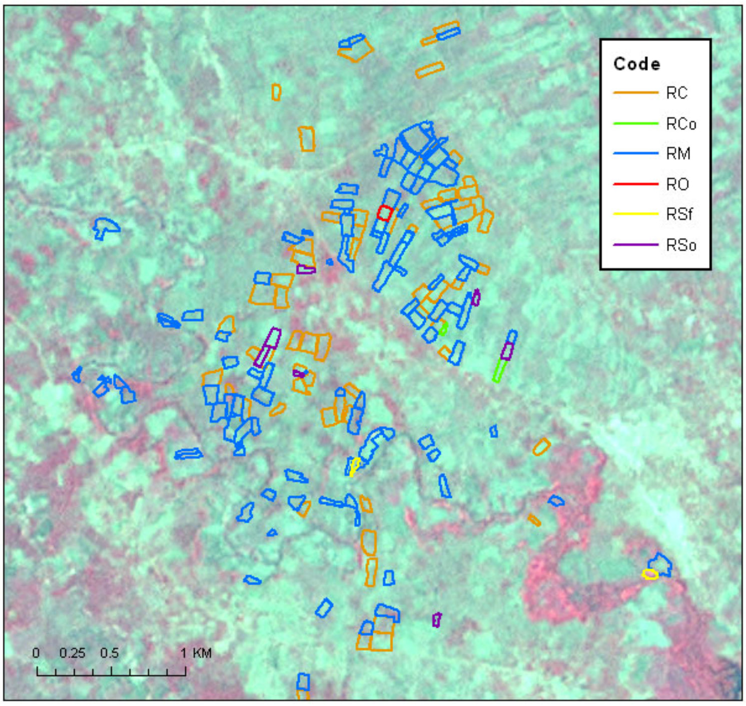


Figure 5. Crop allocation map at Site A during the rainy season

5. Satellite Images

We obtained satellite images taken with an optical sensor at middle-high resolution to identify crop field distributions and land surface conditions reflecting seasonal and inter-annual changes. These images cover almost the entire Sinazongwe district in the Southern province. Table 2 lists the satellite images we obtained from the 1970s to 2000s to identify crop field distribution and land surface conditions according to seasonal and inter-annual changes. The spatial resolutions of Landsat/MSS, TM, ETM and Terra/ASTER are about 80m, 30m, 30m and 15m, respectively. Landsat/ETM has multi-spectral and panchromatic images; the resolution of the panchromatic image is 15m.

Table 2. Satellite images obtained for the study

Satellite/Sensor	period	yyyy/mm/dd					
Landsat/MSS	1970s	1972/11/23	1973/3/11				
Landsat/TM	1980s	1986/11/17	1987/2/21				
Landsat/TM	1990s	1990/3/1					
Landsat/TM		1995/1/26					
Landsat/ETM	2000s	2001/8/30	2001/10/1	2001/12/20	2002/2/6	2002/2/22	2002/5/13
Landsat/ETM		2002/8/17	2002/10/20	2002/11/21	2003/4/30	2003/6/1	
Terra/ASTER		2003/7/3	2003/11/24	2004/1/11	2004/6/3		
Terra/ASTER		2004/7/21	2004/8/22	2005/3/9	2005/6/13		

In FY2008, radiometric and geometric corrections were done for all satellite images to compare them and to overlay the GIS data collected in the field investigations that used GPS, such as in figures 4 and 5.

6. Aerial Photographs

To generate the Digital Elevation Model (DEM) and the large scale topographical map of our study area, Sites A, B and C, we obtained aerial photographs archived by the Survey Department of Zambia. Aerial photos had been taken after the independence at a scale of about 1: 30,000 in 1965, 1970, 1980 and 1991. However, the 1965 photos did not include our study area. Thus we were able to use aerial photographs taken in 1970 (90sheets), 1980 (67sheets) and 1991 (72sheets). Figure 6 shows a sample DEM and an Ortho aerial photo around the middle of Sites B and C.

From the aerial photographs, we can detail and analyze the terrain features by DEM and so generate detailed topographical maps at a scale of about 1:10,000 for 1970, 1980 and 1991.

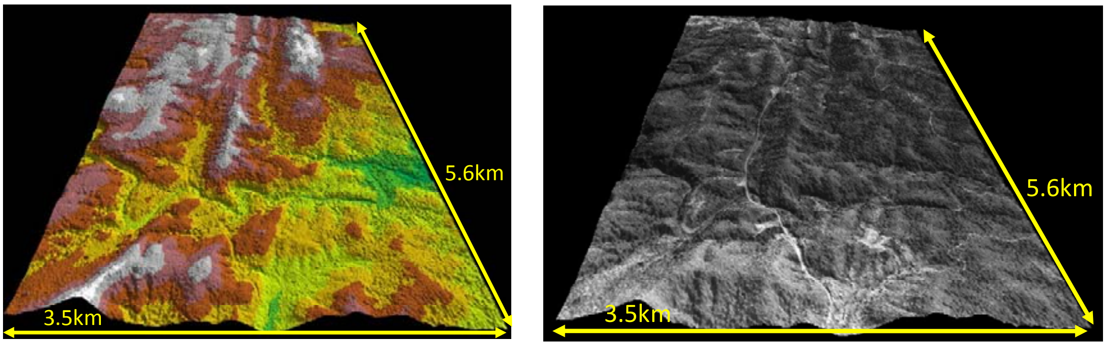


Figure 6. Top views of the Digital Elevation Model (left) and Ortho photo (right)

7. Plans and Expected Results in FY2009

We plan to analyze inter-annual changes in crop field distribution from aerial photos and the satellite images inform the 1970s, 1980s, 1990s and 2000s to understand the land use history related to people's livelihoods. Seasonal changes in crop field distribution will be detected from the satellite images taken in the 2000s based on the crop allocation map of 2007/8 to understand coping strategies related to climate variations the effect on livelihoods. We will then examine the relationship between crop field distribution and terrain features in drought, flood and normal years.

We are also planning to integrate data related to the household census and livestock farming into the data of crop fields.

Constructing the Food Security Institution:
The Early Warning System and Disaster Management Policy in Zambia

Keiichiro Matsumura
Graduate School of Human and Environmental Studies, Kyoto University, Kyoto, Japan

Abstract

In Sub-Saharan Africa, establishment of an early warning system and disaster management policy has been an urgent matter since the 1970s. In Zambia, the initial effort for enhancing national food security started in the early 1980s. In FY 2008 research, we focused on the historical process of establishment of food security institutions and the system of food aid by examining administration documents in several organizations and field surveys. The purpose of my research is to analyse the political and social process of building food security institutions in which several international organizations have been involved, especially focusing on the establishment of the Disaster Management and Mitigation Unit (DMMU) and the Vulnerability Assessment Committee (VAC).

This paper firstly examines the concept of 'Food Security' that has a significant influence for development policies in Sub-Saharan African countries. The concept and its focus have been changed and sophisticated since the 1970s. Food aid is a main measure widely adopted to enhance the food security in the developing countries. Especially, the U.S. has continued to be the biggest supplier of food aid in the world. The recipient countries of food aid have increasingly shifted from Asia to Sub-Saharan Africa in the 2000s.

The research on the food security institutions in Zambia reveals that several organizations and systems for food security have been built with external funding since the 1980s, but many of them have not functioned effectively enough, partly because of lack of government initiative and ownership for those projects. In the process, United Nation's organizations, such as FAO, UNICEF, the World Bank and other donor agencies have played important roles as financial supporters. Nevertheless, those newly built agencies frequently stopped their activities or reduced their functions when the financial support ended. Since the establishment of the DMMU and VAC, the food security institution has been much improved, but the actual implementation still has many difficulties.

In the 2008 fieldwork, we observed the actual implementation of the government food relief programme and the distribution of maize grain in the Sinazongwe district, in which we found some problems concerning its delivery and distribution at the local level. Our research issue in FY 2009 will be focused on an intensive field study about those government institutions' activities and their impacts on local communities. By interviewing NGO staff, camp officers and local farmers, we will try to investigate the food relief programmes and the local responses to them. Through the research, we are expecting to reveal the social and political impact of early warning and disaster management activities on the resilience of local communities.

1. Introduction

In Sub-Saharan Africa, establishment of an early warning system and disaster management policy has been an urgent matter since the 1970s. In Zambia, the initial effort for enhancing national food security started in the early 1980s. This paper shows the process of building food security institutions in Zambia based mainly on the research from August to September in FY 2008.

The purpose of my research is to analyse the political and social process of building food security institutions in which several international organizations have been involved, especially focusing on the establishment of the Disaster Management and Mitigation Unit (DMMU) and the Vulnerability Assessment Committee (VAC). These analyses suggest that United Nation's organizations, such as FAO, UNICEF, the World Bank and other donor agencies have played important roles in building food security institutions in Zambia.

2. Concept of 'Food Security'

The concept of 'Food Security' has a significant influence for development policies in Sub-Saharan African countries. The concept and its focus, however, have been changed and sophisticated since the 1970s (Pottier 1999: 11-18).

The initial concept of food security was to provide a solution to a global supply problem, focusing on the secure flow of basic foodstuff at stable prices. It was launched at the first World Food Conference in 1974. International societies had two concerns about the underperformance of agriculture in the 'Green Revolution' area, especially in South and South-East Asia, and the uncertainties caused by large-scale cereal exports to the Soviet Union.

In the 1970s, disasters such as drought in Sahel and floods in Bangladesh and north-east India occurred. The humanitarian crisis in such disasters has become a critical agenda in international development policy. But it was not until the early 1980s that a new perspective on food security emerged. Sen's approach on poverty emphasizing the 'access' to food encouraged the focus shift from supply to demand (Sen 1981). The FAO argued that, this meant ensuring 'that all people at all times [had] both physical and economic access to the basic food that they [needed]' (FAO 1983).

In the 1990s, the concept was sophisticated much by considering multiple elements on food security. The Rome 1996 declaration on world food security and action showed the widest possible approach, stating:

> food security, at the individual, household, national, regional and global levels…exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO 1996: 3).

Pottier (1999: 13–14) argues that the Rome declaration reflects post-modern uncertainties and that the nutritional status of vulnerable groups, as the delegates agreed, is determined by pathways more complex than previously assumed.

3. Food Security and Food Aid: US and Sub-Saharan Africa

The definition of food security is now targeted to appropriate demand and access to food. Food aid is a main measure widely adopted to enhance food security in the developing countries. Among all, the U.S. has continued to be the biggest supplier of food aid in the world. In 2007, 44.2% of the total amount of food aid was delivered by the U.S., 24% by EU member states, 7.3% by South Korea, 5.2% by China, 4.0% by the UN, 3.6% by Canada and 3.2% by Japan. The U.S., donating 61.1% in 2000, is still the most influential contributor for food security policy nowadays.

At the same time, the recipient countries of food aid have shifted from Asia to Sub-Saharan Africa (INTERFAIS 2008). In 2000, 37.3% of the total amount of food aid was delivered to Asian countries, while 33.4% to Sub-Saharan Africa. Until 2007, the proportion of Sub-Saharan African countries increased to 53.7%, and those of Asia decreased to 29.4%. When we talk about food security in the early twenty-first century, we can never neglect two major actors, the U.S. and Sub-Saharan Africa.

The food aid programme of the U.S. is known as 'Food for Peace' (USAID 2004; Barrett & Maxwell 2005). It started in 1954, through the enactment of Public Law 480 (PL 480) 'Agricultural Trade Development Assistance Act', which became the world's primary food aid programme, providing approximately 106 million metric tons of food to three billion people in 150 countries over the past 50 years. The main purpose of PL 480 was for market promotion, surplus disposal, geopolitical and humanitarian assistance for Western countries. President Eisenhower said, 'Food can be a powerful instrument for all the free world in building a durable peace', and again, it was to 'lay the basis for a permanent expansion of our exports of agricultural products with lasting benefits to our selves and peoples of other lands' (USAID 2004: 6). Early in his administration, President J. F. Kennedy underlined the importance of PL 480 to the U.S. by renaming it 'Food for Peace' and placing it under the U.S. Agency for International Development. By analysing the U.S. policy of food aid, Barrett and Maxwell (2005) argued that because U.S. food aid programmes are captive to domestic political interests, their effectiveness as development tools is limited and thus use of food aid to achieve multiple objectives diminishes its ability to attain any one objective.

4. Food Security Institutions in Zambia

Among the Sub-Saharan African countries, Ethiopia has the longest history of organizing food security institutions. In 1974, just after a disastrous famine in northern Ethiopia, the Relief and Rehabilitation Commission (RRC) was established. It played an important role in distributing food, medicine and shelter for displaced people. Subsequently, their main task shifted from emergency relief to development programmes, for example, the promotion of conservation farming, mechanized agriculture and resettlement.

In 1994, the organization changed its name to Disaster Prevention and Preparedness Commission (DPPC) focusing on early warning and disaster prevention rather than development. In 2004, a newly organized office, the Food Security Coordination Bureau (FSC), took over the co-ordination of emergency aid that were provided by various donor agencies, such as NGOs and UN organizations. As international donors have increasingly had concerns about food security in

Africa, various institutions have been organized and their role has been expanded.

In Zambia, the initial attempt at enhancing national food security started in the early 1980s. Because most of these institutions were established with external funding, their ability to function effectively through time has been highly dependent on an uncertain funding environment.

As one of the first attempts, the FAO and the government of the Netherlands provided financial support for technical training to build an early warning unit for natural disasters (FAO 1990). The main focus of the early warning system was crop forecast and post-harvest monitoring. It was phased out in 1988 and restarted again as a new project with the Ministry of Agriculture (MOA), Central Statistics Office (CSO) and Meteorological Department (MET). For this, the FAO provided more than US$ 2.4 million, but some reports have mentioned lack of budget to continue their task as well as the problem of vertically divided administrations (FAO 1991). Since the MOA and CSO conducted separate crop forecast and post-harvest surveys, their results were not shared and sometimes quite different from each other.

While the early warning office at the Ministry of Agriculture and Cooperatives (MACO) was set up as the National Early Warning Unit (NEWU), UNICEF supported the CSO in organizing the National Food and Nutrition Commission (NFNC) in 1990, which conducted household surveys about nutrition intake in rural areas (SADC-FANR RVAC 2005). In 1991/92, southern African countries were hit by an extensive drought and the government of Zambia declared it as a national disaster. Many UN organizations and NGOs operated their emergency relief programmes and the government set a management committee for encouraging co-operation between donor agencies and separate administrative departments. Although the Food, Health, Agriculture and Nutrition Information System (FHANIS) were established in 1993 at the CSO with support from the FAO, it stopped its activities in 1998 at the end of the financial support.

In order to overcome the fragmentation of disaster management and build an effective unit, the government set up the Disaster Management and Mitigation Unit (DMMU) under the Office of Vice-President (OVP) in 1994. As an official provider of food crops, the National Food Reserve Agency (FRA) was established in 1995, which purchased crops from farmers and reserved them for emergency distribution in case of national food insecurity.

Even in the new century, droughts continued to occur every few years. In 2000/01 and 2001/02, Zambia was hit consecutively by severe droughts. Just after the drought, several international agencies and NGOs such as the WFP, WHO, FAO, UNICEF and CARE, supported the setting up of a Vulnerable Assessment Committee (VAC) aiming at conducting an extensive assessment of risk for local livelihoods hit by drought. Since then, this committee has continued assessments twice a year, usually a first rapid assessment from March to April, and a second in-depth assessment from May to June. It was in August 2002 that the VAC conducted an assessment for the first time. The published results are submitted to DMMU with suggestions of needed crops as emergency relief in each district. This committee then played a central role in disaster management and emergency food relief in Zambia. Moreover, their published report is now almost the only publication with official information disclosure about the food relief activities of the Zambian government.

In 2003, the Zambia Social Investment Fund (ZAMSIF), which was established in 1991 as the second social fund in the world and the first in Africa to support the government poverty reduction strategy, began to support the reconstruction of FHANIS. Furthermore, the World Bank started the 'Emergency Drought Recovery Project' from 2003 to 2005 providing US$ 57.03 million to construct the institution for disaster management and preparedness. It is not very clear, but much of the fund might be used for improvement of DMMU and VAC institutions. Probably because of such huge funding support, it was in 2005 that the government of Zambia first published the 'National Disaster Management Policy' and finally started the systematization of disaster management institutions, even at the local level. The severe drought that occurred in 2004/05, which the government declared a National Disaster again in 2005, became the first case of disaster and relief programme under the official policy.

5. Outline of VAC and DMMU Institution and Operation

The two main actors of the food relief programme in Zambia, VAC and DMMU, have now played a significant role in cooperation with various organizations. Those players in disaster management range from government ministries and departments, donors, the private sector, NGOs to local community structures such as satellite committees at village level. The DMMU co-ordinates their activities and shares the responsibility among various stakeholders. Figure 1 shows the food aid flow and relations among those stakeholders.

In the first place, the VAC organizes survey teams and sends them to each district. Many international agencies, such as the WFP, FAO, NGOs and other government departments, such as the CSO provide their human resources as survey team members. At the in-depth survey on June 2007, for example, the VAC sent the survey teams to 45 out of 72 districts in the country. In each district, the survey team randomly selected fourteen Sample Enumeration Areas (SEAs), which consisted of 300–600 households, and in each SEA, twenty households were surveyed with a vulnerability assessment questionnaire. The questionnaire consisted of 78 questions involving household demographics, productive asset ownership, cereal production in the previous season and current season, cultivated area, received food aid, income sources, expenditure patterns, food purchase, agricultural inputs, health, water supply, sanitation, coping strategy and so on.

Based on the result of the sample survey, VAC calculates the food needs and the number of affected persons in each district and submits the report to DMMU. The DMMU make arrangements with the organizations concerned and decide the amount of food aid to be delivered to targeted districts. The DMMU make a memorandum of understanding with local NGOs or other organizations that operate their activities in each district, and delegates the actual distribution of food, in most cases maize grain. The cereals, usually stocked at the FRA's granaries, are delivered to targeted districts, the local NGO or another organization to take the delivery to each satellite and distribution point in co-ordination with the District Disaster Management Committee (DDMC). A satellite committee usually consists of one representative from each village who decides the beneficiaries of food aid based on the government guidelines. The guidelines show that 20% of food aid should be distributed to the most 'vulnerable' persons for free, such as the aged, the disabled, orphans or widows, and 80% to the ‘vulnerable but viable’ persons through Food For Work. The latter have to undertake work to receive food at the community project designed by the satellite committee, such as road maintenance or brick making to build a teacher’s house.

In the 2008 fieldwork, we observed the actual implementation of the government food relief programme and the distribution of maize grain in the Sinazongwe district, in which we found some problems concerning its delivery and distribution at the local level. We will continue to analyse further, the process and its impact on local communities in 2009.

6. Research Summary and Further Issue

In FY 2008 research, we focused on the historical process of establishment of food security institutions and the system of food aid by examining administration documents in several organizations and field surveys. This research reveals that several organizations and systems for food security have been built with external funding since the 1980s, but many of them have not functioned effectively enough, partly because of lack of government initiative and ownership for those projects. Those newly built agencies frequently stopped their activities or reduced their functions when the financial support ended. Since the establishment of the DMMU and VAC, the food security institution has been much improved, but the actual implementation still has many difficulties.

Our research issue in FY 2009 will be focused on an intensive field study about those government institutions’ activities and their impacts on local communities. By interviewing NGO staff, camp officers and local farmers, we will try to investigate the food relief programmes and the local responses to them. Through the research, we are expecting to reveal the social and political impact of early warning and disaster management activities on the resilience of local communities.

Reference

Barrett C. B. & D. Maxwell 2005 *Food Aid After Fifty Years: Recasting its Role*. Routledge.

FAO 1983 *World Food Security: A Reappraisal of the Concepts and Approaches*. Director General’s Report. FAO, Rome.

FAO 1990 *Crop Forecasting and Early warning System Project, Zambia: Project findings and Recommendations*. FAO, Rome.

FAO 1991 *Early Warning System and Census of Agriculture.* Tripartite Review Mission Report. FAO, Rome.

FAO 1996 *Synthesis of the Technical Background Documents*. World Food Summit. FAO, Rome.

INTERFAIS 2008 *2007 Food Aid Flows*. (URL: http://www.wfp.org/interfais)

Pottier, Johan 1999 *Anthropology of Food: The Social Dynamics of Food Security*. Polity Press.

SADC-FANR RVAC 2005 *Vulnerability Assessment Methodology Review: Zambia Country Report*.

Sen A. 1981 *Poverty and Famines: An Essay on Entitlement and Deprivation*. Clarendon Press.

USAID 2004 *Celebrating Food For Peace1954-2004: Bringing Hope to the Hungry*. (URL: http://www.usaid.gov/our_work/humanitarian_assistance/ffp/50th/)

Ex Ante and *Ex Post* Risk Coping Strategies: How Do Subsistence Farmers in Southern and Eastern Province of Zambia Cope?

Thamana Lekprichakul
Research Institute for Humanity and Nature, Kyoto, Japan

Abstract

Subsistence rain-fed small holders in the semi-arid of Zamia are confronted with numerous idiosyncratic and climate-related common risks. Such has resulted in high variations in household income. In response, the farmers cope by utilizing a complex set of strategies to smooth income and/or asset. A field survey of 1,000 households was conducted in the eastern and southern province of Zambia to examine the farmers' experiences with various shocks and measures they took to reduce risk ex ante and to lessen and insulate from shock impacts ex post. It is found that drought, malaria, livestock diseases, heavy rainfall, flood and dead to the bread winner or household members are the top six most common shocks. Drought is by far the most damaging hazards the majority of sampled households had experienced. Self-sufficiency in food production is the most fundamental form of ex ante risk reduction. This may due perhaps to imperfect agriculture market. Specialization on low risk and low return crop production appears to be a limited practice. At the other end of the spectrum, diversification is widely practiced in both provinces. However, diversification patterns differ. While small holders in the southern province tend to diversify across various production and income generating activities, the easterners tend to center around cash crop production. Ex post responses of farmers in the two provinces are also different. The easterners utilize income smoothing strategies by engaging in the alternative income generating activities and the informal insurance mechanisms to cope with crisis. The southerners tend to engage in the increased austerity and informal insurance mechanism to survive. Differentials in behavioral response may have reflected differences in resource endowment at the household and community level.

1. Introduction

Zambia is a country in a semi-arid area which is an intermediate climatic region between dessert and humid climates. The region can be characterized by variable and low annual rainfall of approximately 250-500 mm. Since 1990, Zambian farmers have experienced six agricultural droughts in addition to occasional floods. Climatic variation is a significant common risk that threatens the livelihood of the subsistence, rain-fed agriculturalists. Besides, individual small farming households face many idiosyncratic risks that are constantly lurking in the backgrounds. Examples of the idiosyncratic risks are pests, damage from animals, fire, livestock diseases, illnesses, etc. High risks facing the small holders result in high income variation. In response, farmers adapt by developing a complex set of strategies to cope with risks.

The goal of this paper is to explore risks the households face and to describe how households cope with risks. Our study area includes Southern and Eastern province. Since Southern province is a drought prone area and the Eastern province is not, behavioral differences between households in these two provinces may shed light on drought-induced strategic responses.

It is important to distinguish between strategies to cope with risk versus shock. While the former refers to strategies to deal with the prospect of being affected by an uncertain event, the latter refers to measures taken in response to a realized uncertainty. Ex ante and ex post risk coping strategies can be literally defined as measures taken before and after experiencing shocks respectively. Although this chronological definition is useful in conceptualizing behavioral response to shocks, it can be misleading. Some measures adopted after experiencing the shock such as migration can later become a permanent measure to reduce exposure to potential shock in the future. Similarly, some ex post shock response will not be available to the household unless it was done ex ante. For example, selling livestock during emergency requires efforts in planning, caring and raising the livestock before the occurrence of the risky event. To avoid this potential confusion, chronology and its functional objective are combined to define ex ante and ex post risk coping strategies. Measures that are taken before the risky event occurs to avoid, transfer or reduce risks or exposure to risk are considered ex ante risk coping strategies. On the other hand, measures taken after the shocks to mitigate or insulate welfare impacts of the shocks are called ex post shock coping strategies. The ex ante and ex post risk/shock coping strategies may be distinguished by their behavioral objectives. While the ex ante risk coping strategies are for long-term survival, the ex post shock coping strategies are merely for short-term survival adjustment.

2. Ex ante Risk Coping Strategies

The primary goal of the ex ante risk coping strategies is to smooth income. The income smoothing strategies are ways in which households use to protect themselves against income shock before it actually happens. This is often achieved by adopting conservative production choices and diversifying economic activities. The income smoothing strategies may be grouped into three main categories, i.e.:

- risk avoidance,
- risk transfer,
- risk reduction,

Moving to a new location that is less prone to the risk is an example of risk avoidance. Relocation is not only a costly but also risky process. The expected return must be sufficiently high to justify the move. The second category of risk coping strategies is risk transfer to a third party via an insurance market or publicly provided safety net. Agricultural insurance is a form of risk pooling and risk sharing that works particularly well with covariate shocks which fail other less formal forms of small-base risk sharing. However, an absence of insurance market or an imperfection of insurance market makes this option unlikely to be available to the rural poor. Social safety net is also not likely to be put in place when the government, for example, Zambia's, is in serious fiscal distress and has high external debt. Alternatively, other less formal forms of risk transfer that can be readily employed by the impoverished agricultural households are risk-sharing and self-insurance. While risk-sharing is a cross-sectional transfer of risk to a group in a social network, self-insurance is a risk transfer to oneself across time via saving. The most common and universal form of risk sharing across social network is within household.

Thirdly, risk reduction is the most common strategies. There are three main methods of risk reduction, i.e. diversification, self-sufficiency and specialization. Diversification reduces risk exposure by spreading it over a portfolio of income generating activities whose returns are not perfectly correlated with respect to the risk of concern. Diversification strategies can be done horizontally or vertically. Horizontal diversification is a portfolio of income generating activities that diversifies between same-types activities. Crop diversification is an example of a horizontal diversification strategy. Vertical diversification is a portfolio that diversifies over different-type activities. Livelihood diversification by simultaneously employing on-farm, off-farm income generating activities is a case in point. Plot diversification may be considered a mixture of horizontal diversification and diversification over geography. This is similar in spirit to diversification across industry in financial investment.

While diversification aims at minimizing risk associated with income generation, self-sufficiency aims at minimizing risk associated with expenditure. Being self-sufficient in food production is to achieve food security by reducing risk associated with imperfect market or market variability. Self-sufficiency is not limited to food production. In an area where labor is a limiting factor, it is observed that self-sufficiency manifests in a form of labor hoarding by having a large number of children. Reducing risk via diversification is costly. Poor agricultural households may opt for specialization instead. Specialization reduces risk by focusing resources on income generating activity that has low risk at a cost of low return. Dercon (2000) terms this type of specialization an income-skewing strategy. Specialization does not necessarily indicate risk taking behavior (Dercon 2000).

3. Ex Post Shock Coping Strategies

Consumption smoothing and asset smoothing are two main methods of ex post shock coping strategies. The consumption smoothing refers to shock coping strategies that aims at defending consumption level by either involving in alternative income generating activities or drawing down either buffer or productive assets. The asset smoothing refers to shock coping strategies aims at defending a threshold level of asset that may be called “Micawber threshold” (Lipton 1994) below which the household will fall into a poverty trap and will not be able to recover unassisted. Asset smoothing is generally accomplished by cutting down consumption level. While the wealthy households tend to use consumption smoothing as their primary strategy to cope with shock, poorer household tend to use a combination of consumption and asset smoothing. The impoverished adopt consumption smoothing at first by drawing down asset until the productive assets approach the Micawber threshold at which point the households tend to switch to asset smoothing (Zimmerman and Carter 1999). It is possible that the poor household may revert back from asset smoothing to consumption smoothing strategy when their immediate survival is at risk

(Dercon 2000). When the productive asset of the household is already at the Micawber threshold level prior to the shock, poor farmers is found to respond to crisis in the following sequence: asset preserving, asset depletion and destitution (Drèze 1990).

Post shock behavioral responses to mitigate impacts of the shock may be categorized into five types by their salient characteristics (Takasaki, Barham, and Coomes 2002):

- alternative income generating activities (natural resource collection, fishing, making charcoal, theft, prostitution),
- dissavings (drawing down food stock or selling off assets),
- informal insurance mechanism (mutual insurance, gift exchange, remittance, borrowing, relief food),
- labor adjustment (taking children out of school, increased child and female labor market participation)
- increased austerity (meal substitution, meal reduction, reducing household items, postponing health care expenditure).

The first four categories share one common goal, i.e. raising additional income and consumption to compensate for the shortfall as a result of shocks, which is consumption smoothing. The austerity measures, on the contrary, allow consumption to fall further to, perhaps, preserve productive asset, which is asset smoothing.

4. The Data

The data used in this paper is from the Research Institute for Humanity and Nature's Agricultural Household Survey (RAHS) conducted in March-April of 2007. The RAHS of 2005/2006 agricultural season is conducted to supplement Post Harvest Survey (PHS) conducted annually by the Central Statistical Office of Zambia. The primary purpose of this survey is to assess vulnerability and resilience of subsistence small holders to climatic variations.

Sampling method of RAHS is based on PHS's stratified random sampling. The population is first stratified into standard enumeration area (SEA) with probability of being selected being proportional to its size in the first step. In the next step, a number of small farming households living in selected SEA, which cultivates on more than 0 hectare to no more than 15 hectare of land, will be selected. The sampling frame of SEAs is based on Census of Population and Housing in 2000. In total, 410 SEAs were sampled for PHS.

The RAHS 2005/2006 covers 59 SEAs previously selected in PHS 2004/2005 in Eastern and Southern Provinces. The 59 SEAs were randomly chosen with 32 and 27 SEAs for Eastern province and Southern province respectively. The distributions of SEAs by district are shown in the table below:

Table 1: Numbers of Selected SEAs by District

District	No. SEA
Eastern Province	
Katete	11
Mambwe	3
Nyimba	4
Petauke	14
Sunb-total	32
Southern Province	
Choma	8
Gwembe	2
Kalomo	7
Monze	7
Sinazongwe	3
Sunb-total	27

The selection of the SEAs is not designed to represent provincial situations. This is not necessary a drawback because the focus of this survey is to examine behavior at household level and not to obtain provincial estimates as it is usually done in the PHS.

A total of 20 households that were previously interviewed in the PHS 2003/2004 and 2004/2005 are chosen from each SEA. The expected sample size is 1,180 households. However, CSO actually attempted to conduct an interview on 1,156 households of which 1,011 households completed the interview. This constitutes an attrition rate of 12.5 percent. Important reasons for failure to get complete response are (i) moving out of SEA, (ii) non contact, and (iii) households dissolved.

5. Results

The paper presents the results by proceeding from what can be loosely characterized as ex ante risk coping strategies, types of shocks and ex post shock coping strategies. The ex ante risk coping strategies focuses primarily on examining various methods of diversification the farmers employed.

Ex Ante Risk Coping Strategies

Livelihood Strategies

Table 2 shows some household characteristics. On average, the small holders maintain relatively large household size around 7-8 person per household. Household in Southern province is slightly larger than that in the Eastern province, i.e. 7.8 vs. 6.7. The larger household size of the southerners is due partly to more prevalence of polygamous households. Larger household size allows the households flexibility to pool resources and share risks by taking advantage of household return to scale and labor supply they need during peaked demand season.

A picture that emerges from Table 2 is that the small holders in Southern province appear to be relatively more diversified in their livelihood strategies than their counterpart in the Eastern province. While between one-sixths and one-fifth of the Southern households engaged in off-farm income activities, only one-eighth of the Eastern households did so. While 3 percent of Eastern households engage in giving/receiving remittance, nearly 10 percent of the Southern households involved in an informal insurance of risk sharing. Against this background, it is interesting to note that household head with no education and female headed households[1] are clearly higher in the Eastern than in the Southern province. Both suggest lower investment in human capital among the easterners.

Table 2: Household Characteristics

Household	Eastern	Southern	All
Size	6.7	7.8	7.2
Polygamous household (%)	12.1	28.6	19.6
Female HH head (%)	21.1	18.2	20.1
HH head w/o education (%)	33.7	8.4	22.2
HH involved in wage employment (%)	12.5	18.2	15.1
HH involved in business (%)	12.9	22.1	17.0
HH give/receive remittance (%)	2.7	9.8	5.9
No. of sampled HH	552	459	1,011

Table 3 provides details on the type of wage income employment available in both provinces. The pattern is similar in both provinces. Their primary employment source is from their small farm neighbors. It is interesting to observe that the second largest source of wage income for the Southern households is civil servants.

Table 4 shed light on the type of formal and informal business activities. Both provinces are quite different in their business livelihood strategies. While charcoal production, shop-owner, livestock trading and builder are four most important businesses in the south, shop-owner, vender, agricultural trading and local brewing are for the east. The differences may reflect different resource endowment between the two regions in our study areas. The Southern area in our study sample is relatively richer with forest and other natural resources; and that may explain the greater prevalence of charcoal production, builder and livestock trading. On the other hand, our samples in the Eastern province are located in relatively flat land and have better access to roads. That probably explains why a high percentage of the farmers in the Eastern province engaged in retailing, market vending, agricultural trading and brewing. The business activities appear to be vertically more diverse (by industry) in the east than in the south.

[1] Death to the male household head and dissolved marriage are two likely causes leading to female headed household. Premature death to the male household head is an indicator of household health. Income of female headed farming households is generally lower than that of the male counterpart; and the lower income can potentially have adverse impact on child nutritional and health status.

Table 3: Type of Wage Employment by Province

ACTIVITY	Eastern		Southern		All	
	No.	%	No.	%	No.	%
On smallholder farm	55	67.1	57	49.6	112	56.9
On commercial farm	0	0.0	3	2.6	3	1.5
In a factory	-	-	-	-	-	-
In a mine	1	1.2	0	0.0	1	0.5
Other industrial work	3	3.7	1	0.9	4	2.0
Teacher	2	2.4	19	16.5	21	10.7
Other civil servant	1	1.2	9	7.8	10	5.1
Clerk	0	0.0	1	0.9	1	0.5
Shop attendant	-	-	-	-	-	-
Non-agricultural piece	8	9.8	5	4.3	13	6.6
Other	12	14.6	20	17.4	32	16.2

Note: No. represents frequency and not the number of households. Some households reportedly engage in multiple wage income activities.

Table 4: Type of Formal and Informal Business Activity by Province

Business Activity	Eastern		Southern		All	
	No.	%	No.	%	No.	%
Agricultural trading	9	11.7	4	3.3	13	6.6
Livestock trading	1	1.3	10	8.3	11	5.6
Retailer /shopowner	16	20.8	15	12.4	31	15.7
Marketer/hawker/vendor	9	11.7	9	7.4	18	9.1
Firewood/charcoal production	1	1.3	16	13.2	17	8.6
Carpentry	3	3.9	1	0.8	4	2.0
Builder	1	1.3	9	7.4	10	5.1
Local brewing	9	11.7	3	2.5	12	6.1
Butchery	2	2.6	0	0.0	2	1.0
Agriculture services	-	-	-	-	-	-
Milling	4	5.2	3	2.5	7	3.5
Oil processing	1	1.3	0	0.0	1	0.5
Agro processing	-	-	-	-	-	-
Tailor	0	0.0	1	0.8	1	0.5
Bicycle repair	2	2.6	0	0.0	2	1.0
Weaving	5	6.5	8	6.6	13	6.6
Blacksmithing	2	2.6	3	2.5	5	2.5
Traditional doctor	-	-	-	-	-	-
Fishing & selling	0	0.0	11	9.1	11	5.6
Precious stone mining	0	0.0	1	0.8	1	0.5
Other	12	15.6	27	22.3	39	19.7

Note: No. represents frequency and not the number of households. Some households reportedly engage in multiple business income activities.

Crop Strategies

Table 5 provides details of farmers' crop choices. Nearly every household in both provinces grow maize which is Zambia's staple crop. Other cereal crops such as millet and sorghum that are relatively more drought resistant are not well practiced in both provinces. The second most common crop in both provinces is groundnuts. Around 50% and 60% of households in Eastern and Southern province respectively grow groundnuts. The striking difference is the prevalence of cotton which is the second most important crop for the Eastern province. While one in two Eastern households grow cotton, only one every five Southern households do so. Cotton is a relatively capital intensive crop; and production by subsistence households is usually unlikely unless they can have an access to credit via an out-grower scheme. Sunflower plays important role in the Eastern province. Approximately, two of every seven households grow sunflower which is another cash crop for oil production. A quarter of households in Southern province grow cowpeas and sweet potatoes which is a low risk low return crop. Dercon (2006) found that households with less liquid tend to grow more sweet potatoes.

Overall, self-sufficiency in food production either completely or partially appears to be a basic strategy in both provinces. Portfolio composition of the Southern province seems to contain significantly higher proportion of low risk and low return crops. The easterners' portfolio, on the other hand, contains high concentration of high return cash crops.

Table 5: Crop Choice by Household and Province

Crop	Eastern		Southern		Total	
	Household	Percent	Household	Percent	Household	Percent
Maize	535	96.9	441	96.3	976	96.6
Sorghum	19	3.4	56	12.2	75	7.4
Rice	10	1.8	3	0.7	13	1.3
Millet	0	0.0	56	12.2	56	5.5
Sunflower	162	29.3	49	10.7	211	20.9
Groundnuts	261	47.3	275	60.0	536	53.1
Soyabeans	13	2.4	5	1.1	18	1.8
Seed cotton	277	50.2	104	22.7	381	37.7
Irish potato	0	0.0	0	0.0	0	0.0
Virginia tobacco	3	0.5	4	0.9	7	0.7
Burley tobacco	6	1.1	1	0.2	7	0.7
Mixed beans	22	4.0	14	3.1	36	3.6
Bambara nuts	0	0.0	20	4.4	20	2.0
Cowpeas	3	0.5	114	24.9	117	11.6
Velvet beans	0	0.0	11	2.4	11	1.1
Coffee	0	0.0	0	0.0	0	0.0
Sweet potato	10	1.8	98	21.4	108	10.7
Casava	0	0.0	2	0.4	2	0.2
Kenaf	0	0.0	0	0.0	0	0.0
Cashew nut	0	0.0	0	0.0	0	0.0
Paprika	1	0.2	0	0.0	1	0.1
Other crops	0	0.0	0	0.0	0	0.0

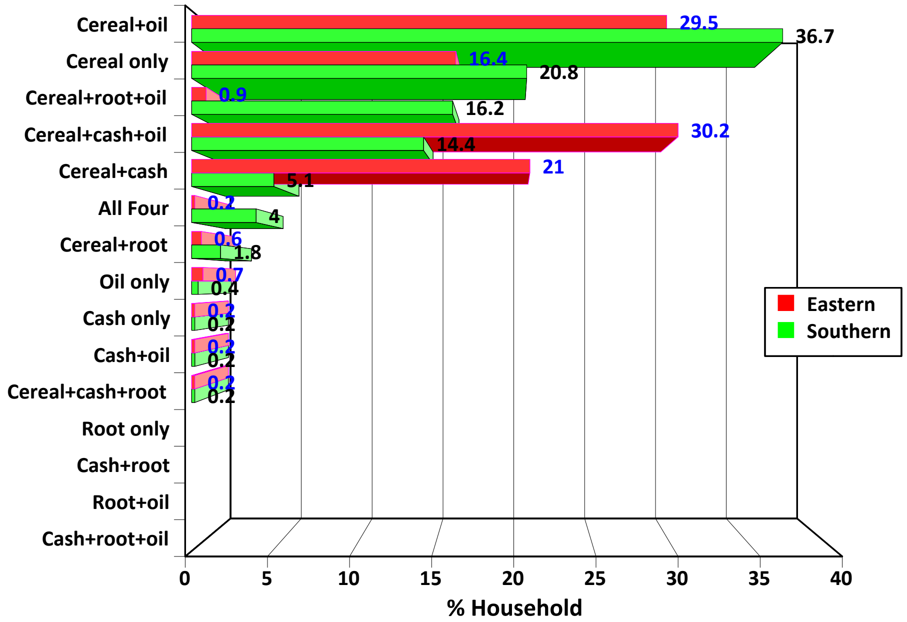


Figure 1: Crop Portfolio by Crop Type

To gain further insight into how households' crop portfolio strategies, I look into crop combination by categorizing each crop in table 5 into cereal, root, seed or oil, or cash crop. Figure 1 shows that low diversification is untypical. Farmers tend to diversify over two or more crop types. Cereal crop appears to be the only exception with Southern province leading in growing cereal crop only. Cereal-oil crop combination is the most prevalent in the Southern province. In Eastern province, cereal-cash-oil and cereal-oil crops are equally popular practices. Since oil crop is also cash earning crop, the dominant characteristic of the easterners' portfolio is an emphasis on cash crop. The crop portfolio of the Southern province seems to emphasize cereal crop. It is interesting to note that root crop is not grown independently but in combination with cereal crop only.

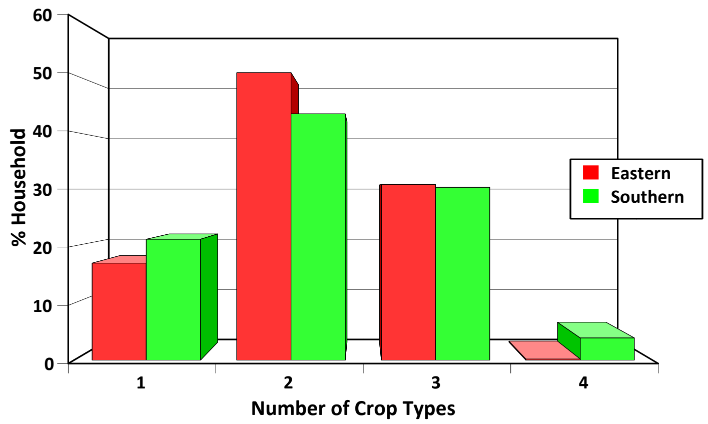


Figure 2: Household Crop Diversification by Crop Type

Figure 2 show that Eastern province is slightly more likely to adopt diversified portfolio across crop types. Two-crop type appears to be the most common strategy. Higher level of diversification is also significant in both provinces.

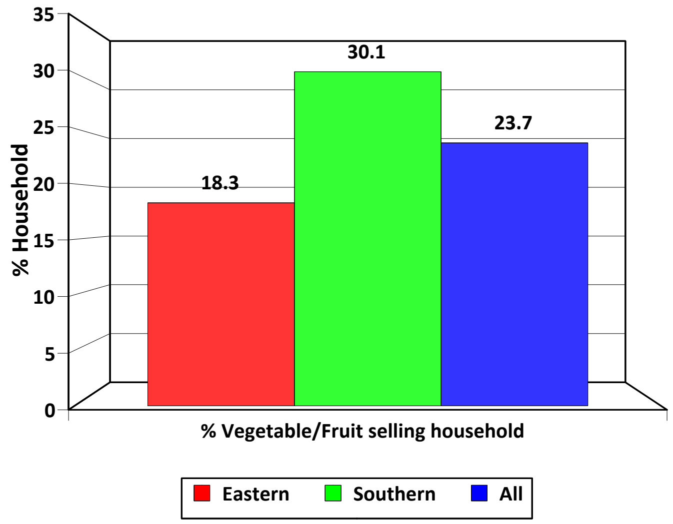


Figure 3: Vegetable/Fruit Selling Household

However, when garden activities are examined, it is found that the small holders in Southern province are more likely to involve in selling vegetable or fruits. While 2 in every seven households in Southern provinces sell fruits or vegetables, only 1 in every six households does so in the Eastern province.

How land is allocated to each crop can be an indicator of relative significances of each crop. Table 6 shows average household land allocation by crop type. The patterns are very similar across provinces. The marked difference is the greater emphasis the southerners place on cereal crops whereas the easterners tend to have greater preference for cash crops.

Table 6: Average Household Land Allocation by Crop

Land Allocation	Eastern	Southern	All
% Land allocated to cereal crop	63.0	70.0	66.2
% Land allocated to cash crop	42.7	34.3	40.3
% Land allocated to oil/seed crop	24.7	26.6	25.6
% Land allocated to root crop	12.7	13.3	13.2

Asset Holding Strategies

Table 7 provides details of productive asset the households reportedly owned. Bicycles are equally common in both provinces. Approximately 60 percent of the households own bicycles. Two-thirds of the households in Southern province owned ox-drawn ploughs but only one-third owned them in the Eastern province. Scotch-cards and sprayers are equally popular assets to own in both provinces. This is where the similarity in asset holdings ends. Overall, the asset portfolio of the Eastern province's households is comprised of narrow base which is mainly the four aforementioned types. The productive asset portfolio of the Southern province's households is more diverse. There are seven and four asset types that more than 10 percent of households have in Southern and Eastern province respectively.

Table 7: Productive Asset Holding by Type

Asset Type	Eastern		Southern		Total	
	Number of HH	Percent	Number of HH	Percent	Number of HH	Percent
Ox-drawn ploughs	195	35.6	296	64.9	491	49.0
Disc ploughs	13	2.4	11	2.4	24	2.4
Harrows	1	0.2	102	22.5	103	10.3
Cultivators	4	0.7	108	23.7	112	11.2
Rippers	4	0.7	13	2.9	17	1.7
Tractors	0	0.0	6	1.3	6	0.6
Hand driven tractors	1	0.2	2	0.4	3	0.3
Scotch carts	120	21.9	105	23.1	225	22.5
Water pumps	2	0.4	5	1.1	7	0.7
Trucks / lorries	1	0.2	7	1.5	8	0.8
Pick-ups / vans / cars	7	1.3	8	1.8	15	1.5
Trailer truck / tractor	0	0.0	3	0.7	3	0.3
Motorcycles	8	1.5	11	2.4	19	1.9
Bicycles	325	59.4	267	58.7	592	59.1
Hammer mills	6	1.1	11	2.4	17	1.7
Hand hammer mills	1	0.2	78	17.1	79	7.9
Rump presses / oil expellers	2	0.4	2	0.4	4	0.4
Sprayers	134	24.5	101	22.2	235	23.5
Shellers	2	0.4	3	0.7	5	0.5

Livestock Holding Strategies

Figure 4 shows average holding of livestock by types. It is apparent that the southerners are holding equal or more livestock, on average, in nearly every category. An exception is pig. The Southern province farmers show strong preference for high value animals, i.e. cattle. For cattle, the ratios of the average holding between the two provinces are approximately 2:1 or higher. Goats and chickens are also significantly higher in the Southern province. This is due, perhaps, to greater availability of community forest in the Southern province.

When livestock ownership is examined by household, it is found that approximately 10 percent of households owned no animal. Eastern province has higher proportion of livestockless households than the Southern province by 5 percentage points. The proportions of households owning livestock in Southern province are higher than those in the Eastern province in every category of livestock.

Table 8: Livestock Holding by Household

Livestock	Eastern	Southern	All
None	13.8	8.5	11.4
Cattle	46.0	56.6	50.8
Pig/Goat/Sheep	63.8	65.9	64.8
Poultry	69.9	87.1	77.7
Donkey	0.5	2.0	1.2

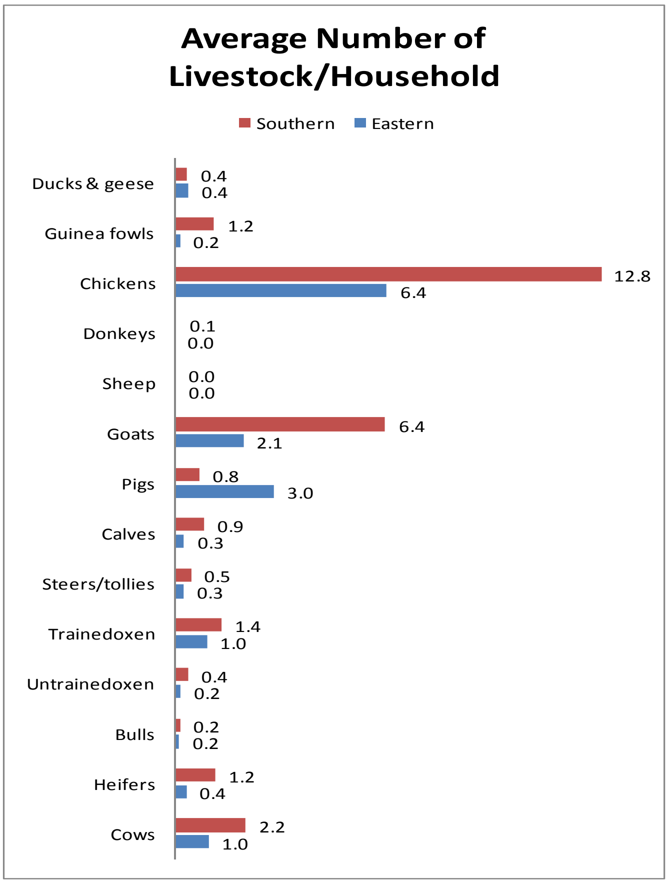


Figure 4: Livestock Holding Per Household

Table 9 summarizes animal holding strategies. The patters are quite similar between the two provinces. Farmers simultaneously hold cattle, pig/goat/sheep and poultry in their livestock portfolio. The second most popular portfolio is to hold pig/goat/sheep and poultry.

Table 9: Livestock Diversification

Livestock	Eastern	Southern	All
None	13.77	8.52	11.39
Cattle only	3.44	0.87	2.28
PGS only	7.43	1.53	4.75
Poultry only	11.96	14.63	13.17
Donkey only	-	-	-
Cattle & PGS	5.07	1.97	3.66
Cattle & poultry	6.88	9.39	8.02
Cattle & donkey	-	-	-
PGS & poultry	20.29	18.56	19.5
PGS & donkey	0.36	-	0.2
Poultry & donkey	0.18	-	0.1
Cattle, PGS & poultry	30.62	42.58	36.04
Cattle, PGS & poultry	-	-	-
Cattle, poultry & donkey	-	0.66	0.3
PGS, poultry & donkey	-	0.22	0.1
Cattle, PGS, poultry & donkey	-	1.09	0.5

Type of Shocks

Figure 5 displays types of shocks households had experienced in the past six year between 2001 and 2006. Farmers in both provinces experienced similar kind of shocks. Drought, malaria, livestock diseases, loss of employment, heavy rainfall and death to household members are top five types of shocks the households in Southern province reported to having experienced. In Eastern province, drought, malaria, livestock diseases, heavy rain and floods were five most familiar shocks to households. Although drought is the most common type of shock in both provinces, the scope was much wider in the Southern than in the Eastern province counterpart. Three quarter of households reported to experience drought in the Southern province whereas about one-half of the Eastern province's households reported so. Flooding seems to be more common in the Eastern than in the Southern.

When respondents were asked to provide subjective evaluation of each type of shocks, drought is clearly the most severe shock to the subsistence farmers of both provinces. And it is more severe in the Southern than in the Eastern province (see Figure 6). Heavy rainfall, nevertheless, is rated more severe in the south than in the east. This is due probably to Southern province's topographical condition that is on a plateau and sloppy. Heavy rain may quickly wash away farmers' crops. On the other hand, floods are reported to cause relatively more damage in the east than in the south. The pattern of shock severity closely resembles the pattern observed in the prevalence rates as mentioned above. In all, climatic related shock is the principal risks threatening the small holders' livelihoods.

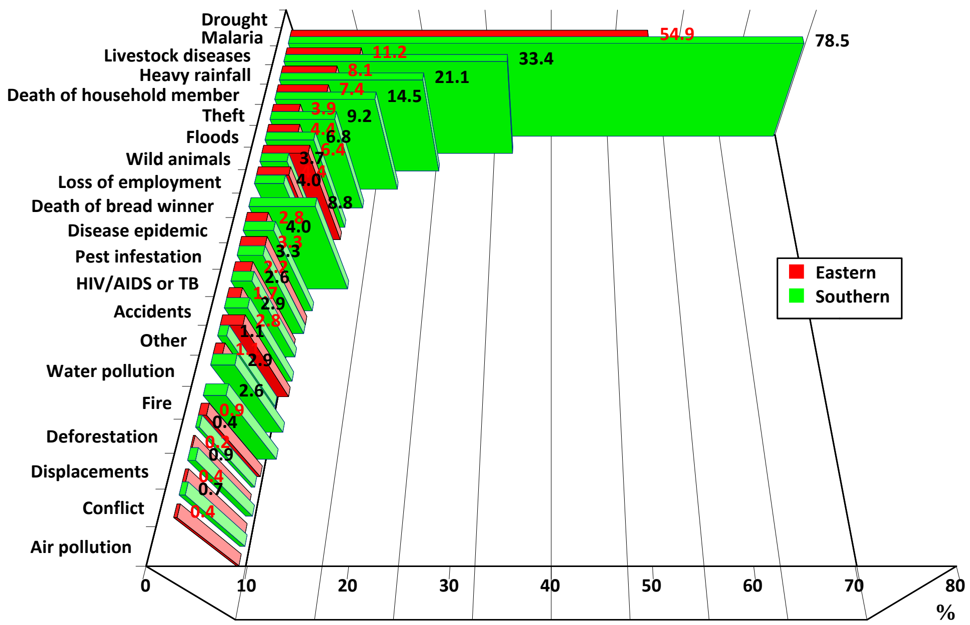


Figure 5: Shocks to Households in the Past 6 Years, 2001-2006

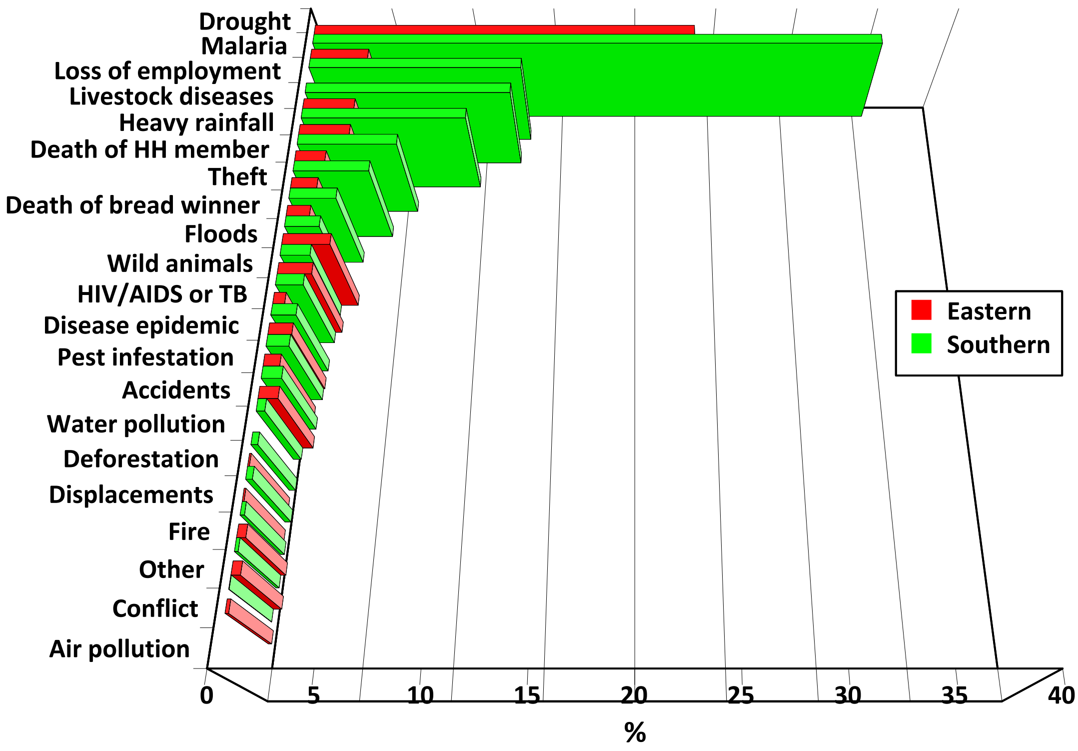


Figure 6: Subjective Evaluation of Severity of Shocks Weighted by Prevalence Rate

Table 10 shows an aggregation of hazards into two categories, i.e. idiosyncratic and covariate shock. It reveals an interesting pattern. Idiosyncrasy is the primary shocker to the Eastern province's households whereas the southerners largely suffer a mixture of idiosyncratic and common shock s. interestingly, one-third of Eastern households failed to report any shock experienced during the past 6 years. The proportion of no shock reported or failing to report any shock in Southern province is only one-tenth.

Table 10: Household Experiencing Shocks in the Past 6 years, 2001-2006

Shock	Eastern	Southern	Total
None/No report	32.1	11.6	22.8
Idiosyncratic only	32.2	36.5	34.2
Covariate only	8.5	5.9	7.3
Idiosyncratic & covariate	27.2	46.1	35.7

Ex Post Shock Coping Strategies

Figure 7 displays how farmers cope at time of drought. Patterns are markedly different between the two provinces. While easterners turn to piece work as their chief solution, the southerners cut down their meals and relying on relief food. This may reflect different job opportunities in the two provinces. Selling assets to smooth consumption is almost equally popular in both Eastern and Southern province.

When each of every coping strategy is characterized into five major strategic groups, it is evident that approach to deal with shocks of the two provinces is distinctly different (see Table 11).

The households in Eastern province employ alternative income generating activities to compensate for the income shortfall. If successful, such strategy can help to smooth both income and asset. The southerners, on the other hand, adapt to hazards by increasing austerity and relying on informal insurance mechanisms. Labor adjustment at time of crises is not a likely practice in both provinces.

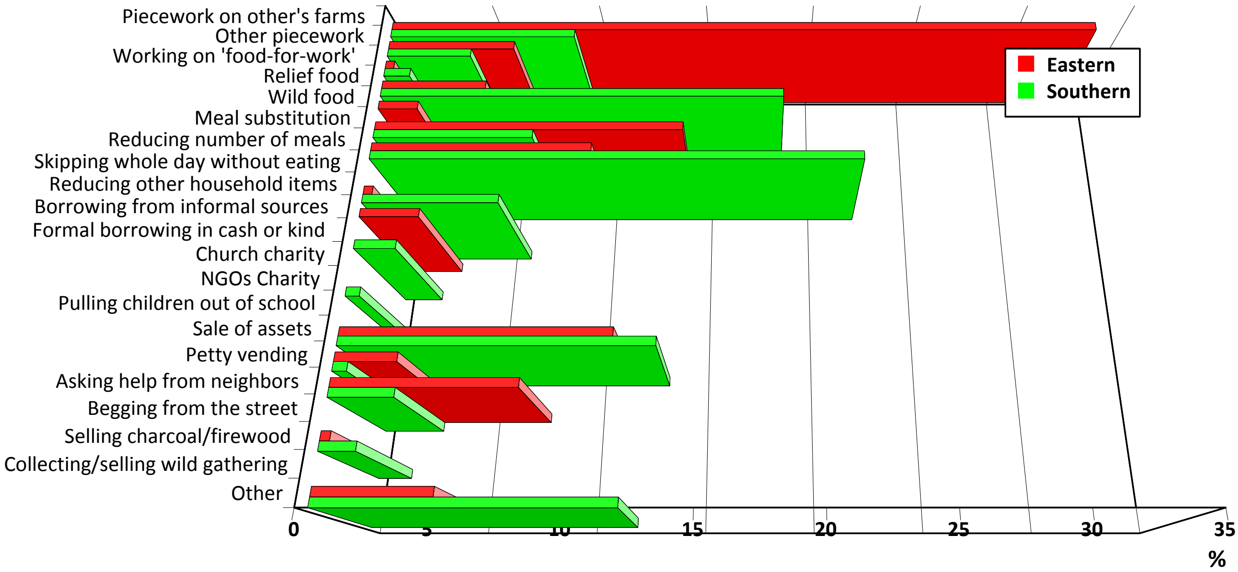


Figure 7: Drought Coping Strategies

Table 11: Ex Post Shock Coping Strategies by Selected Hazard

Coping Strategies	Drought	Malaria	Livestock diseases	Heavy rainfall	Floods	Theft	Death of bread winner	Average
Eastern								
Alternative income generating activities	42.3	42.1	35.7	17.1	33.3	21.4	41.7	33.4
Dissavings	11.4	5.3	3.6	2.9	10.0	7.1	0.0	5.7
Informal insurance mechanisms	15.1	26.3	32.1	51.4	20.0	35.7	8.3	27.0
Labor adjustment	0.4	5.3	0.0	0.0	0.0	0.0	8.3	2.0
Increased austerity	26.1	10.5	10.7	28.6	20.0	21.4	25.0	20.3
Others/unknown	4.8	10.5	17.9	0.0	16.7	14.3	16.7	11.5
Southern								
Alternative income generating activities	14.7	9.2	6.5	8.5	26.7	14.3	5.9	12.2
Dissavings	13.2	0.0	8.7	8.5	13.3	3.6	5.9	7.6
Informal insurance mechanisms	23.7	14.3	7.6	8.5	20.0	7.1	11.8	13.3
Labor adjustment	1.2	1.0	0.0	2.1	0.0	0.0	0.0	0.6
Increased austerity	35.3	9.2	22.8	29.8	40.0	10.7	5.9	22.0
Others/unknown	12.0	66.3	54.3	42.6	0.0	64.3	70.6	44.3

6. Conclusion and Discussion

In Southern and Eastern province of Zambia, small scale farmers are facing substantial livelihood risks that result in high variability of their living standard. In response, they develop a complex set of risk coping strategies to avoid, transfer, or reduce risks before crises and to mitigate or insulate welfare impact after experiencing shocks. Drought, malaria, livestock diseases, heavy rainfall, flood and dead to the bread winner are the top six hazards the small holders reportedly experienced in the past six years between 2001 and 2006. Drought is by far the most damaging hazards the majority of sampled households had experienced.

There are several ways for households to cope with risk before it occurs. Risk avoidance, risk transfer and risk reduction are three main strategies. This study focuses attention on risk reduction because it is the most commonly practiced form of risk coping. Risk reduction can be achieved by diversification, self-sufficiency and specialization. Among the three, specialization in a low risk low return livelihood system seems to be limitedly practiced. Self-sufficiency in food production, on the other hand, is the fundamental and most common strategies. An absence or imperfect market system may have contributed to the prevalence of self-sufficient strategies. In addition, farmers in both provinces engage in various diversification strategies which include livelihood diversification, crop diversification, plot diversification, asset diversification, and livestock diversification.

The small holders in Southern and Eastern provinces approach diversification strategies differently. In comparison to households in Eastern province, farmers in Southern province are more likely to have larger household size, engage in wage and business income activities, give and receive remittance which is a form of informal risk sharing, sell vegetables/fruits, hold more diverse type of assets, hold more diverse type of livestock. Crop portfolio of the southerners is relatively more defensive by giving greater emphasis on cereal crops which has low market risk while the easterners put a great deal of importance to cash crops that are more susceptible to downside risk. If one looks at diversification as a spectrum where the vertical diversification is at one end and the horizontal diversification is at the other end, the risk coping behavior of the southerners is likely to locate closer toward the complete vertical diversification; and the easterners' behavior is located closer to the complete horizontal diversification by emphasizing diversification by cash crop choice that will yield the highest possible return.

Ex post shock coping strategies of the two provinces are also apparently different. The easterners utilize income smoothing strategies by engaging in the alternative income generating activities and the informal insurance mechanisms to cope with crisis. The southerners tend to engage in the increased austerity and informal insurance mechanism to survive. It is uncertain whether the adoption of austerity measures might indicate asset smoothing strategy. More study is needed to better understand motives of their behaviors. It should be cautioned that the ex post crisis coping strategies of the small holders in Southern province are quantified with relatively less degree of precision than those of the Eastern province. The significant proportions of other/unknown category of the shock coping strategies in Southern province may indicate misreported errors.

Reference

Dercon, Stefan. 2000. Income Risk, Coping Strategies and Safety Nets. Background paper World Development Report 2000/01: Centre for the Study of African Economies, Oxford University.

Drèze, J. . 1990. Famine Prevention in India. In *The Political Economy of Hunger Vol. 2*, edited by D. J. and A. Sen: Oxford University Press.

Fafchamps, Marcel. 2004. *Rural Poverty, Risk and Development*. Cheltenham: Edward Elgar Publishing.

Lipton, Michael. 1994. Growing Points in Poverty Research: Labour Issues. In *International Institute for Labour Studies Discussion Paper No. 66*: International Labor Organization.

Takasaki, Yoshito, Bradford L. Barham, and Oliver T. Coomes. 2002. Risk Coping Strategies in Tropical Forests: Flood, Health, Asset Poverty, and Natural Resource Extraction. In *The 2nd World Congress of Environmental and Resource Economists*,. Monterey, California.

Zimmerman, F., and M.R. Carter. 1999. Asset Smoothing, Consumption Smoothing and the Reproduction for Inequality under Risk and Subsistence Contracts. In *Agricultural and Applied Economics Staff Working Paper No. 402*: University of Wisconsin, Madison.

Diversification of Agriculture in Coastal Districts of Tamil Nadu– a Spatio- Temporal Analysis

K.Palanisami[1], C.R.Ranganathan[1], S.Senthilnathan[1] and Chieko Umetsu[2]
[1]Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, India
[2]Research Institute for Humanity and Nature, Kyoto, Japan.

Abstract

Crop diversification is considered as a resilience mechanism followed by farmers in different regions. Socio-ecological systems of coastal areas are more vulnerable to the impact of climatic changes. In the present paper, it is shown that there exists wide spatio-temporal disparity in the diversification of crops in the coastal districts of Tamil Nadu State, India. This is done by constructing a crop diversification index which provides a basis for ranking the different districts. So in those regions which are more vulnerable for climatic change, more diversification of crops must be attempted to avoid risk of crop failure and loss of income and employment to the rural people.

1. Introduction

Socio-ecological system of coastal areas are usually fragile and sensitive to vagaries of weather. They are more vulnerable to the impact of climatic changes. For such a society faced with diminishing natural resources and every increasing demand for food consumption and food security due to increase in population growth, agricultural intensification including fisheries is the only course of action for future growth of agriculture. Agricultural intensification can be achieved by changes in cropping pattern or crop diversification. It is certainly an important component of the overall strategy for small farm development. It is usually viewed as a risk management strategy. It also provides for self provisioning in the context of non-monetized traditional system. As market opportunities develop and or risks are somehow reduced, the enterprise mix begins to respond to market forces and it was this perspective which was more relevant in the context of altered economic environment. Agricultural diversification really started in the early eighties in India and it has picked up momentum over the recent past and farmers were always quick to diversify into higher value crops as market opportunities developed.

Crop diversification has lot of benefits food & nutrition security, income growth, poverty alleviation, employment generation, judicious use of land and water resources, sustainable agricultural development and environmental improvement. To improve the incomes, to provide gainful employment and to stabilize the income flow, diversification of crops emerges as a major strategy. Besides in several circumstances diversification is needed to restore the degraded natural resource base or to enhance the value of natural resources. In several instances cropping systems have been diversified or new cropping systems have been introduced to retain or to enhance the value of natural resources principally land and water. There is also the claim that diversification tends to stabilise farm income at a higher and higher level. This happens when the pattern of diversification is such as to accommodate more and more rewarding crops. This is particularly important for the small farmers who strive to make their farms viable (Saleth, 1995).

2. Earlier Studies on Diversification

Saran and Kaur (2002) analyzed the changes in cropping pattern in Punjab during 1970-71 and 1996-97. The study revealed that in almost all the districts in Punjab, specialization was mainly due to agricultural development. Availability of agricultural inputs and institutional factors and infrastructural facilities are essential for attaining most desirable land use patterns best suited to the region. The study indicated that the economic reforms and new international scenario are likely to promise further changes in land use pattern and crop diversification as well.

Shiyani and Pandya (1998) examined the levels of crop diversification in different agro climatic zones over a period o time. The study observed that the farmers have shifted their cropping pattern from the subsistence crops to the commercial crops. On an average, relatively higher growth rates of acreage under tur castor, rapeseed, mustard, sugarcane, maize and wheat were found in different agro climatic zones of Gujarat, whereas negative compound growth rates of acreage under pearl millet, jowar and cotton were noticed in most oft the zones. The study suggested the establishment of agro processing industries and infrastructural facilities, arrangement for crop protection, construction, maintenance and management of irrigation works, research prioritization, distribution of quality seeds and seed materials of the specific crops in the specific zone on the basis of cropping pattern and need of the people of the region.

Ajjan and Selvaraj (1996) analyzed the impact of crop diversification among the small tea growers in the Nilgiris district of Tamil Nadu. The results showed that there had been a major shift in cropping pattern. The area under potato registered negative growth (-8.58 per cent and the area under tea showed positive growth (5.19 per cent). The economics of crop diversification revealed that tea generated a higher rate of return as compared to potato. It was also observed that the land value of tea increased substantially to Rs.1.59 lakh per ha for potato due to diversification. The crop diversification also had a positive effect on soil conservation and ecology.

Lathar *et al.*(1996) examined the prospects of enhancing the income of the marginal and small farmers through diversification of farming in Sonepet district of Haryana for the year 1993-94. The results revealed that the farmers of both the categories were found to be quite close to the optimal plan which was derived by considering the commonly prevalent crop production activities at the existing level of technology. However with the adoption of advanced production technology being followed by the top 10 per cent of the progressive farers for various crops and high value farm products, the return over variable cost increased by 356 and 184 per cent over the base period for marginal and small farms respectively. Similarly, it was also found that the magnitude of gainful employment has also increased by 30 and 71 per cent over the base period in the case of marginal and small farms respectively. The study suggested that for achieving the gains of diversification of farming, there is an urgent need for further strengthening the required infrastructure pertaining to input supply system, marketing system and the existing research and extension programmes to increase the adoption of advanced production technologies.

Sharma *et al.* (1996) examined the growth of production of different crops in Rajasthan and the changes that had taken place in the cropping pattern from 1960-61 to 1993-94. The results showed that there was a major breakthrough in the growth rate of area and oilseeds at 8.45 and 13.2 per cent respectively resulting in high growth of production at 32.42 per cent per annum. Crop wise results revealed the declining share of cereals in gross cropped area was due to declining share of bajra[1], (from 30.2 to 24.5 per cent), jowar[1] (from 7.6 to 4.1 per cent) in kharif[2] and barley (from 3.0 to 1.1 per cent) in the rabi[3] season. The share of wheat crop in the gross cropped area has increased from 7.8 per cent to 10.5 per cent. Thus the cropping pattern had changed in favour of remunerative crops and it had not affected food security adversely as there is enough scope to increase the cropped area.

Saini *et al.* (1996) in their study on the impact of diversification on small farms economy in Kangra district of Himachal Pradesh observed that the diversification of arable farming systems with commercial enterprises such as high yielding milk animals, poultry birds, bee-keeping, floriculture etc. resulted in a marked increase in the farm income from 6 to 138 per cent. Similarly the capital and credit requirement showed an increasing trend with the extent of diversification implying thereby that to diversify the existing farming systems with the most systematically, remunerative and technically feasible enterprises, adequate facilities should be made available by the financial institutions.

Given the importance of crop diversification under the changing scenarios, a study was undertaken to examine the crop diversification in coastal districts of Tamil Nadu over years and to suggest suitable policy options for furthering the diversification towards the sustainability of agriculture in the region.

3. Date Base

The data for the analysis consisted of area under different crops grown at nine coastal districts of Tamil Nadu (see, Figure 1) during 1980-81, 1985-86, 1990-91, 1995-96, 2000-01 and 2005-06. Nine major crops grown in the coastal districts were selected. The details of the coastal districts and the crops selected for the study are given in Table 1.

Table 1. Coastal Districts of Tamil Nadu and Crops Selected for Study

Coastal Districts	Crops selected for the study
Kancheepuram, Cuddalore, Nagapattinam, Thanjavur, Pudukottai, Ramanathapuram, Tirunelveli, Thoothukudi and Kanniyakumari	Paddy, Cholam, Maize, sugarcane, Cotton, Groundnut, Chillies, Banana and Total pulses

[1] A millet crop largely grown in many States of India
[2] A crop season from June to October
[3] A crop season from November to Februrary

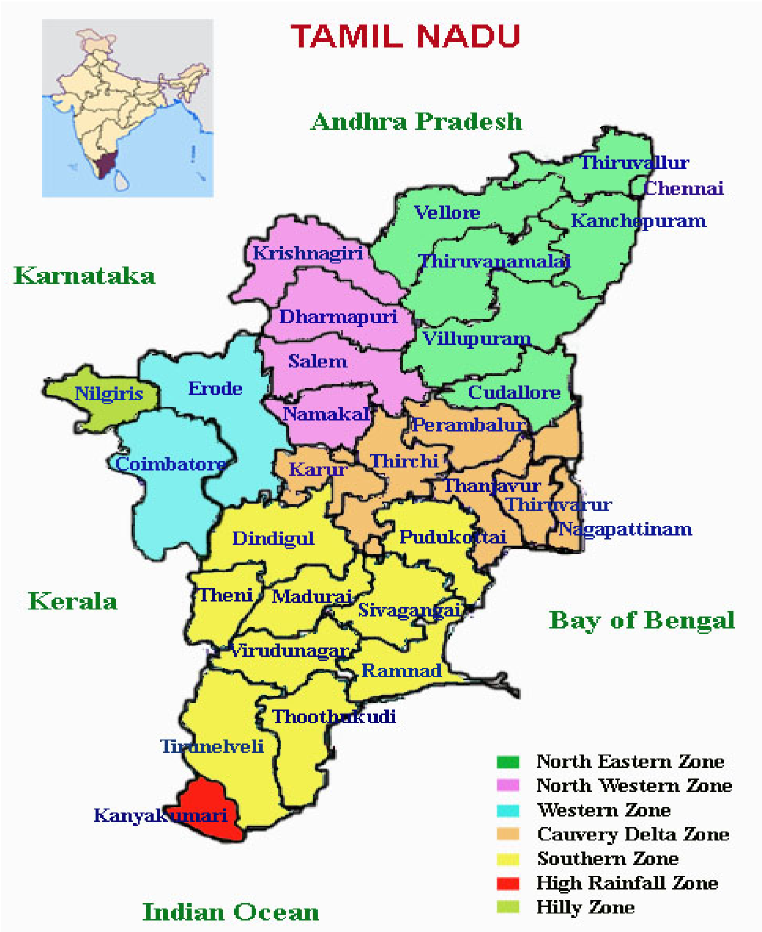


Figure 1. Agro Climatic Zones of Tamil Nadu and its Position in India (Inset)

4. Methodology

There are different indices used to measure crop diversification. These indices measure by a single quantitative indicator, the extent of dispersion and concentration of different crops at a given point of time and space, i.e., these indices are calculated for each 5 year time period from 1980-81 to 2005-06 for each coastal district of Tamil Nadu. Shiyani and Pandya (1998) also have used similar indices to study the diversification of agriculture in Gujarat State, India. Below we discuss the most commonly used indices of diversification and their properties.

(a) Hefindahl Index (HI)

The Hefindahl Index is the sum of the squares of the acreage proportion of each crop in the total cropped area. That is,

$$HI = \sum_{i=1}^{i=N} p_i^{\,2}$$

It can be shown that this index attains a minimum value equal to 1/N when p_i = 1/N (i = 1,2.3..N), and N is the total number of crops, that is, when maximum diversification occurs. It attains a maximum value of 1 when N = 1, that is, when there is a single crop or when complete specialization occurs.

(b) Entropy Index (EI)

This is a measure widely used by research workers. Unlike Herfindahl Index, the Entropy Index increases with increase in diversification. It is defined as

$$EI = -\sum_{i=1}^{N} p_i \ln(p_i)$$

It reaches a maximum value of log(N) when p_i = 1/N (i = 1,2.3..N), that is, when maximum diversification occurs. It reaches a minimum value of 0 when there is only one crop, that is, when specialization happens. The EI has a limitation. Since the upper limit of EI is log(N) (which depends on N), it can’t be used to compare the degree of diversification in different locations where different number of crops are grown. This limitation is overcome by defining a Modified Entropy Index.

(c) Modified Entropy Index (MEI)

This index is defined as

$$MEI = -\sum_{i=1}^{i=N} p_i \log_N (p_i)$$

Hence MEI is same as EI except that the base of the logarithm is N. It can be shown that at maximum diversification, this index takes a value of 1 and at maximum specialization it attains a value 0f 0. The MEI provides an uniform and fixed scale and hence it is used as a norm to compare and rank the extent of diversification spatially. Hence in the present study this index has been used to rank the different coastal indices. Table 2 provides a summary of the three different measures of diversification and their properties.

Table 2. Characteristic features of different measures of diversification

Index	**Formula**	**Measure of**	**Value at Perfect Diversification**	**Value at Perfect Concentration**	**Is ranking of activities possible?**
HI	$\sum_{i=1}^{i=N} {p_i}^2$	Concentration	1/N	1	No
EI	$\sum_{i=1}^{N} p_i \ln(p_i)$	Diversification	Ln(N)	0	No
MEI	$-\sum_{i=1}^{i-N} p_i \log_N (p_i)$	Diversification	1	0	Yes

5. Results and Discussion

The computed values of Modified Entrophy Index for the nine coastal district of Tamil Nadu are presented in Table 3.

Table 3. Crop Diversification Indices (Modified Entrophy Index) for Coastal Districts of Tamil Nadu.

District	Year					
	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06
Kancheepuram	0.722	0.731	0.768	0.768	0.747	0.741
Cuddalore	0.634	0.637	0.717	0.688	0.623	0.622
Nagapattinam	0.414	0.426	0.469	0.370	0.397	0.414
Thanjavur	0.493	0.518	0.566	0.505	0.386	0.428
Pudukottai	0.449	0.519	0.574	0.515	0.425	0.453
Ramanathapuram	0.449	0.401	0.373	0.382	0.379	0.403
Tirunelveli	0.571	0.641	0.646	0.645	0.663	0.593
Thoothukudi	0.839	0.857	0.811	0.819	0.864	0.772
Kanniyakumari	0.319	0.413	0.408	0.376	0.509	0.516

The table shows that in coastal districts, the diversification index varied from 0.319 (corresponding to Kanyakumari during the year 1980-81) and 0.864 (corresponding to Thoothukudi during the year 2000-01). Kanniyakumari district registered maximum increase in the diversification index during the 25 years from 198 0-81 to 2005-06, whereas kancheepuram, Pudukottai and Tirunelveli registered marginal increase. All other districts registered decrease or remain unchanged diversification index during the study. The largest decrease in diversification was in Toothukudi district with a decrease of 0.057. Table 4 provides ranking of coastal districts based on Modified Entropy Index.

Table 4. Ranking of Coastal District of Tamil Nadu Based on Modified Entropy Index

District	Year					
	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06
Kancheepuram	2	2	2	2	2	2
Cuddalore	3	4	3	3	4	3
Nagapattinam	8	7	7	9	7	8
Thanjavur	5	6	6	6	8	7
Pudukottai	6	5	5	5	6	6
Ramanathapuram	7	9	9	7	9	9
Tirunelveli	4	3	4	4	3	4
Thoothukudi	1	1	1	1	1	1
Kanniyakumari	9	8	8	8	5	5

The table 4 shows that Thoothukudi and Kancheepuram occupied first and second position in terms of crop diversification in the past 25 years. From table 3 the average diversification indices are respectively 0.827 and 0.746. This shows that in those district more than 75 percent agriculture land had been diversified to the nine crops taken for the study. Kanyakumari district has registered considerable increase in the rankings during the period of study. All other districts occupied the same position or ranking or decrease in ranking during the period of study.

6. Relationship between Crop Diversification Index Vulnerability and Resilience

Palanisam et al (2009) have examined the vulnerabilities of the costal districts of Tamil Nadu to climatic change. They have concluded that Ramanathapuram and Nagapattinam districts are most vulnerable to climatic change. The crop diversification indices of the two districts for the year 2005-06 (Table 3) are respectively 0.403 and 0.413 which means that only about 40% of the agricultural area are occupied by diverse crops. This show that there is an inverse relation between crop diversification and vulnerability to climatic change. Resilience in general refers to the level of resistance or recovery from shocks. In the case of coastal districts, the normal shock will be changes in rainfall resulting in floods or droughts, or other natural calamities. One of the major resistance identified was the cropping pattern changes in the coastal districts for the past 30 years. The area under food crops in coastal regions which was 88.8% during 1975-76 reduced to 82.7% during 2005-06 and the percentage area under non food crops increased from 11.2% to 17.3%. This clearly confirms that farmers in the coastal region are resilient to climatic changes by changing cropping pattern. Hence it is confirmed that crop diversification is considered as one of the resilient mechanism particularly in the coastal region.

7. Conclusion

It may be concluded from the results presented in the study that there exists wide spatio-temporal disparity in the diversification of crops in the coastal districts of Tamil Nadu. The diversification in the coastal districts can be effectively utilized by strengthening of the linkage between agricultural and industrial sectors. In those districts where the deceleration of diversification had been exhibited, efforts must be taken for singling out the causative factors and adoption of appropriate measures for augmenting the diversification. In this regard, the technology has a dominant role to play and as such adequate measures should be taken for propagating the innovative technologies in agriculture among the coastal farmers. Besides, diversification of enterprises should also be encouraged as a measure of minimizing the risk via resilience mechanism in those coastal districts where the index of diversification had showed plateau over years which will help to minimize the crop failure and income loss including employment to the rural people.

References

Ajjan,N. and K.N.Selvaraj (1996). “Crop Diversififcation and its Implications in Tamil Nadu – A Micro Analysis”, *Indian Journal of Agricultural Economics*, Vol.51, No.4, pp 695.

Lathar,R.K, R.N.Pandey and S.K.Goyal (1996). “Diversification for Enhancing the Income on Marginal and Small Farms in Harayana”, *Indian Journal of Agricultural Economics*, Vol.51, No.4, pp 691.

Palanisami, K., P.Paramasivam, C.R.Ranganathan P.K. Aggarwal, and S.Senthilnathan,2009. “Quantifying Vulnerability and Impact of Climate Change on Production of Major Crops in Tamil Nadu, India”, From Headwaters to the Ocean-Hydrological changes and Watershed Management, Taylor & Francis Group, London, U.K, ISBN 978-0-415-47279-1 pp 509-514.

Shiyani,R.L, and Pandya (1998). “Diversification of Agriculture in Gujrat: A Spatio-Temporal Analysis”, *Indian Journal of Agricultural Economics*, Vol.53, No.4, pp 627-639.

Sharma,A.K.,P.Metha and S.K.Sharma (1996). “Evaluation of Risk in Diversified Crop Farming of Himachal Pradesh-A Case Study of Vegetable Farms”, *Indian Journal of Agricultural Economics*, Vol.53, No.4, pp 688.

Saleth, R.Maria, 1995, Agricultural Diversification in Tamil Nadu: Potentials and Prospects, Institute of economic Growth, Delhi, pp 710.

Saini,A.S., K.D.Sharma and B.K.Singh (1996). “Impact of Diversification on Small Farms Economy in Himachal Pradesh”, *Indian Journal of Agricultural Economics*, Vol.51, No.4, pp 697-698.

Deficit Rainfall Insurance Payouts in Most Vulnerable Agro Climatic Zones of Tamil Nadu, India

S.Senthilnathan[1], K.Palanisami[1], C.R.Ranganathan[1] and Chieko Umetsu[2]

[1]Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

[2]Research Institute for Humanity and Nature, Kyoto, Japan

Abstract

Weather based insurance is a resilience strategy adopted by farmers. It is intended to provide protection to the cultivator against declined rainfall, which is deemed to adversely affect the crop during its cultivation period. It is becoming popular nowadays in India due to high fluctuation in rainfall and other climate related parameters. The present paper provides a method to compute the initial premium for each crop based on the premium structure given by Agricultural Insurance Company of India Limited, New Delhi. For this, the duration in each stage of selected crop identified by Crop Production Guide(2005) jointly published by Tamil Nadu Agricultural University and Department of Agriculture, Government of Tamil Nadu and 30 years of rainfall data from Indian Meteorological Department (IMD) were used. The payout structure was derived for each stage of the selected crop in the respective district. The strike or upper threshold of the rainfall corresponds to the 30 year average accumulated rainfall of the district reference weather station while the exit or lower threshold is intended to equal the water requirement of the respective crop necessary to avoid complete crop failure. This way, the weather based crop insurance acts as a resilience mechanism for rainfall uncertainties.

1. Introduction

Weather insurance is a mechanism, which protects the cultivators against anticipated shortfall in crop yield arising out of adverse weather incidence within a specific location and period. Most of the poor households living in rural areas suffer from low average incomes due to high variability in rainfall in the crop season. Hence, developing simple cost-effective crop insurance programs would clearly help the farmers from the adverse weather conditions.

The aim of deficit rainfall distribution index insurance is to allow households, groups and governments to reduce their exposure to weather risk by purchasing a contract that pays an indemnity during periods of deficient rainfall. Rainfall index insurance is transparent, inexpensive to administer, enables quick payouts and minimizes moral hazard and adverse selection problems associated with other risk-coping mechanisms and insurance programs (World Bank 2005; Gine *et al.*, 2007).

The purpose of this paper is to estimate a distribution for payouts structure on rainfall insurance polices offered to farmers in the vulnerable agro climatic zones of Tamil Nadu. This weather based crop insurance keeps the farmers to cope with the risk in rainfall pattern. Thus, this crop insurance scheme acts as a resilience mechanism for rainfall uncertainties and fluctuations and to protect the farmers from financial loss on account of anticipated crop loss resulting from incidence of adverse conditions rainfall.

2. Data Sources

The database for the current study is taken from secondary sources. The necessary secondary data were collected from the various published and unpublished records, viz., crop production guide (2005) to identify the duration in each stage of the respective crop. For rainfall variables, Indian Meteorological Department (IMD) data set is used.

3. Methodology

Rainfall based insurance is useful to protect the farmers from crop failure in most vulnerable agro climatic zones of Tamil Nadu. Palanisam *et al.* (2008) developing the composite vulnerability index relating to climate change for the different agro climatic zones of Tamil Nadu. They have concluded that Southern zone and Western zone are most vulnerable to climate change. Accordingly, the Deficit Rainfall Distribution Index (DRDI) is derived to safeguard the farmers from the adverse effect of rainfall. The deficit rainfall insurance scheme is intended to provide insurance protection to the cultivator against declined rainfall, which is deemed to adversely affect the crop during its cultivation period. Deficit rainfall insurance payouts are linked to accumulated low rainfall.

The payout structure for the phase 1 of the crop is illustrated in Figure 1. The strike or upper threshold corresponds to the 30 year average accumulated rainfall of the respective reference weather station. While the exit or lower threshold is intended to equal the water requirement of the respective crop necessary to avoid complete crop failure.

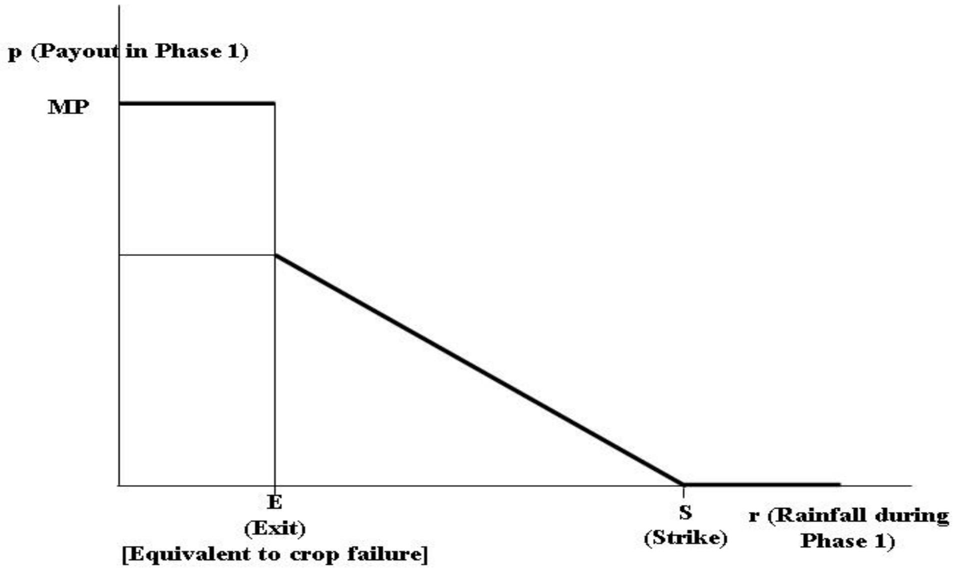


Figure1. Structure of insurance contract for the first phase of the crop

From the Figure 1, it can be observed that the rainfall insurance policy pays zero if accumulated rainfall during the phase 1 exceeds strike or upper threshold. Otherwise, the policy pays required amount for each mm of rainfall deficiency relative to the strike, until the exit or lower threshold is reached. If rainfall is below the exit value, the policy pays a fixed maximum indemnity. Mathematically, the payout for accumulated rainfall is as follows,

$$
\begin{aligned}
p(r) &= MP, && \text{if } r < E \\
p(r) &= (S-r)\, m, && \text{if } E < r < S \\
p(r) &= 0, && \text{if } r > S
\end{aligned}
$$

where, *p(r)* is the actual payout for each phase with respect to rainfall, *MP* is the maximum payout and *m* is the payout per mm of deficient rainfall. The total payout for each season is then simply the sum of payouts across all the specified phases for the respective crop. In other words, the total payout p_t is given in the following formula.

$$p_t = \sum_{i=1}^{n} \left(I\left[r_i^{**} < r_{it} < r_i^{*} \right]\left(r_i^{*} - r_{it} \right) p_i^{*} + I\left[r_{it} < r_{it}^{**} \right] p_i^{**} \right)$$

p_t = *total payout*

I = *is an indicator function equal to 1, if rainfall falls in the range specified and 0 otherwise*

r_i^{**} = *Lower strike level in each phase*

r_{it}^{*} = *Actual accumulated rainfall in phase I of year t*

r_i^{*} = *Lower strike level for each phase*

p_i^{*} = *Payout per mm of deficient accumulated rainfall*

p_i^{**} = *Maximum lump sum payout for each phase*

Premium Calculation

The policy premium is calculated based on the premium structure given by Agriculture Insurance Company of India Limited. The premium was initially calculated to be equal to the sum of the 3.5 per cent of sum insured and 12.49 per cent of government service tax to the premium. This will declare in the notified area before commencement of the season which shall be binding on all.

4. Measuring Deficit Rainfall Distribution Index

Rainfall insurance polices are designed for the most vulnerable agro climatic zones of Tamil

Nadu to protect the farmers against adverse effects of rainfall. The most vulnerable agro climatic zones due to climatic change are high rainfall zone, southern zone and western zone (Palanisami *et al*., 2008). Among this, high rainfall zone has minimum cultivated area and only rice is the major crop, so insurance polices are derived for the southern zone and western zone. These zones consist of many districts and Madurai and Coimbatore districts are selected to represent the southern zone and western zone respectively. In each district, two major crops are selected to construct the deficit rainfall insurance index.

The scheme will operate on the principle of 'Area Approach' in selected Reference Unit Areas (RUAs). These RUAs are linked to specific reference weather stations which are responsible for providing weather data for the purpose of assessment of compensation. RUAs are a geographical area around a reference weather station, pre-notified by State level insurance coordination committee, which is deemed to be reflective of the reference weather stations rainfall data. To the extent predictable, such RUAs will be restricted to 25 km radius around the reference weather station.

Risk period will be from sowing to maturity of the crop and this is depending on the duration of the crop. Sum insured is broadly equivalent to the cost of cultivation and this is pre-declared by the State level insurance coordination committee. The sum insured for an individual cultivator will be the product of the cultivators declared area under cultivation and the sum insured per hectare for that notified crop in the respective RUAs.

5. Payout Structure for Major Crops

Rainfall Insurance policies are designed for the two main crops viz., groundnut and cotton for the most vulnerable southern region and groundnut and maize for the western district and these crops occupy major cultivated area in this zone. Also, these two crops are more profitable than other crops, but they are more sensitive to drought. In addition, since the seeds are relatively expensive, some farmers purchase them using crop loans, but when harvest fails these loans are often difficult to repay. Hence, the payout structure for each crop is derived from using the historical weather data and different crop stages. Payout structure is a pre-defined benefit table, specific to a respective crop in a notified reference unit area. Payout structure defines the scale of payout for a given strike and exit.

The coverage is mainly for the Kharif season (South west monsoon season), which is the prime cropping season running from approximately June to October. The contract divides the entire season into three phases *viz.*, sowing, vegetative and flowering or maturity period, and pays out if rainfall levels fall below particular strike levels. An upper and lower threshold is specified for each in all the three phases. If accumulated rainfall exceeds the strike level, the policy pays zero for that phase. Otherwise, the policy pays a fixed amount for each mm of rainfall below the strike or upper threshold level, until the exit or lower threshold level is reached. If rainfall falls below the exit level, the policy pays a fixed, maximum payout. The payout structure for each crop is given in the following tables.

Table 1. Rainfall insurance chart for groundnut crop in Madurai district

Phase	Premium (Rs/ha)	Crop stage	Calendar period	Strike (mm)	Exit (mm)	Payout for deficient rainfall* (Rs/mm)	Maximum lump sum payout** (Rs/ha)
1	410	Sowing and germination	1st June to 30th June	35	5	133.33	4000
2		Vegetative phase	1st July to 31st July	50	10	75	3000
3		Flowering or pod formation	1st August to 15th September	70	20	70	3500

Note: * 35-5=30; 4000/30=133.33.

** Equivalent to approximate cost incurred during particular phase

The required premium, crop stages and their corresponding calendar period, strike and exit level, payout for each mm of rainfall and maximum lump sum payout for deficit rainfall insurance of groundnut and cotton crops for Madurai district are presented in the Table 1 and 2. The calculated premium is Rs 410 and Rs 375 for the groundnut and cotton crops respectively. In the case of groundnut the first phase extends up to one month. The policy pays zero if accumulated rainfall during this phase exceeds the 35 mm, otherwise Rs 133.33 for each mm of rainfall deficiency relative to the strike until the exit (5 mm) is reached. If rainfall is below 5 mm, the policy pays a fixed maximum lump sum payout of Rs 4000. In the same way, other two phases of both the crops are shown in the same tables.

Table 2. Rainfall insurance chart for cotton crop in Madurai district

Phase	Premium (Rs/ha)	Crop stage	Calendar period	Strike (mm)	Exit (mm)	Payout for deficient rainfall (Rs/mm)	Maximum lump sum payout (Rs/ha)
1	375	Germination phase	1st Sep to 15th Sep	60	10	40	2000
2		Vegetative phase	16th Sep to 15th Oct	120	30	38.89	3500
3		Flowering phase	16th Oct to 30th Nov	200	50	26.67	4000

Payout structure for deficit rainfall insurance for groundnut and maize crops in Coimbatore district are presented in the Table 3 and 4. The calculated premium is Rs 410 and Rs 240 for the groundnut and maize crops respectively. In the case of maize the first phase of germination and establishment stage extends only 15 days. During this period the maximum lump sum payout is fixed at Rs 1500, which is the cost incurred by the farmers during this phase. The policy pays zero if accumulated rainfall during this phase exceeds the 15 mm, otherwise Rs 150 for each mm of rainfall deficiency relative to the strike until the exit (5 mm) is reached. If rainfall is below the 5 mm, the policy pays a fixed maximum lump sum payout of Rs 1500. In the same way other two phases of both the crops are explained in the below tables.

In this way, the deficit rainfall index insurance will help the farmers to sustain their farm income against the weather shocks.

Table 3. Rainfall insurance chart for groundnut crop in Coimbatore district

Phase	Premium (Rs/ha)	Crop stage	Calendar period	Strike (mm)	Exit (mm)	Payout for deficient rainfall (Rs/mm)	Maximum lump sum payout (Rs/ha)
1	410	Sowing and germination	1st June to 30th June	30	5	160	4000
2		Vegetative phase	1st July to 31st July	25	5	150	3000
3		Flowering or pod formation	1st August to 15th September	50	10	87.50	3500

Table 4. Rainfall insurance chart for maize crop in Coimbatore district

Phase	Premium (Rs/ha)	Crop stage	Calendar period	Strike (mm)	Exit (mm)	Payout for deficient rainfall (Rs/mm)	Maximum lump sum payout (Rs/ha)
1	240	Germination and establishment phase	1st July to 15th July	15	5	150	1500
2		Vegetative phase	16th July to 10th August	20	5	133.33	2000
3		Flowering and cob formation	11th Aug to 5th Sep	30	10	125	2500

6. Crop Insurance, Vulnerability and Resilience

Since crop failure is often occurring due to variation in rainfall (particularly droughts). Normally, the rainfed crops are mostly affected by the drought spells. Sixty five percent of Indian agriculture is heavily dependent on natural factors, particularly rainfall. Studies have established that rainfall variations account for more than 50% of variability in crop yields (Agricultural Insurance Company of India Limited, 2005).

Government of India has already introduced the Comprehensive Crop Insurance Scheme (GCIS) in 1985 and subsequently replaced by National Agricultural Insurance Scheme (NAIS) in 1999-2000 which was based on crop cutting experiments to assess the crop yield. However due to problems in monitoring the crop yields and paying the compensation, this was not successful. Hence, the Government of India and State Governments have now following the weather based crop insurance programmes in 2007-08 which are getting popular in several regions.

This weather based crop insurance keeps the farmers to cope up with the variation in rainfall pattern. Since insurance itself is a risk mitigation strategy, the weather based crop insurance acts as a resilience mechanism for rainfall uncertainties. Since not many studies have done in assessing the premium and compensation aspects, the research study attempted to arrive the parameters so that weather based crop insurance will be solid resilience mechanism under climate variability.

7. Conclusion

Since weather based crop insurance is a resilience mechanism against rainfall uncertainties, it is important to do research on these aspects. In this connection, establishment of automatic weather station at block level at least covering about 25 km radius is needed to implement weather based insurance for protecting the farmers from adverse weather conditions. Development of knowledge based decision support system for translating weather information into operational management practices is also important. Promotion of weather based insurance among the farming community to avoid the risk related to climatic factors such as rainfall, temperature, frost etc. should be followed up regularly.

References

Crop Production Guide, 2005. Report Jointly Prepared by Department of Agriculture, Chennai 5, Government of Tamil Nadu and Tamil Nadu Agricultural University, Coimbatore - 3.

Gine, X., R.Townsend, and J.Vickery, 2007a. “Patterns of Rainfall Insurance Participation in Rural India”, Working Paper, World Bank.

Gine, X., R.Townsend, and J.Vickery, 2007b. “Statistical Analysis of Rainfall Insurance Payouts in Southern India”, Policy Research Working Paper, The World bank Development Research Group.

Palanisami.K, C.Ranganathan, S.Senthilnathan and Chieko Umetsu, 2008. “Developing the Composite Vulnerability Index relating to Climate Change for the Different Agro Climatic Zones of Tamil Nadu”, Inter-University Research Institute Corporation, National Institutes for the Humanities, Research Institute for Humanity and Nature, Japan, Pp 127-137. ISBN: 978-4-902325-28-7.

Skees, Jerry, Varangis, Panos, Larson, Donald, Siegel and Paul, 2002. “Can Financial Markets be Tapped to Help Poor People Cope with Weather Risks?”, World Bank Policy Research Working Paper Series.

World Bank, 2005. “Managing Agricultural Production Risk: Innovations in Developing Countries”, World Bank Agriculture and Rural Development Department, World Bank Press.

WWW.aicofindia.org. 2005, Agricultural Insurance Company of India Limited

Resilience Project 5th Workshop

Date： 28th（Sat）/June/2008 9:30-18:00 29th (Sun) /June/2008 10:00-15:40

Place： Research Institute for Humanity and Nature (RIHN) Lecture Hall
457-4 Motoyama, Kamigamo, Kita-ku, Kyoto, 603-8047 JAPAN
Tel. +81-75-707-2206 Fax.+81-75-707-2106

28th（Sat）/ June

9:30-10:00 Registration（travel document etc.）

10:00-10:20 Opening and the resilience project overview
Vulnerability and Resilience of Social-Ecological Systems
Chieko UMETSU (RIHN)

10:20-11:50 Session1（Chair Hitoshi SHINJO）

10:20-10:40 Coping and Adaptation Processes under Economic Liberalization and Agro-ecologic Changes by Smallholders in Central Kenya
Matheaus Kioko KAUTI （Graduate School of Environmental Studies, Tohoku Univ.）

10:40-11:00 Framework for an Agent-Based Model of Agricultural and Land Use Decision-Making.
Tom EVANS （Department of Geography, Indiana Univ.）

11:00-11:10 Break

11:10-11:30 The Challenge of Resilience and Adaptation to Erratic Rainfall in Rural Zambia
Chileshe L. MULENGA
（Institute of Economic and Social Research, University of Zambia）

11:30-11:50 Field Report of Intensive Survey: Progress and Challenges
Thamana LEKPRICHAKUL （RIHN）

11:50-12:00 Group Photo

12:00-13:00 Lunch

13:00-14:20 Session2（Chair Shuhei SHIMADA）

13:00-13:20 Flexibility of Mixed Subsistence among the Lozi on the Upper Zambezi Valley Floodplain
Masahiro OKAMOTO
（Graduate School of Asian and African Area Studies, Kyoto Univ.）

13:20-13:40 Livelihood Diversification for Mitigating Vulnerability:
Focusing on the Role of Labour Migration in Rural Zambia.
Chihiro ITO （Graduate School of Asian and African Area Studies, Kyoto Univ.）

13:40-14:00 Vulnerability and Livelihood Strategies of Smallholder Households in Southern Zambia:
From the View Point of Off-farm Activities among the Plateau Tonga
Noriko NARISAWA
（Graduate School of Asian and African Area Studies, Kyoto Univ.）

14:00-14:20 The Livelihood of Escarpment Tonga
Tetsuya NAKAMURA
（Graduate School of Asian and African Area Studies, Kyoto Univ.）

14:20-15:20 Session3（Chair Mitsunori YOSHIMURA）

14:20-14:40 Preliminary Analysis of Precipitation Variability over Zambia
Tazu SAEKI (RIHN)

14:40-15:00 Seasonal and regional variations in maize productivity in Zambia
Hiroyuki SHIMONO （Faculty of Agriculture, Iwate Univ.）

15:00-15:20 Integration of Maize Growth under the Different Agroecosystem and the Land Use Strategy for the Natural Environment Factors
-toward the Multi-Spatial and Temporal Understanding of Livelihood-
Hidetoshi MIYAZAKI （RIHN）
Megumi YAMASHITA （Survey College of Kinki）
Hitoshi SHINJO （Graduate School of Agriculture, Kyoto Univ.）
Ueru Tanaka （Graduate School of Global Environmental studies, Kyoto Univ.）
Mitsunori YOSHIMURA（Remote Sensing Technology Center of Japan）

15:20-15:30 Break

15:30-17:30 The Progress Report and Research Plan of each Theme （Chair Chieko UMETSU）

Theme I Ecological Resilience and Human Activities under Variable Environment
Hitoshi SHINJO （Graduate School of Agriculture, Kyoto Univ.）

Theme II Household and Community Responses to Variable Environment
Takeshi SAKURAI
（Faculty of Economics and Business Management, Wako Univ.）

Theme III Political-Ecology of Vulnerability and Resilience: Historical and Institutional Perspective
Shuhei SHIMADA
（Graduate School of Asian and African Area Studies, Kyoto Univ.）

Theme IV Integrated Analysis of Social-Ecological Systems
Mitsunori YOSHIMURA
（Remote Sensing Technology Center of Japan）

India Research Progress and Plan of India Group

Takashi KUME （RIHN）

Discussion

17:30-18:00 Sub-group meeting by theme members

29th（Sun）/ June

10:00 -12:00 Discussion and brainstorming

1. Project overall plan for publication
2. Inter-researcher, inter-theme collaboration
   Dev info lecture
3. What can we present at the mid-term evaluation?

12:00-13:00 Lunch

13:00-15:00 Discussion

15:00-15:10 Break

15:10-15:40 Administrative information （UMETSU）

･Travel (domestic/overseas)

･Reimbursement

･Advance payment

･Juls guesthouse & rental car

15:40 Closing

Resilience Project 6th Workshop

Date： 5th（Fri）/December/2008 12:30-15:30 6th (Sat) / December/2008 10:00-15:40

Place： Research Institute for Humanity and Nature (RIHN) Seminar Room 3 & 4
457-4 Motoyama, Kamigamo, Kita-ku, Kyoto, 603-8047 JAPAN
Tel. +81-75-707-2242 Fax.+81-75-707-2506

5th（Fri）/December

12:30-13:00 Registration（travel document etc.）

Coordinator Takashi KUME

13:00-13:20 Opening and the resilience project overview
Vulnerability and Resilience of Social-Ecological Systems
Chieko UMETSU (RIHN)

13:20-14:20 Session1（Chair Chieko UMETSU）

13:20-13:40 Human network in Southern Province, Zambia
Yudai ISHIMOTO (RIHN)

13:40-14:00 Linking Social vulnerability study to environmental change
Shuhei SHIMADA（Graduate School of Asian and African Area Studies, Kyoto Univ.）

14:00-14:20 Deterioration and Introduction of new farming in C village of Central Province, Zambia
Kazuo HANZAWA (College of Bioresoure Science, Nihon University)

14:20-14:30 Break

14:30-15:30 Session2（Chair Mitsunori YOSHIMURA）

14:30-14:50 Disaster management system and food aid in Zambia
Keiichiro Matsumura (Graduate School of Human and Environmental Studies, Kyoto Univ.)

14:50-15:10 Multi-spatial and temporal data accumulation for understanding the livelihood in village level
Megumi YAMASHITA（Survey College of Kinki）, Hidetoshi MIYAZAKI (RIHN)

15:10-15:30 Meteorological data analysis for the rainy season of 2007
Hiromitsu Kanno (National Agricultural Research Center for Tohoku Region)

16:00-17:15 The 25th Resilience Seminar (E-04) Lecture Hall
Combating drought in South Africa, and southern Africa
Mitsuru TSUBO (Arid Land Research Center, Tottori University)
(Place: RIHN Lecture Hall)

6th (Sat) / December

10:00-11:00 Session3 （Chair Hitoshi SHINJO）

10:00-10:20 An attempt of visualization of the resilience by dynamics and structure stability
Takashi KUME (RIHN)

10:20-10:40 Some observations on the vegetation of the experimental site in Petauke District
Reiichi MIURA and Takenaka Shotaro（Graduate School of Agriculture, Kyoto Univ.）, Elias TEMBO（ZARI）

10:40-11:00 Ex Ante and Ex Post Shock Coping Strategies: Evidences From Southern and Western Province
Thamana LEKPRICHAKUL (RIHN)

11:00-11:10 Break

11:10-12:10 Session4 （Chair Shuhei SHIMADA）

11:10-11:30 Prevalence of undernutrition and overnutrition in Zambia: A re-examination
Thamana LEKPRICHAKUL (RIHN)

11:30-11:50 Changes in small-scale irrigation in a village in Central Province of Zambia
Shiro KODAMAYA (Graduate School of Social Science, Hitotsubashi Univ.)

11:50-12:10 Asset Holding and Resilience of Rural Households in Southern Province, Zambia
Takeshi SAKURAI （Faculty of Economics and Business Management, Wako Univ.）

12:10-13:10 Lunch

13:10-14:40 Overview and Perspective of each Theme (Chair Chieko UMETSU)

Theme I Ecological Resilience and Human Activities under Variable Environment
Hitoshi SHINJO （Graduate School of Agriculture, Kyoto Univ.）

Theme II Household and Community Responses to Variable Environment
Takeshi SAKURAI
（Faculty of Economics and Business Management, Wako Univ.）

Theme III Political-Ecology of Vulnerability and Resilience: Historical and Institutional Perspective
Shuhei SHIMADA
（Graduate School of Asian and African Area Studies, Kyoto Univ.）

Theme IV Integrated Analysis of Social-Ecological Systems
Mitsunori YOSHIMURA
（Remote Sensing Technology Center of Japan）

14:40-15:40 Discussion

15:40 Closing of Workshop

Abstract of Resilience Seminar in FY2008

The 22nd Resilience Seminar

Date and time: 15:00-16:15, April 11th, 2008

Place: RIHN Lecture Hall

Title: Socio-ecological Resilience in an Arena of Rapid Environmental Change: Climate Variability and Adaptation in the Upper Zambezi Valley Floodplain

Speaker: Dr. Lawrence Flint (RIHN Visiting Fellow and ENDA)

Language: English

[Abstract]

People have made unprecedented demands on ecosystems in recent decades to meet growing demands for food, water, fibre and energy. These demands have placed pressure on ecosystem balances, depleted the ability of the natural environment to replace biocapacity consumed and weakened the capacity to deliver ecosystem services such as purification of air and water, waste disposal and aesthetically pleasing environments. There is an apparent tension between the aspirations of social and economic development and environmental sustainability.

Direct drivers of change that engender a reduction in ecosystem goods and services include habitat change, invasive species, over exploitation, pollution and, climate variability and change. These processes threaten to diminish socio-ecological resilience and heighten sensitivity to both environmental and socio-economic change.

This paper seeks to discuss the scientific ways in which socio-ecological vulnerability and resilience can be examined, in particular the inter disciplinarity of approach necessary to address these wide ranging issues.

It will also analyse the nature of socio-ecological resilience and adaptation to vulnerability. This is contextualised in a discussion covering the historical and contemporary production of politico-economic and socio-cultural networks and dynamics affecting resilience.

The study considers floodplain ecosystems, the sites of human settlement, economic activities and the appearance of 'hydraulic civilisations'. An example discussed here is the Bulozi 'natural' floodplain of the Upper Zambezi Valley in western Zambia, currently exhibiting biophysical and socio-economic change.

This floodplain was populated by the ancestors of the present Lozi peoples who, using the ecological goods and services offered by the plain, produced a strong and vibrant politico-economy that became dominant in the region, using surplus food with which to specialise, raise an army and take advantage of economic opportunities.

Today Bulozi is an arena of relative underdevelopment and this condition may become exacerbated by increasing climate dynamics, but these act only as additional stressors to

socially created vulnerabilities that became entrenched over time. The paper discusses the production of vulnerability in Bulozi and the adaptive capacity required to increase resilience.

The paper concludes that people's capacity to adapt to exogenous and endogenous pressures and maintain the cohesion of the socio-ecological system (SES) depends much on their ability to deal with stressors from a position of autochthonous (indigenous) 'ownership'. It depends also on their ability to adapt current practices and diversify productive activities so that society can regain a sense of momentum, control and motivation to enhance living standards whilst conserving the integrity of the SES.

The 23rd Resilience Seminar

Date and time: 15:00-16:15, June 18th, 2008

Place: RIHN Lecture Hall

Title: Resilience of Rural Households and Communities to HIV/AIDS and Recurrent Droughts: Case of People around Mwami Adventist Hospital, Chipata, Zambia

Lecture: Chileshe L. Mulenga (Institute of Economic and Social Research, University of Zambia)

Language: English

Key Words: Rural, Households, Communities, HIV/AIDS, Recurrent Drought, Poverty, Elderly, Young People and Socialization

[Abstract]

Rural communities respond to socio-economic and ecological shocks primarily at the household and community levels. The household and community level responses aim at ensuring integrity of households and preservation of communities as social and cultural entities. High prevalence of HIV/AIDS in Zambia, however, poses serious challenges to the survival of households and communities. The situation has been worsened by recurrent droughts, which have caused crop failure, food shortages and losses of assets. Households and communities confronted by HIV/AIDS and recurrent droughts have therefore become poorer and more vulnerable.

Deep socio-cultural changes are required for households and communities around Mwami Adventist Hospital to endure the HIV/AIDS scourge and recurrent droughts. Appropriate socialization of young people and a shift to agricultural livelihood systems capable of withstanding recurrent droughts are essential to resilience of rural households and communities.

Socialization of orphans is, however, problematic, as most orphans are looked after by elderly female guardians, who equally need support. The female guardians moreover cannot provide adequate socialization to young men, due to the division of labour between women and men. Elderly guardians cannot also effectively provide knowledge of "essential" edible wild leaves, fruits, tubers, insects and small animals that are part of the rural livelihoods, as

they may not walk long distances. Changing agricultural livelihood systems is equally difficult, due to lack of knowledge and experience of alternative agricultural livelihood systems. Entrenched poverty also precludes unsubsidized technological solutions on account of cost.

Socialization of young people that prevents HIV infections and livelihood systems capable of withstanding recurrent droughts are critical to resilience of rural households and communities.

The 24th Resilience Seminar

Date and time: 15:00-17:00, July 17th, 2008

Place: RIHN Lecture hall

Title: Modeling Household-Level Deforestation and Reforestation with Agent-Based Approaches: Case Studies from Laos PDR, United States and Zambia

Speaker: Tom Evans (Department of Geography, Indiana University (RIHN invited researcher))

[Abstract]

Social-ecological systems are inherently complex and composed of dynamics at multiple spatial scales that govern their behavior. An important part of these systems is how humans interact with each other, how these interactions change their behaviors and how their actions affect the biophysical environment. Agent-based models are one tool that can be used to examine these types of system dynamics. This seminar will discuss past research employing agent-based models (ABMs) to study household level behavior in social-ecological systems with an emphasis on land cover change, especially deforestation and reforestation. These ABMs are used to examine how households make land-use decisions and how these decisions lead to macro-level outcomes at a regional scale of analysis. Agent-based approaches are useful for this type of research because they are designed to identify the interactions between actors and the heterogeneity of actors.

To demonstrate this research, examples will be discussed from the following set of studies: 1) the process of reforestation in the Midwest United States, 2) the transition from slash and burn agriculture to rubber plantations in Laos PDR, 2) and a prototype of a model to study adaptation to climate change in Zambia. The seminar will also discuss different methods of linking actors to the physical environment using geographic information systems (GIS), and the scale- dependence of social-ecological systems. The overall objective of this presentation is to discuss the advantages and disadvantages of these types of local-level approaches, and new emerging directions of household-based research on the human-dimensions of global change.

The 25th Resilience Seminar

Date and time: 16:00-17:15, December 5th, 2008

Place: RIHN Lecture Hall

Title: Combating Drought in South Africa, and Southern Africa

Speaker: Mitsuru Tsubo(Associate Professor, Arid Land Research Center, Tottori University)

[Abstract]

In Africa drought is the most devastating natural event, and severe drought causes people to be starved to death. The Sahel drought disaster in 1974-1975 resulted in a total of 325,000 casualties. In 1984 the worst drought event occurred in Ethiopia and Sudan; approximately 450,000 people were died. In 1992 southern African countries dealt with the most severe drought disaster of the century in the region. Zimbabwean faced food shortage due to insufficient rainfall during the crop season. This crisis was escalated by the misconduct of the government; their policy failed and they were blamed for the damage. The lesson learned from the crisis is that pre- and post-disaster management for drought is critical for prevention and mitigation of the disaster. South Africa is one of the countries which are at the cutting edge of drought management, as the National Disaster Management Centre has been formed to promote an integrated, coordinated system of disaster management by national, provincial and municipal governments. Their drought management has been strengthened in connection with the Weather Service which releases seasonal rainfall outlooks, but an operational system to alleviate drought disasters is not yet formulated. A drought early warning system thus needs to be developed for the country and then the Southern African Development Community (SADC) region.

The 26th Resilience Seminar

Date and time: 15:00-16:30, February 10th, 2009

Place: RIHN Lecture Hall

Co-organized with Ecosopy Program

Title: Human Security in Africa: Between Normalcy and Emergency

Speaker: Yoichi Mine (Associate Professor)

Osaka Univ. Global Collaboration Center (GLOCOL)

[Abstract]

The concept of human security was first propounded in UNDP’s HumanDevelopment Report 1994 and further expanded in the Final Report of theCommission on Human Security published in 2003. Placing nationalsecurity in a relative perspective, human security tries to empowerpeople and communities from below, and assigns the special role of protecting vulnerable people to multi-lateral organizations. Human insecurities are caused by the manifestation of risks, sudden serious downturns, including the outbreak of violent conflicts,

economic crises and natural disasters, as well as the spread of infectious diseases. Many African societies have historically been prepared for such calamities as famine disasters, but the situations are becoming increasingly complex. A noticeable trend is that the structural, long-term poverty and the conjuctural, acute poverty are converging in the continent. The main part of the talk will not be about empirical case study but rather directed to a policy framework for international cooperation, African history, and a reevaluation of Amartya Sen's entitlement theory in the light of human security approach in the African context.

FY2008 E-04 (FR2) Project Research Activity Overview

2008	4	5	6	7	8	9	10	11	12	1	2	3
Resilience Seminar	15:00-16:15	13:30-15:00	15:00-16:15	15:30-16:45					16:00-17:15		15:00-16:30	
	11-Apr	12-May	18-Jun	17-Jul					5-Dec		10-Feb	
	(22nd Seminar)	Agent-based model	(23rd Seminar)	(24th Seminar)					(第25回)		(第26回)	
Core-mamber Meeting		＊5/17	＊6/29		＊8/26			＊11/7	＊12/5		＊2/10	
Workshop			28-29 June WS						4-5 Dec WS		20-21 Feb WS	
			9:00-17:00						9:00-18:00			
Study Meeting	＊4th 4/12	＊5th 5/23	＊6th 6/14	＊7th 7/12								
FR2 Project Report								FR2 Project Report due		Printing	HP upload	
	FY2009				Special Budge		Budget report		Budget report	FY2008 Budget		
	Budget (4/7)				18-Aug		7-Oct		19-Dec			
FR Related Meetings												
	(IS application 8 April)					Special budget	HydroChange2008		RIHN Project			(FS Hearing)
	IS Hearing 18 April					hearing 9/11	10/1-10/3		Meeting			3-Mar
							Kyoto Garden Palace		10-12 December			
RIHN Events			First Farmers Symposium	RIHN Forum					Coop In Kyoto		PEC	
			23-Jun	7-Jul			RIHN Int'l Symposium				2/19-20	
			Shiran Kaikan	KICC			22-23 October					
Field Trip Schedule							RIHN					
Shinjo	4/22 - 5/17							11/9-12/1	12/7 - 12/25			
Tanaka									(12/3-12/17)			
Miyazaki	8/31- 4/24	(8 months)			8/18 - 9/18			10/25 - 12/18				3/16 - 4/27
Noro(M1)	4/22 - 5/17						10/4 - 10/25					
Miura	4/22 - 5/17											
Shibata												
Takenaka (M1)	4/22 - 5/17											
Ando (M1)	4/22 - 5/17						10/4 - 10/25	11/9 - 12/25				3/1 - 3/17
Miyashita (M1)								10/25 - 12/18				
Sakurai					8/25 - 9/6							
Kanno					8/25 - 9/6							
Shimono					8/25 - 9/6							
Yamauchi										1/13 - 1/18		
Shimada												
Hanzawa					8/25 - 9/8							
Kodamaya					(8/25 - 9/8)							
Araki												
Okamoto								11/8 - 12/10				3/5 - 4/5
Ishimoto			6/19 - 10/30 (4.5 months)								2/17-3/7	
Narisawa (D2)												
Itoh (D1)					(August 6-March 2009)							
Nakamura (D1)								10/13 - 12/5				
Kyo (M2)	2/18 - 8/2 (5.5ヶ月滞在)											
Yoshimura				7/2 - 7/11	(Beijin)						(Beijin)	3/17 - 3/22
Saeki												
Yamashita											(Beijin)	3/19 - 3/22
Matsumura					8/26 - 9/27							
Umestu					8/31 - 9/6	(India)			12/13-12/25		(Copenhagen)	3/9-3/14
Lekprichakul		5/5 - 5/24								1/12 - 1/30		
Kume					8/31 - 9/6	(India)			12/13-12/25	1/21 - 2/1	(India)	
Kakungu						9/13 - 9/22	RIHN					
Palanisami												
Ranganathan							9/27 - 10/6	RIHN				
Flint (Visiting Fellow)	2/4 - 5/3	RIHN										(FS Hearing)
Evans (Visiting Fellow)	4/25 - 7/31	RIHN							(12/13-12/25)			
Mulenga (Visiting Fellow)		4/30 - 7/31	RIHN									

はじめに

地球研平成 20 年度フルリサーチ (FR) 研究「社会・生態システムの脆弱性とレジリアンス」は本プロジェクトとしての 2 年目を無事終了した。本プロジェクトは地球研の５つの領域プログラムの中で「地球地域学プログラム」に所属する。

平成２０年は世界的金融危機と政治変遷の年であった。株価は 100 年に 1 度の規模で暴落した。原油価格は年明け 1 バレル 100 ドルから、６月には 139 ドルまで高騰し、12 月には 43 ドルまで急落した。9 月にはレヴィー・ムワナワサがパリで逝去し、それに引き続く大統領選挙ではルピアー・バンダが新大統領となった。新政権への移行は比較的平和に行われた。アメリカでは歴史上初めて、アフリカ系アメリカ人が大統領として就任することとなった。

平成２０年度はプロジェクト研究員の長期滞在による調査を実施した。東部州ペタウケ郡では、異なる休閑システムが作物収量と土壌に与える影響を調べる実験は継続中である。南部州シナゾングェ郡では、2007/2008 年の農作期に平年の２倍を超える雨量を記録した。農家圃場の雨量を測定するために 2007 年９月に設置した雨量計と気象ステーションはこの異常な減少を着実に記録した。この年の年降水量はシナゾングェ郡の一部の地域で 1600 mm を記録した。農民達は、作付けを変更するなど、この状況をさまざまな対処行動によって克服していた。集中的な世帯調査は、続行中である。衛星データや航空写真を使った土地利用と植生被覆の歴史的変遷の状況把握と広域世帯調査のデータ分析も進行中である。今年はじめに研究成果公開の一環としてレジリアンス・ワーキングペーパーのホームページでの公開を開始した。プロジェクトメンバーや招へい外国人研究員からの寄稿を得ている。日本語・英語のワーキングペーパーも大学院生らによって出版された。

本プロジェクトは今年度 FR2 の段階を終えた。プロジェクトメンバーの方々にはプロジェクトの順調な発展のためにご尽力をいただき感謝したい。また地球研のプロジェクト評価委員会 (PEC)、所長、プログラム主幹、管理部のスタッフの方々をはじめ、研究部スタッフの方々にこの様な統合プロジェクトを実施するためにご支援いただいたことに感謝申しあげる。

平成 21 年 2 月

総合地球環境学研究所
E-04(FR2) プロジェクト・リーダー
梅津　千恵子

E-04 (FR2)　社会・生態システムの脆弱性とレジリアンス

プロジェクトリーダー：　梅津　千恵子
領域プログラム：「地球地域学」プログラム

１．研究プロジェクトの全体像

（１）目的と背景

背景：貧困と環境破壊は密接に関係しており，貧困が環境破壊を生み，環境破壊が貧困を生むという悪循環を生み出している。この悪循環は森林破壊や砂漠化などの「地球環境問題」の主原因の一つであると考えられている。世界の貧困人口の大部分は集中するサブサハラ・アフリカや南アジアの半乾燥熱帯に集中し、伝統的なコミュニティ（社会）や環境資源（生態）に強く依存して生業を営んでいる。これらの地域では、天水農業に依存する人々の生活は環境変動に対して脆弱であり、植生や土壌などの環境資源は人間活動に対して脆弱である。ゆえに，さまざまな環境変動に対する社会・生態システムのレジリアンスの弱体化は深刻な問題となり、その保全と強化は重要な課題となっている。よって，この「地球環境問題」の解決のためには，人間社会および生態系が環境変動の影響（ショック）から速やかに回復すること（レジリアンス）が鍵となる。

目的：本プロジェクトでは，途上国地域の農村において，環境変動に対する社会・生態システムのレジリアンスを高める方策を考えることを主目的とする。そのため，まず，環境変動に対する人間活動を社会・生態システムの脆弱性とレジリアンスという観点からとらえ，社会・生態システムのレジリアンスの解明、それを捉えるための要素は何か、を探ることを実施する。次に，環境変動が社会・生態システムに及ぼす影響とそのショックから回復するメカニズムを明らかにする。これらと平行して，具体的な事例から社会・生態レジリアンスの要因を特定するために，家計やコミュニティ，そして社会制度が果たしている役割を分析する。これらレジリアンスを規定する要因の特定とショックからの回復メカニズムの解明を通じて，社会・生態レジリアンスの本質を明らかにする。そして，レジリアンスを高めるための方策を議論し，途上国地域において人間の安全保障を醸成するための示唆を与える。

（２）地球環境問題の解決にどう資する研究なのか？

　環境変動の被害は社会経済的に脆弱なグループがまず被害を受ける。本プロジェクトでは，社会・経済システムの脆弱性を「地球環境問題」として捉え，脆弱性を規定する要因を解明し，途上国農村で地域社会のレジリアンスを高める方策を提案することが「地球環境問題」の解決につながると考える。現地での実験、測定，インタビュー、観察，分析を通してレジリアンスの鍵となる要素を検討し，その要素を用いて地域の生態系と資源管理へのオプションを提示する。

（３）領域プログラムにおける位置付け

本プロジェクトは「地球地域学」プログラムの構成員として、概念、方法、地域を主体にした学際的研究による統合研究の開発・実施へ貢献している。概念はレジリアンス、方法はレジリアンスへの総合的アプローチ、地域は南部アフリカ・ザンビアの旱魃常襲農村地域である。レジリアンス研究は「地球地域学」プログラムが掲げる「地域の知」のみならず、地球研がキーワードとして掲げる「人間と自然の相互作用環」、「未来可能性」の実現に具体的な事例で貢献するものである。

２．全研究プロセスにおける本年度の課題と成果

（１）本年度の研究課題

平成 19 年度は、気象観測装置の準備・設置、試験圃場の整備、広域世帯調査を実施しながら、南部州・東部州の主要調査地にて 11 月の雨期の始まりと供にレジリアンスの規定要因に関する本格的な調査・観測を開始した。平成 20 年度は調査・観測の継続、１年目 2007/2008 年農作期の観測データの収集・整理・分析を行う。

—ザンビア東部・南部州でそれぞれ実施している圃場試験において、メイズ収量の規定要因を明らかにする。ザンビア南部州の対象村において、土地利用図を作成し、環境条件と作目の対応関係を明らかにする。

—プロジェクトの共通調査地域であるザンビア南部州の 3 地点で昨年度の雨期（2007 年 11 月）より開始した農家家計調査を継続し，雨期に続く乾期の終わりまで（2008 年 10 月）の 1 年間をカバーするデータセット（2007 年データセット）を完成させる。このデータセットには，調査対象となった 48 戸の農家の農業生産，非農業活動，消費だけでなく，各農家の構成員の身体計測，各農家の圃場における降水量を含む。調査は途切れることなく，引き続き 2008 年度雨期にも継続し，2008 年データセットの作成を目指す。

—グローバルな政治・社会変動の中で旱魃や多雨といった自然環境の影響を受けやすい南部ザンビアのトンガ社会における脆弱性増大の問題を、個人、世帯レベルでミクロに追究する。特に今年度は、個人、世帯が①地域資源利用に関係した生業レベルでどの様な脆弱性緩和の手段をとっているのか、②それがうまく働かない場合の広域の資源利用方法としてどの様な経済活動を行っているのか、③その両者の関係性、について焦点を合わせて研究を進める。

—衛星データ・気象データに加え、航空写真などの詳細な研究基盤情報の蓄積を進め、異なる空間スケールにおける土地利用の現況や変化を把握する。さらに、共通調査地域である南部州において、カリバ湖の水をめぐる自然的要因と対象村の人々の暮らしや結びつきなどの社会的要因を資源アクセスとの関係から地域の脆弱性に対する社会・生態的な対処として明らかにするデータ統合に関する研究を進める。

（２）本年度に挙げ得た成果

平成 20 年度は順調に１年目の 2007/2008 年農作期の調査・観測を終え、２年目の 2008/2009 年農作期を迎えたところである。プロジェクトメンバーの長期滞在による、食料援助の分配システムや世帯の社会的ネットワーク等の社会的レジアンスに重要と思われる項目の新たなフィールド調査を開始した。

—ザンビア東部州の試験では、開墾・火入れに伴う土壌養分の放出によるメイズの増収が確認されたが、その増収した面積の割合は開墾面積全体の１割程度であった。南部州では、平年を大幅に上回る降水量のため、斜面下部の圃場では、洪水による減収が認められた。当初、周辺から水分が涵養される斜面下部のほうが高収量を与えると予想していたのとは正反対の結果となった。作成した土地利用図からは、洪水被害を受けた圃場の位置を特定でき、洪水時の農民の作付体系の変更等のレジリアンス対処行動を観察することができた。

—2007 年データセットの分析を行った。テーマ 2 では，2007 年から 2009 年の 3 年間にわたるデータ（2007 年 11 月から 2010 年 10 月まで）の分析に基づき最終成果を産出することを目標としており，本年度の分析は予備的な分析の位置づけである。3 つのサイトの 2007/2008 雨季降水量の平均値は，湖岸低地の 1600mm から斜面上部の 1426mm まで幅があり、斜面上部で最も少なかった。各農家の圃場に設置した降水量計の計測結果から，同じ村落内といった狭い範囲でも年間降水量の空間変動幅には 140mm（湖岸低地），190mm（斜面上），176mm（斜面上部）と大きな違いがあることが判明した。テーマ 2 の最終目標は，このような降水量の空間的変動が農家家計のレジリアンスに及ぼす影響を明らかにすることである。

—現地調査の結果をまとめプロジェクトからワーキング・ペーパーとして公表した。（中村哲也「丘陵地におけるトンガの生業活動—ザンビア南部一農村の事例から—」、Ito, Chihiro, “Re-thinking Labour Migration in Relation with Livelihood Diversity in African Rural Area: A Case Study in Southern Province, Zambia.”）島田周平「アフリカ農村社会の脆弱性分析序説」を『日本地理学会 E-Journal』に投稿し受理された。

—共通調査地域である南部州において、衛星データ・気象データに加え、航空写真などを集中的に収集し、対象村の土地利用現況や変化と土地所有の関係が把握できた。カリバ湖の水位の変動は、周辺村の生業に大きな影響を与えていることが推測された。さらに、食糧援助の村レベルにおける分配の実態も明らかになった。こういった状況を自然/社会的変化としてとらえ、資源へのアクセスとの実態を解明する体制を整えることができた。広域世帯調査 1000 件のデータから、特に南部州で食事回数の減少等旱魃への対処行動の概要が明らかになった。

—レジリアンスセミナーを 5 回、ワークショップを 3 回開催。レジリアンス・ワーキングペーパー、004, 005, 006 を刊行した。またレジリアンス・アライアンスのワークブックを日本語に翻訳した。成果は近日中にプロジェクト HP へ掲載予定である。

http://www.chikyu.ac.jp/resilience/publication-W_e.html

３．本年度の研究体制

（１）　研究体制

４つのテーマについて研究を実施し，世帯，地域レベルから歴史的，空間的分析などを相互にリンクさせる。特に自然科学分野の研究者との学際的研究により，科学的情報を社会科学の研究に応用できる研究者の参加を得ている。今年度新規にプロジェクトへ参画した研究分野は作物学（作物モデル)、自然地理学（エージェントベースモデル)、生態人類学（ネットワーク）である。また地球研の他のプロジェクトとの連携として，同様の研究目的を持つプロジェクトと合同でエージェントベースモデルの研究会を開催した。特に今年度は統合に重点を置き、その方法等を検討した。予算は燃料費高騰により海外旅費が増加したため長期滞在を重点とし、観測体制の強化を行った。

４．本年度の研究成果についての自己診断

（１）　水準以上の成果を挙げげたと評価出来る点

—2007/2008 年の雨期は、南部州では洪水が発生したが、それに対する住民の適応行動をメイズからサツマイモやマメへの転換等、土地利用の面から明らかにすることができた。

—調査地の降水量については，空間的変動が大きいと事前に予測はしていたが，今回の計測により初めて具体的な証拠が得られた。この成果を挙げることができた理由は，降水量の自動計測装置の設置・維持に村人の協力が得られたことと，装置の信頼性が高かったことである。

—長期の現地調査の成果を取りまとめ公表することができ、多生業の脆弱性緩和機能の実態が明らかにされた。しかし森林資源利用の調査結果から、多生業の一角である森林資源利用が森林破壊につながる危険性もあり、社会的レジリアンスと生態的レジリアンスのトレード・オフ的関係も明らかにされた。

（２) 水準に達しなかったと評価すべき点

—多生業がもつ脆弱性緩和機能についての実態調査を計画していたが、長期滞在する研究者が得られず、この分野の新しい成果が得られなかった。またムワナワサ大統領の急死による政治状況に直面し、8-10 月の間の村落調査の一部が当初の予定のようには実行できな

５．来年度以降への課題

—レジリアンス理論の具体的な応用可能性をフィールドの現場から考えることが重要である。

—世帯調査・身体計測のデータの質を向上させながら、データ整備を行うことが重要となっている。データの整備と同時にレジリアンスの要因の定性的・定量的解明を重点的に実施する予定である。

—来年度は気象観測、圃場実験、世帯調査を継続し、データを蓄積・整理・分析する予定である。
—特に１年目の 2007/2008 は異常年であったため、平均年の観測との比較が重要である。来年度は 2008/2009 年農作期のデータを分析し、2007/2008 洪水年の農作期との比較を行いたい。
—地球地域学プログラムの課題のひとつに「調査地域住民への対応」があるが、調査世帯へのプロジェクトからの情報のフィードバック（雨量、身体計測）を可能な限り継続的に実施する。
—フィールドへ長期滞在するメンバー・研究員に対する住環境改善および支援体制の強化を行いたい。

６．年次進行表

	H17 FS	H18 PR	H19FR1	H20FR2	H21FR3	H22FR4	H23FR5
分析手法の確立	xxx	xx	xx	x			
ザンビア							
I. 生態レジリアンス	x	xx	xxx	xxx	xxx	xx	x
II. 環境変動と農家世帯	x	xxx	xxx	xxx	xxx	xx	x
III. 脆弱性と制度･歴史	xx	xx	xxx	xxx	xxx	xxx	x
IV. 広域と統合解析	x	xx	xxx	xxx	xxx	xxx	xxx
インド		x	x	x	x		
ブルキナファソ			x	x	x	x	
国際ワークショップ			x		x		x
報 告 書	FS 報告	PR 報告	年度報告	中間報告	年度報告	年度報告	最終報告

Figure 1. Resilience of Social-Ecological System and Four Themes

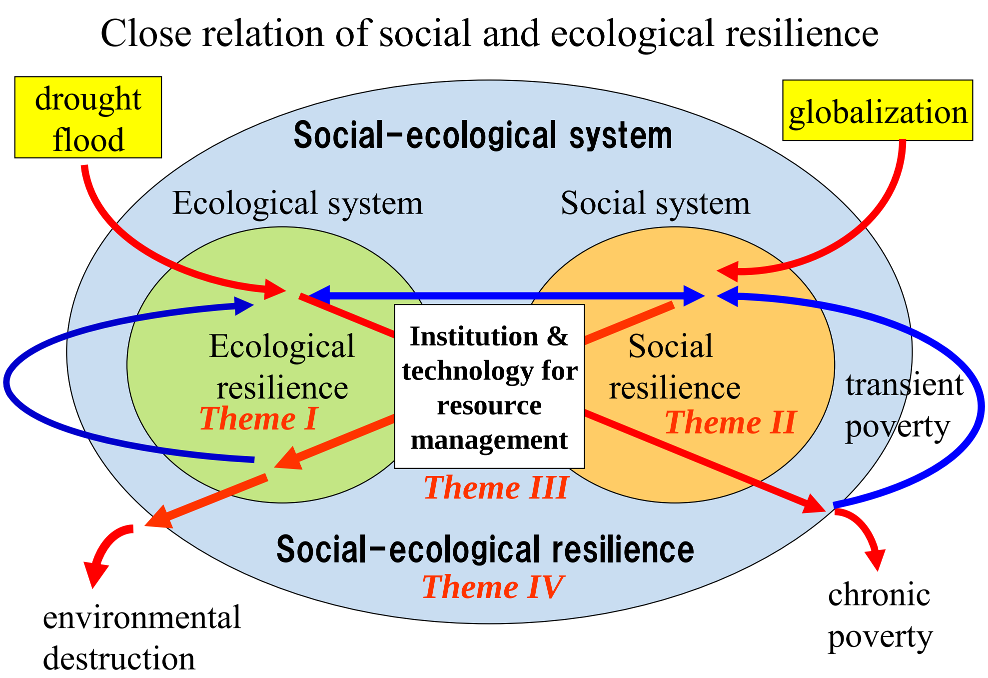


Figure 2. Regions of Semi-Arid Tropics

E-04(FR2) プロジェクトメンバー表 （平成20年度） 2008.11.25

	氏名	フリガナ	所属	サブ所属	職名	専門分野	役割分担
リーダー	梅津　千恵子	ウメツ　チエコ	総合地球環境学研究所	研究部	准教授	環境資源経済学	地域経済分析・農村調査
A	谷内　茂雄	ヤチ　シゲオ	京都大学生態学研究センター		准教授	数理生態学	アドバイザー
	Theme I						
○	真常　仁志	シンジョウ　ヒトシ	京都大学大学院農学研究科	地域環境科学専攻土壌学分野	助教	土壌資源学	土壌有機物の分解・肥沃度測定
	安藤　薫	アンドウ　カオル	京都大学農学研究科	地域環境科学専攻土壌学分野	大学院生	土壌資源学	土壌有機物の分解・肥沃度測定
	柴田昌三	シバタ　ショウゾウ	京都大学フィールド科学教育研究センター	上賀茂試験地	教授	森林生態	樹木構成種調査
○	田中　樹	タナカ　ウエル	京都大学大学院地球環境学堂	陸域生態系管理論分野	准教授	境界農学	土地利用とリスク管理の仕組み
	野呂　葉子	ノロ　ヨウコ	京都大学大学院農学研究科	地域環境科学専攻土壌学分野	博士課程前期	土壌資源学	土壌有機物の分解・肥沃度測定
	三浦励一	ミウラ レイイチ	京都大学大学院農学研究科	農学専攻雑草学分野	講師	雑草学	草本群落構成種調査
○	宮嵜英寿	ミヤザキ ヒデトシ	総合地球環境学研究所	研究部	プロジェクト研究員	土壌資源学	土地利用・履歴調査
	宮下　昌子	ミヤシタ　マサコ	京都大学大学院地球環境学堂	陸域生態系管理論分野	大学院生	境界農学	土地利用とリスク管理の仕組み
○	Moses Mwale		Mt. Makulu Central Research Station, Zambia Agriculural Research Station	Ministry of Agriculture and Cooperatives	Vice Director	土壌学	土壌分析
	Theme II						
○	櫻井　武司	サクライ　タケシ	和光大学経済経営学部	経済学科	教授	開発経済学	農村世帯調査
	菅野洋光	カンノヒロミツ	(独)農業・食品産業技術総合研究機構　東北農業研究センター	やませ気象変動研究チーム	チーム長	気候学・農業気象学	気象観測
	下野　裕之	シモノ　ヒロユキ	岩手大学農学部	農学生命課程	助教	作物学	作物モデル化
	山内太郎	ヤマウチ タロウ	北海道大学大学院保健科学研究院	保健科学専攻	准教授	人類生態学	成長、栄養状態と健康の評価
	Theme III						
○	島田　周平	シマダ　シュウヘイ	京都大学大学院アジア・アフリカ地域研究研究科	アフリカ地域研究専攻	教授	環境地理学	農村社会・制度調査
	荒木美奈子	アラキ　ミナコ	お茶の水女子大学文教育学部	グローバル文化学環	准教授	開発学	農村社会・制度調査
○	石本　雄大	イシモト　ユウダイ	総合地球環境学研究所	研究部	プロジェクト研究員	生態人類学	農村社会・ネットワーク
	伊藤千尋	イトウ チヒロ	京都大学大学院アジア・アフリカ地域研究研究科	アフリカ地域研究専攻	博士課程	人文地理	農村の出稼ぎ労働
	岡本　雅博	オカモト　マサヒロ	総合地球環境学研究所	研究部	プロジェクト研究員	人類学、地域研究	農村社会・生業調査
	姜　　明江	キョウ　アキエ	京都大学大学院アジアアフリカ地域研究研究科	アフリカ地域研究専攻	博士課程	緩和医療学	やまいの共生とケア
	児玉谷史朗	コダマヤ シロウ	一橋大学大学院社会学研究科	総合社会科学専攻	教授	アフリカ社会学	農業生産と社会変容
	中村哲也	ナカムラ テツヤ	京都大学大学院アジア・アフリカ地域研究研究科	アフリカ地域研究専攻	博士課程	農業経済	環境変動への農村の対応
	成澤　徳子	ナリサワ　ノリコ	京都大学大学院アジアアフリカ地域研究研究科	アフリカ地域研究専攻	博士課程	ジェンダー人類学	農村女性の現金稼得
	半澤和夫	ハンザワ カズオ	日本大学生物資源科学部	国際地域開発学科	教授	農業経済	農村世帯調査
	Gear M. Kajoba		University of Zambia	Department of Geography	Senior Lecturer	地理学	土地制度と食料安全保障
	Chileshe Mulenga		University of Zambia	Institute of Economic and Social Research (INESOR)	Senior Lecturer	経済地理学	社会行動分析
	Theme IV						
○	吉村　充則	ヨシムラ　ミツノリ	(財)リモート・センシング技術センター		副主任研究員	リモートセンシング	生態変移モニタリング
	梅津　千恵子	ウメツ　チエコ	総合地球環境学研究所	研究部	准教授	環境資源経済学	地域経済分析・農村調査
	佐伯　田鶴	サエキ　タヅ	国立環境研究所	地球環境研究センター	NIESアシスタントフェロ	大気物理学	気候モニタリング
	松村圭一郎	マツムラ ケイイチロウ	京都大学大学院人間・環境学研究科	文化地域環境論講座	助教	文化人類学	農村社会と土地所有
	山下　恵	ヤマシタ　メグミ	学校法人　近畿測量専門学校		講師	地理情報学	植生モニタリング
○	Thamana Lekprichakul		総合地球環境学研究所	研究部	プロジェクト上級研究員	医療経済学	農村世帯調査・分析
	India						
○	K. Palanisami		Tamilnadu Agricultural University	Centre for Agrl. & Rural Development Studies	Director	農業経済学	農村世帯調査・分析
○	久米　崇	クメ　タカシ	総合地球環境学研究所	研究部	プロジェクト上級研究員	土壌水文学	津波被害調査
	谷田貝亜紀代	ヤタガイ　アキヨ	総合地球環境学研究所	研究部	助教	気象・気候学	モンスーン降雨分析
	C.R Ranganathan		Tamilnadu Agricultural University	Department of Mathematics	Professor	数理モデル	社会経済モデル分析
	B. Chandrasekaran		Tamilnadu Agricultural University	Directorate of Research	Director	作物学	米作影響評価
	V. Geethalakshmi		Tamilnadu Agricultural University	Department of Agricultural Meteorology	Professor	農業気象学	モンスーン降雨分析
	Burkina Faso						
	Kimseyinga Savadogo		University of Ouagadougou	Department of Economics	Professor	経済学	家計調査データ分析
	Tom Evans		Indiana University	Department of Geography	Associate Professor	geography	agent-based modelling

○＝コアメンバー; A = アドバイザー

土地管理手法が生態レジリアンスに与える影響
—サブテーマ１－１進捗報告—

真常仁志、野呂葉子、安藤薫、竹中祥太朗、三浦励一
京都大学大学院農学研究科

2008 年度は、昨年度に試験設定をした野外試験地（ザンビア東部州ペタウケ郊外）におけるメイズの収量調査、土壌分析、雑草調査を行った。本サブテーマでは、複数年におけるメイズ生産の変動、土壌特性の変化、休閑植生の回復過程を調べることを目的としており、本年度の結果だけをもって、土地管理手法が生態レジリアンスへ与える影響を議論することはできない。ここでは、1 年目のメイズの収量調査の結果について報告するにとどめたい。

2007-08 年の雨季の総雨量は、820mm であった。試験地から 30km 南に位置するペタウケ市での長期平均の 900mm と比較して、平年並みであったといえるだろう。当雨季の降雨量分布の特徴として、11 月後半に雨の降らない期間があったために、11 月前半に播種し発芽したメイズの枯死が顕著となり、再播種を余儀なくされたこと、降雨が例年に比べ 1 ヶ月ほど早い 3 月初旬で止んだことが挙げられる。

実験１：開墾後 1 年目であった 2008 年のメイズ収量および地上部バイオマス量は、高木を燃やした跡で顕著に高い値を示した。それ以外の場所では、生産量は概して低かった。施肥区では収量および地上部バイオマス量が増加していた。しかし、施肥区と無施肥区では、高木を燃やした領域の割合が異なるので、高木焼却の影響のある領域を除いてから詳細な解析を行う予定である。また、メイズ収量および地上部バイオマスを推定する方法として、収穫期の基部直径の測定が簡便ながら精度がよいことがわかったので、次年度以降もこの方法を採用する。

実験２：高木の焼却および耕起が土壌およびメイズ生産に与えた影響をより微細に解析することを目的とした実験をおこなった。その結果、1)高木の焼却が影響を及ぼす範囲は、せいぜい幅３m 程度であること、2)焼却がメイズ収量と地上部バイオマス量に与える影響は、耕起の有無によって異なること、3)焼却の影響が及んでいない地点では耕起によってメイズ生産が向上することがわかった。今後、上記結果を生むに至った土壌環境について明らかにする予定である。

今後も、すでに定めたとおりに開墾、耕作および耕作放棄の処理を行い、1)作物生産と雑草の種構成、2)休閑植生の回復、3)土壌特性値について経時的変化を追跡し、当地の農業生態系において土地管理手法が生態レジリアンスに与える影響を明らかにする。

異なる農業生態系下における生態レジリアンス評価
- サブテーマ I-2　進捗報告 -

宮嵜英寿[1]、田中樹[2]
[1]総合地球環境学研究所
[2]京都大学大学院地球環境学堂

サブテーマ I-2 では、異なる生態系下で生態レジリアンスを評価することを目的としている。本稿では、昨年度に試験設定した圃場試験区でのトウモロコシのバイオマス重量と収量の調査の結果について報告する。

試験圃場は、ザンビア南部州・チョマ県からシナゾングェ県に至る斜面の３つの異なる農業生態系に設置した。調査対象村は５ヶ村、試験圃場は 11 区画に及ぶ。詳細については、昨年の報告書及び本稿の英文を参照されたい。

2007-08 年度の雨季の各サイトの総雨量はサイトＡで 1600㎜、Ｂで 1586㎜、Ｃで 1426㎜であった。平均年降雨量が 800㎜ 以下であるこの地域の降雨量から考えて、2007-08 年度は多雨年であったと考えられる。そのため、多雨による被害を受けた圃場が多く発生し、農民へのインタビューによるとその割合は全圃場数に対して 34%を占めた。

圃場試験の結果から、プロット BCh1、BCh2 を除いて、高地から低地へゆくにつれて、地上部バイオマス重量、メイズ収量ともに減少した。これは多雨による被害が低地ほど大きかったからだと考えられる。

被害を受けた圃場の多くは、雨季の間に、トウモロコシからサツマイモやマメなどに転畑された（リスクの回避）。また、転畑されなかった圃場についても、乾季に、土壌中に残っている水分を利用したトウモロコシやその他の作物、野菜の栽培がおこなわれていた（被害の緩衝・解消）。

洪水や旱魃のような生態的問題に対する脆弱性は、地形や土壌特性といった環境要因によって左右される。したがって、それらのインパクトに対する農民の土地利用戦略を明らかにするために、世帯レベルで環境要因を評価することは重要である。生態的問題に対する彼らの対処行動を理解するために、５ヶ村のすべての世帯において、GPS を用いた土地利用図を作成した（土地利用図に関する詳細はページ 101-107 参照）。

生態的問題、社会的問題に対処するためのレジリアンス対処行動には、予防・回避・緩衝・解消・復元およびそれらの組み合わせがあると考えられる。それらがどのように働くかは、空間的スケール（圃場、村落、地域）、社会的スケール（個人、世帯、氏族、コミュニティー）、時間的スケール（週や月、雨季や乾季、通年、数年から数十年）および適用される技術オプションによって異なる。上述のケースは、圃場という空間スケールで短期的時間スケールのもと行なわれた対処行動だと考えられる。

「社会・生態システムの脆弱性とレジリアンス」プロジェクト
テーマⅠ・ザンビア東部州ペタウケ試験地調査レポート

M. Mwale, S.B. Sokotela, G.K. Siulemba and M.J.Malambo (Ms)
農業組合省ザンビア農業研究所マウントマクル中央研究所

本研究の目的は、統合的土壌肥沃度管理システムとしてアグロフォレストリーと緑肥用植物の導入によって、地域の農民、生態系、土壌資源に資すると同時に、生態環境に悪影響を与えることなく、土壌と土地資源の生産性を向上することで社会と生態レジリアンスの双方を高めることに役立つことを目的とする。

調査村はペタウケ市郊外の 38 キロ北東（南緯 14° 55’ 東経 31° 25’ ）に位置し、Sandwe-Ukwimi 定住プログラム道沿いにある。標高は海抜 980 m である。この地域は農業生態ゾーンの IIa に属し、平均年間降水量は 900 mm である。ザンビアの他の地域同様、この地域は亜大陸性・亜熱帯サバンナ気候・植生に属す。

ZARI(Zambia Agricultural Research Institute)の研究員は２種類の成長の早いアグロフォレストリー植物、*Grilicidia sepium* (Grilicidia) 、*Cajanus cajan* (Pigeon pea)と、２種類の緑肥用植物、*Mucuna repensis* (Velvet bean) 、*Chlotolaria juncea* (a Sunnhemp) を選び、土壌生態レジリアンスを向上させる効果を評価するために、持続的農業活動による土壌肥沃度の回復を測定する栽培試験を実施した。目的は以下のとおりである。

１）改良された休耕期間の短い農業技術での土壌肥沃度の改善を上記の植物で実施する。
２）土地利用と作付の結果として土壌特性の変化と特質を測定する。
３）長期的便益としての世帯やコミュニティによる技術の適用によってもたらされる社会・経済的影響を評価し、社会・生態レジリアンス概念と原理を評価する。

今後、データの蓄積によって統計分析を行うが、１年目の現時点ではまだ達成されていない。２年目からは、より包括的なデータの作成と分析を実施する予定である。

リスク対処戦略としての農業外就労
―ザンビア南部州における家計調査に基づく予備的実証―

櫻井武司
和光大学

本稿は、総合地球環境学研究所のレジリアンスプロジェクトのテーマ 2 として実施した家計調査の予備的分析結果を提示するものである。社会生態システムの脆弱性とレジリアンスについて考察する際に、所得が低下し消費が減少するようなショックを受けた農家家計が、消費水準をいかにして回復するかを精査することは極めて重要である。もし、消費水準の回復が迅速であれば、そのような家計は、消費水準の回復が困難な家計と比べてレジリアンスが高いと考えられる。レジリアンスプロジェクトのテーマ 2 は、大きく変動する降水量が農家家計にしばしば負のショックを及ぼしているザンビア南部州を調査地に定め、農業生態的に異なる 3 つの地帯に分布する 48 戸のサンプル家計を対象に実施した家計調査データを基づき、家計レベルのレジリアンスの証拠を明らかにし、その決定因を解明することを目的とする。

サブサハラ・アフリカの農家家計は、様々な外生的ショックが存在する中で消費を平準化するために、ショックの事前的およびショックの事後的な多様なリスク対処戦略を採用している。テーマ 2 が実施する家計調査は、家計レベルで潜在的な利用可能性のあるすべてのリスク対処戦略を評価できるようにデザインしてある。数あるリスク対処戦略の中で、本稿は農業外就労に焦点をあてた。なぜなら、調査地において農業外就労は農家家計の重要な所得源になっているからである。

まず、家計構成員の毎日の時間の使い方に関する週ごと聞き取り調査に基づいて、6 種類の活動への家計の時間配分（大人 1 人あたり、1 日あたりの時間数）を求めた。次に、サンプル家計の平均値と分散を、作付期間中の 3 時点で比較した。3 時点とは、植え付け期（時期 1)、収穫前（時期 2)、収穫後（時期 3）である。その結果、農家家計は、農業ついては時期 1 に、非農業については時期 3 に、それぞれ他の時期と比べて有意に長い時間を費やしていることがわかった。しかし、時期 3 であっても、非農業の労働時間を増やさない家計もあれば、増やしている家計もある。そのため、非農業への配分時間の分散は、時期 3 が他の時期よりも有意に大きい。これらの結果は、一部の（すべてではない）家計が、作付期中に受けた農業生産ショックに対処する事後的戦略として非農業活動に従事していることを示唆している。しかし、これだけでは結論を出すには十分ではない。まず、非農業就労を、事前的対処部分と事後的対処部分に分ける必要があり、さらに事後的に非農業に従事した場合に消費が実際に平準化しているかどうかを検定しなければならない。このような頑強な分析は、将来の課題として残されている。現在進行中の週ごと聞き取り調査に、農家圃場ごとの降水量記録、さらに毎週実施している家計構成員の身体計測を合わせれば、非常に豊富な情報量のあるデータセットが完成し、変動する環境下における家計レベルのレジリアンスを解き明かすことが可能となるであろう。

ザンビア共和国南部州の多様な生態学的環境に居住する子どもの成長と大人の栄養状態

山内太郎
北海道大学大学院保健科学研究院

気候変動がもたらす地域住民の栄養と健康への影響を評価するため、旱魃常襲地帯であるザンビア共和国南部州シナゾングウェ地区から生態学的に異なる３地域（上部平原地、中間斜面地、下部平原地）を選び、2007 年 11 月から定期的に身体計測を実施している。

本報告書は、利用可能なデータ 48 世帯 303 名（成人 140 名、子ども 163 名）の身長と体重、これらから算出される栄養状態の指標、ボディ・マス・インデックス（BMI = 体重(kg)÷{身長(m)}^{2}）を用いて、モニタリング調査開始初期段階における子どもの成長と大人の栄養状態について解析した結果を報告する。

現地での測定記録用紙からコンピュータへの入力が遅れているため、利用可能なデータは限られていた。そのため身体計測の測定項目によって分析可能な対象者数は異なっていたが、３地域の性別、成人・子どもの割合はほぼ釣り合っていた。年齢の不明な子どもは分析対象から除外したものの、子どものサンプルサイズは大人よりも大きかった。

成人の BMI の平均値は男性 19.7、女性 20.9 であり、「標準（18.5≦BMI < 25.0）」に分類された。また、個別に BMI を検討したところ 70%以上の成人の BMI は「標準」であった。以上の結果から、成人対象者の栄養状態は全般的に良好であったといえる。また３地域間の比較からは、下部平原地の居住者は中間傾斜地および上部平原地居住者に比べて身長が高くまた体重も重いことが分かった。BMI では身長と体重の影響が相殺され、有意な地域間差はみとめられなかった。

一方、成人に比べて子どもの成長および栄養状態は悪かった。性・年齢別に身長および体重をプロットし、平滑曲線を引くと、米国国民栄養調査データの３パーセンタイルに相当した。また、性・年齢別の BMI に基づく栄養状態では、男子の 35%、女子の 45%が「低栄養」と判定された。ちなみに成人では男性の 28%、女性の 15%が「低栄養」であった。

今後データ入力が進み分析可能なデータが増えていくため、本稿で報告した数値は将来的に若干修正される見込みである。個人に関して十分な経時データが得られるようになれば、本報告のような横断的分析のみならず縦断的分析も可能となり、環境変動がもたらす地域住民の栄養と健康に関する影響を個人レベルでより詳細に評価することができる。

さらに、テーマⅡでは身体計測のみならず、世帯の社会経済状況に関するシステマティックな聞き取り調査を同時並行で行っている。これらのデータと身体計測データを合わせることによって、降雨量の変動に対する世帯レベルの適応メカニズムについて解明することが期待される。

ザンビア、シナゾンウェにおける 2007/2008 年雨季の気象観測解析

菅野洋光[1]，佐伯田鶴[2]
[1](独)農業・食品産業技術総合研究機構　東北農業研究センター
[2]国立環境研究所　地球環境研究センター

2007 年 9 月から、ザンビアのシナゾンウェ州にて気象観測を開始した。以下にここまでの観測・解析結果をとりまとめる。

2007/2008 年雨季は 12 月初旬から 3 月中旬頃までであったと考えられる。3 つの観測サイト（A：低地、B：斜面地、C：高地）では、雨量がそれぞれ異なっており、サイト A と B で多く（A：1600mm、B：1586mm）、C では少なかった(1426mm)。なお、ここで示した雨量は、村内に配置した雨量計（A：11 地点、B：13 地点、C：12 地点）の平均値である。

時別の平均雨量をみたところ、A と B では日変化が大きく、特に夕雨が顕著であった。一方、C では日変化が小さく、夕方のピークも認められない。総降水量は C が A、B よりも 150mm 以上少ないが、C の夕雨が無いところがそれらの差に寄与していると考えられる。

これまでの聞き取り調査の結果、調査地域の人々の意識として、高地では低地よりも雨量が多いというものが得られている。しかしながら、今回の観測では逆の結果が得られた。観測がまだ 1 年分なので確定的なことは言えないが、雨季の期間は、高地の方が気温が低く日射量も少なかったことから、土壌の乾燥速度が低地の方が早く、それが人々の印象として、低地で雨量が少ないということになった可能性が考えられる。

各サイトでは、雨量観測点間の差が大きかった。すなわち、最大雨量観測点と最小雨量観測点の差が、A では 140mm、B では 190mm、C では 176mm である。また、降水分布パターンにも特徴的な分布が見られた。A では降水量の多い地点が南西方向に偏在しており、B では標高に比例して降水が増加しており、また C では中心域で降水量が少ない。降水量の季節変化は他の地上気象要素とよく一致していた。気温、風、日射量などの気象要素は 3 つのサイト間で異なった変化を示している。以上のような季節変化が、シナゾンウェにおける観測対象地域の一般的な気候特性を示しているのか否か、今後も観測を継続することによって明らかにしていきたい。

アフリカ農村社会の脆弱性分析序説

島田周平
京都大学大学院アジア・アフリカ地域研究研究科

要旨

脆弱性理論は、脆弱性概念の多義性のために未だ有効な分析概念とは認められていない。しかし、アフリカの貧困問題や農業の持続性の理解のための学際的研究分野においては大きな可能性を持つと考えられている。

本稿では、アフリカ農村社会の分析にとって適切な脆弱性の定義を試み、つぎに個人、世帯、社会集団という主体の違いによって現れる脆弱性の多様性を整理した。その上で、ナイジェリア、ブルキナ・ファソ、ザンビアで行った農村調査の結果をもとに、個人、世帯、社会集団の脆弱性がどのような過程で増大してきているのか考察した。

その結果、個人、世帯、社会集団の脆弱性は、相互に密接な関連をもち影響しあっていることが明らかとなった。たとえば、ブルキナ・ファソから南部諸国への出稼ぎは、干ばつ常襲地域の世帯の脆弱性を緩和するものであったが、2000 年にコート・ジボワールで起きた外国人排斥運動に遭い突然中止せざるを得なくなった。このことで国外追放された個人、世帯はもとより、彼らが帰った先の故郷の農村社会の脆弱性にも深刻な影響を与えた。

このような複雑な脆弱性を理解するためには、主体間の脆弱性増大の影響やそのプロセスを明らかにした上で、つぎにそれらの間の相互関係を解析する必要がある。

1. はじめに

脆弱性理論は、脆弱性概念の多義性のために未だ有効な分析概念とは認められていない。しかし、アフリカの貧困問題や農業の持続性の理解のための学際的研究分野においては大きな可能性を持つと考えられている。

本稿では、アフリカ農村社会の分析にとって適切な脆弱性の定義を試み、つぎに個人、世帯、社会集団という主体の違いによって現れる脆弱性の多様性を整理した。その上で、ナイジェリア、ブルキナ・ファソ、ザンビアで行った農村調査の結果をもとに、個人、世帯、社会集団の脆弱性がどのような過程で増大してきているのか考察した。

その結果、個人、世帯、社会集団の脆弱性は、相互に密接な関連をもち影響しあっていることが明らかとなった。たとえば、ブルキナ・ファソから南部諸国への出稼ぎは、干ばつ常襲地域の世帯の脆弱性を緩和するものであったが、2000 年にコート・ジボワールで起きた外国人排斥運動に遭い突然中止せざるを得なくなった。このことで国外追放された個人、世帯はもとより、彼らが帰った先の故郷の農村社会の脆弱性にも深刻な影響を与えた。

このような複雑な脆弱性を理解するためには、主体間の脆弱性増大の影響やそのプロセスを明らかにした上で、つぎにそれらの間の相互関係を解析する必要がある。

2. 脆弱性の定義

脆弱性という言葉は、日常的にもいろいろな場面で使われる。情報システムの欠陥や構築物の工学的脆さにも使われるし、社会組織の集団的・組織的動員力弱さを表現する時にも使われる。このため定義なしにこの言葉を使用すると思わぬ誤解が生じることになるので、ここでは本稿で使用する脆弱性という言葉の定義についてまず明らかにしておきたい。その上で、アフリカの農村社会の脆弱性について論じてみたい。

脆弱性の概念は、未だ具体的な調査手法がイメージできるほど厳格に規定されたものではない(Osbahr, Boyd and Martin 2007)。ここでは著者がかつて提起した定義 (島田 2007)を再整理して提示しておきたい。その論文でも指摘しておいたことであるが、脆弱性の内容は、対象となる主体のスケールの違いによって異なる。すなわち、個人、世帯、社会集団と主体をかえるごとに脆弱性の意味内容が変わるのである。本稿ではその点について分析を加えておきたい。

2.1. 脆弱性(Vulnerability)の定義

地理学者であるワッツとボールは、自らの地域研究の経験をもとに、脆弱性をつぎのように考えた(Watts and Bohle 1993)。アフリカやアジアの農村地帯では、社会集団、世帯、個人が、様々な外的変化（政治経済的変化、自然環境の変化）に晒されている。社会集団や世帯、個人は、直接行動、慣習遵守、制度利用、その他の方法でそれらの変化に対応しつつ、自らも変容している。その変容が社会集団や世帯内部で制度化され蓄積されてきた制度、慣習、権力構造、資源配分等のあり方に変化をもたらす。その変化が、社会集団、世帯、個人の各レベルで、危機に対する脆弱性を強めている、と考えたのである。

そして彼等は、脆弱性を規定する要素として以下の 3 つを挙げた。

(1)危機、緊張、衝撃に晒される危険性　　(exposure)、

(2)それらに対抗するための充分な能力を欠く危険性 (capacity)、

(3)上記の結果引き起こされる状況の危険性および付随的危険性 (potentiality)、である。

(1)と（2）の危険性は、エンタイトルメントの概念と関連しており、(3)の危険性はエンパワーメント(empowerment)の概念と関連しているという。

またチェンバースは、個人や世帯単位の脆弱性に焦点をあて、それらの脆弱性を、危機(risk)や衝撃(shock)、緊張(stress)に対して無防備(defenseless)で、安全性に欠け(insecurity)、晒されている状態を意味すると言った(Chambers 1989)。この定義はワッツとボールの定義のうち(3)の状況的危険性を除いたものといえる。それは、(1)と(2)の結果起きた短期的脆弱性増大に焦点をあて、より長い時間的経過の中で展開してくる政治経済的プロセスを除くことによって、脆弱性をより狭義に定義しようとしたものといえる。

著者は、(3)の状況的危険性こそ、(1)や(2)の理由によって起きた突発的脆弱性増大が社会の中に構造化されていく過程を分析する場合に重要な認識であると考える。逆の言い方

をすれば、(3)はある時点の(1)や(2)を規定する政治経済的状況を示すものであるといえる。したがって、(1)と(2)の分析視点と分析手法は(3)のそれとはかなり違っている。本稿では、脆弱性増大の要因の明確化や、短期的な増大過程に分析に重点を置きたいと考えているので、(1)、(2)の狭義の脆弱性概念の分析に重点を置いて以下の分析を進めたい。

ところで、この狭義の脆弱性は二つの危険性から構成されているといえる。すなわち個人や世帯、社会集団にとっては外在的存在である外的要因による危険性と、その危険性に対処する能力が充分ではないという内的要因による危険性の二つである。こう考えると、脆弱性について考える時は二つの方向から分析することが可能であることになる。外的要因による危機や衝撃、緊張などに関する分析とそれらの外的要因に対する人々の対処方法に関する内的要因分析である。

このうち外的要因による危機や衝撃などの分析に関しては、社会経済的データの整備や気象データの精度向上、衛星画像の解析度の向上など、分析精度の向上が著しい。それに対し現在もその具体的分析手法が確立していないのが内的要因の方である。本稿ではこの内的要因に焦点を絞って検討してみたい。

2.2. 脆弱性を規定する内的要因

個人や世帯が、危機や衝撃、緊張等に直面したときにとる対処方法に関してはスウィフトの研究が重要である(Swift 1989)。

彼は、脆弱性増大の危険性は、低所得で貧困状態にあることよりも純資産（財産）が失われることとの関連性が強いことを明らかにし、その財産に対する請求権の確かさの程度が脆弱性と密接な関係にあることを主張した。もちろんここで彼がいうところの財産とは、広義の意味での財産であり、有形無形の価値の貯蔵および危機に際し頼りにすることができる援助要求(claims to assistance)を意味している。

そして彼は、飢饉により引き起こされる場合の脆弱性と密接な関連のある世帯の財産を、投資(investments)、貯蔵(stores）、請求(claims)の三つに分けて説明した。

(1)投資とは、人間に対する投資（教育と健康）、個々人が所有する生産的財に対する投資（家畜、農具、家、家財道具、土地、樹木、井戸など）、そして共同所有財に対する投資（土壌保全作業、灌漑事業、灌漑システム、共有財産へのアクセス）などを含む。

(2)貯蔵とは、食糧の保存はもとより、金や宝石などの貴重品の貯蔵、さらには現金や銀行預金等を含む。

(3)請求とは、共同体内の他の世帯への要求（生産資源、食糧、労働、家畜）や、親方や金持ち、首長、あるいは他の共同体への援助要求、さらには政府への要求、国際社会への要求も含むという。

これらの三つの形態の財産は、いずれもアフリカにあっては純粋に個人に帰属するものということが難しく、その多くが世帯や社会集団への帰属を通して利用や処分が可能な財産である。スウィフトのいう援助要求(claims to assistance)にはこのことも含まれている。結局、脆弱性とは広義の財産へのアクセス権の様態とその確かさによって判断することが出来るといえ(島田 1999)、投資も貯蔵も含め、人々が社会関係を利用していかに自然資源を自らの意図、目的のために使うことができるかという、資源へのアクセス権の確かさの

ことであるといえよう。

2.3.　内的要因と主体性の関係

脆弱性を引き起こす危険性を外的要因と内的要因に分けて議論することは、主体としての個人や集団が、外的要因に対して常に受け身的に対処する存在として捉えることになるという批判がある(Zimmerer 1994)。そして何よりもその対処の仕方が多様であることを見失いがちになる点を批判する意見もある。

例えばペルーとボリビアのアンデス山地の農村における作付け形態を調査したジメラー(Zimmerer)は、実際に観察された作物の作付け状況が、垂直統合論などで想定されている高度別の作付け体系を示しておらず、一つの畑に複数の作物が混在して作付けされており、各作物も高度差のある広い範囲で作付けされていることを明らかにした。農民たちは、伝統、作物の生産性、作物の市場価格、好みなど様々な理由で作物を選択しており、経済的理由や土壌浸食の防止といった単一の理由で作付けを決めている訳ではないことが示されている(Zimmerer and Bassett 2003: 137-158)。対処の仕方は多様であるというのである。

また同じ本の中に再録されているバッセットとズエリ(Bassett & Zueli 2003)の論文[2)]は、コート・ジボワール北部における森林破壊のシナリオに疑問を投げかけ、牧畜民フルベの家畜使用頭数の増加と農民による耕作地面積の増大が、灌木林の減少をもたらしたものの森林面積の増大をもたらしたことを明らかにした。これは、人口増大による過耕作や家畜増大による過放牧が森林破壊をもたらすとする世界銀行やコート・ジボワールの国家環境行動計画が想定していた単線的なシナリオとは異なるものであった。この指摘の重要なところは、世界銀行などの描くシナリオが誤りであったという点だけではなく、牧畜民や農民という主体の行動が、生態環境という外的要因の変化に大きな影響を与えているという点にもある。

本稿でも、外的要因に対する主体の対処行動が多様であること、さらにそれが逆に外的要因に変化を与えていることに十分な注意を払う必要があると考える。

ある主体の対処行動が生態環境を変えるということは、その環境へのアクセス権を持っている他の主体との間で脆弱性をめぐるトレード・オフ関係が起きる可能性があることを示している。別の言い方をすれば、ローカル・コモンズに対するアクセス権に変化をもたらすことになる。

こうして脆弱性増大に関わる外的要因と内的要因とは密接に相互に関連しているのである。しかし具体的レベルで、対処行動が生態環境に与える影響を観察することは容易ではないので、多くの研究は外的要因による危険性、衝撃に対する対処行動を分析するだけで手一杯となる。これは分析視点上の問題ではなく、方法論上の問題である。社会的事象の変化と生態環境の変化との時間スケールの違いも関係する難しい問題である。本稿でも外的要因に対する対処行動の解析に重点を置かざるを得なかったのは方法論上の問題による。

3.　脆弱性の主体

先に述べたように、資源へのアクセスの確かさが脆弱性の内的要因を規定するとしても、

資源へのアクセスの確かさは、個人、世帯、社会集団といった主体の違いによってその意味も異なる。さらに言えば、資源へのアクセスの確かさは、それら主体相互間でしばしばトレード・オフの関係になることすらある。脆弱性と対立的概念ともいえる持続性の議論においても、誰にとっての持続性なのかという主体の問題が大きな問題とされている(Sneddon 2000)。

3.1.　個人レベルの脆弱性

人々と資源との関わりに関して集団への帰属性が大きな役割を果たすことの多いアフリカにおいて、個人の脆弱性を問題にすることは、私的所有権が確立されている社会における場合よりも複雑である。

アフリカ研究において個人の脆弱性についての研究が一番進んでいるのは、ジェンダー研究の分野においてであろう。多くの研究が、アフリカにおける性別分業がさまざまな形で女性の脆弱性を高めていることを主張してきた。例えば、貨幣経済の浸透が農村部における換金作物生産を刺激し、それによって農家の現金所得が増大したものの、女性はその恩恵に預かっていないという指摘や、開発援助による換金作物生産導入計画が、男性の換金作物生産独占、その結果としての男性の現金所得の増大と、女性の食糧作物生産労働の増大を引き起こし、女性は労働強化の問題に直面しているといった指摘がなされている。

また、最近は HIV・エイズの感染拡大による個人レベルの脆弱性増大の問題も多く指摘されている。HIV・エイズの感染拡大により寡婦や孤児が増加し、彼女たちの社会的経済的環境が悪化してきているという指摘である。寡婦や孤児たちの脆弱性が増大する理由は、主たる労働力であった男性（夫であり父親である）が亡くなったことによる基幹労働力の不足に加え、男性の死後、夫方の親族が家の財産を奪い、彼女たちから生産手段と生活用品を奪い去ってしまうことからも生じているという(Foster and Williamson 2000)。両親を亡くした孤児を養育することになった老人たちの脆弱性も増大することが多い。HIV・エイズによる脆弱性増大は、家族レベルで緩和されているところも多いが、個人レベルで女性や子供の脆弱性増大を引き起こしていることも多いという(FAO 2004)。

ところで、個人と世帯の脆弱性増大をめぐる関係について、開発学の分野で興味ある議論が行われてきた。それは、世帯の中で最も脆弱な対象であると思われる女性と子供を援助のターゲットにすることと、世帯の主たる稼ぎ手（Bread　Earner:多くの場合男性なのであるが）といえる世帯主(多くの場合男性)を対象にすることと、どちらの方が効果的なのかという議論として展開されてきた。主たる稼ぎ手への食料援助の方が、女性や子供にターゲットを絞った食料援助よりも長期的に見て世帯員全体の健康にとって有利であるという調査報告もだされたのである。もちろんこれには反対意見もあるのであるが、個人の脆弱性といった問題を考えるときに世帯の役割をどのように考えるべきか、この議論は一つの問題を投げかけたといえる。

3.2.　世帯レベルの脆弱性

人々と資源との関わりにおいて集団への帰属性が大きな役割を果たすアフリカにおいては、資源へのアクセスに関して世帯が果たす役割は大きい。スウィフトも、広義の財産に

対する請求権という場合に、個人のみではなく世帯も主体として考えている[3)]。

世帯の脆弱性は当然のことながら、パトロンークライアント関係や支配構造を通して地域社会や社会集団の脆弱性とも密接な関係を持つ。しかし、個人と世帯との間に見られる関係と同じように、世帯と地域社会や地域集団の脆弱性との関係も必ずしも相関関係にあるわけではない。それは例えば後で述べるブルキナ・ファソの例でもみられる。

地域社会の脆弱性は、個別の世帯の脆弱性よりは地域の生態環境の影響を受けやすいといえる。なぜなら、世帯の脆弱性は一つの地域的生態環境の中で閉鎖系として考えることが出来ない。世帯は、一つの生態環境の影響を他の生態環境の利用で緩和するという空間的広がりを持つ手段を持っているのである。

3.3. 社会集団の脆弱性

社会集団という場合、ある空間的範域の中で存在する地縁的社会集団(地域社会)を指すのか、空間的まとまりのない非地縁的社会集団を指すのか区別して考える必要がある。地理学では前者の集団を対象とすることが多いが、社会学や経済学においては社会階層や生業の違いに焦点を合わせた後者を想定することが多い。

前出の地理学者ワッツは、北部ナイジェリアにおける飢饉の発生について分析し、世帯では常時飢饉の危険性に晒されているのに対し、村レベルでは 4～5 年に一回、より大きな地域的単位の飢饉は7～10 年に一回の割合でみられることを明らかにした(Watts 1983: 104)。

この地域的範域の大きさと飢饉発生の確率の大きさに見られる逆相関の関係が、世帯の脆弱性緩和に役立ってきた。これは地縁的社会集団が、世帯や個別の農村社会の脆弱性にとってどの様な役割を果たしているかを示したものである。もちろん人類学的研究が明らかにしているように、非地縁的社会集団も世帯の脆弱性緩和に大きな働きをしていることも認められている。

ところで、社会集団にとって脆弱性増大をもたらす要因としてはどのようなものが考えられるであろうか。ワッツの表現を借りて言うとすれば、7～10 年に一回の割合で発生する地域単位の飢饉の原因は何かと言うことである。それについては、自然的原因として大規模な旱魃や虫害が挙げられ、社会経済的要因として、植民地支配以降の小農による商品生産の「内部化」を挙げている(島田 1985)。さらに最近では強制移住を引き起こすような内戦などもあげられる。そしてさらに社会学者ウォルデ・マリアム(1986)が述べるように、構造的抑圧や搾取も社会集団の脆弱性増大の要因としてあげられる(Wolde Mariam1986: 191)。

ウォルデ・マリアムは、エチオピアの小農に焦点を当て、その脆弱性は、社会的システムによって生み出されるものであると述べた。その社会的システムとは、小農世界(遊牧民を含む)、自然の諸力、社会・経済・政治的力の 3 つの構成要素から成っているという。小農たちは、一方で自然の力に依存し他方で社会・経済・政治的な力に抑圧され搾取されているというのである(Wolde Mariam1986: 11)。

小農たちは、リスクや抑圧、搾取などのもとで自給的生産を行っているのであり、彼らの生産物を多くの要求者と分け合うことを強いられている。そのため、自分たちの自家消費用に確保できる食糧はせいぜい 6 ヶ月から 9 ヶ月分でしかなく、穀物や現金の貯蔵など

不可能な状態だという。彼らはいかなる権利も持っていないにもかかわらず、驚くべき多くの義務を負わされている。これが彼らの飢饉に対する脆弱性を増大させているのだという。小農たちは、自然的原因による食糧不足で飢饉に陥る前に、社会の中の一つの階層として、すでに社会・経済・政治的諸力によって脆弱化させられているというのである。

3.4. 主体の違いによる脆弱性の多様性

以上みてきたように、脆弱性増大の対象を個人とするのか世帯またはそれより大きな社会集団にするのかで脆弱性増大の原因やそのプロセスはかなり異なっていることが分かる。個人、世帯、社会集団と対象が大きくなるほど、それらの脆弱性が生態環境から受ける影響も大きくなるように思われる。個人や世帯は、自らが属するより上位の集団、たとえば拡大家族や地縁的・血縁的集団に脆弱性緩和の機能を預託しており、自然災害などが起きたときには、直接的被害の影響を和らげるためにこの機能を発動させる。つまり、個人や世帯は、自然災害に対しては二次的な対処手段をもっている(Dercon 他 2008)。これに対し、政治社会的変動は個人、世帯に直接影響を及ぼすものがあり、場合によっては脆弱性増大が集団の大きさに関係なく各レベルで同時に進行する。この場合、個人、世帯は社会集団に依存することなく、自らの行動で脆弱性増大に対処することになる。

ところで、1 つの地縁的集団としての農村社会をみると、その中には地主や小農、さらに小作や農業労働者がいる。地主、小農、小作、農業労働者などが直面している脆弱性は、同じではない。農村社会内部には相対的に脆弱な世帯や階層があり得るのであり、各階層の脆弱性は、均一な動きをしないことが多い[4)]。

各主体の脆弱性増大要因が異なれば脆弱性の現れ方も異なってくるとなれば、脆弱性の分析においては、その対象を明確にして議論をすることが必要となる。第 1 表にはそのような視点から、各主体の脆弱性増大のシグナル、要因、そしてその観点を示しておいた。

第 1 表　集団のレベルごとの脆弱性増大のシグナル、要因、観点

集団のレベル	脆弱性増大のシグナル	脆弱性増大の主たる要因	脆弱性増大を見る観点
個人レベル	健康状態の悪化 離村	耕作権の喪失、 生産手段・財産の喪失	婚姻制度、相続制度 土地制度、性別分業 健康
世帯レベル	離村 共同組織の崩壊 相互扶助の衰退	投資の減少、貯蔵減少 請求権の弱体化	共同労働、共食関係 相互扶助制度、貸借関係 耕作経営状態
社会集団レベル	地域的飢饉	地域的飢饉 政治的混乱	社会構造、政治制度 経済政策、開発援助、 民族・宗教問題

4. アフリカ農村の脆弱性分析試論

脆弱性が、広義の財産へのアクセス権の様態とその確かさによって推し量ることができること、しかしその内容や増大プロセスが、アクセスする主体によって異なることを明らかにしてきた。また、アフリカの農村社会では、個人の脆弱性は世帯の脆弱性をみるよりもとらえどころがないことをⅢ-1 で述べた。それは個人がもつ財産へのアクセス権が、世帯や拡大家族内での認知・了解のもとで初めて実現される権利が多く、中には世帯や拡大家族が単位となって土地保有集団に交渉して初めて土地へのアクセスが可能となる権利もあるからである。個人のアクセス権は、排他的で自立した権利ではないのである。

それ故アフリカの農村社会における脆弱性の分析において、個人を主体に考えることは、方法論的にも容易ではない。それに代わる主体として□-2 で検討した世帯かⅢ-3 で取り上げた社会集団を考えることになる。

4.1. 共同体理論と脆弱性論

現代アフリカの農村社会において、資源へのアクセス権に最も強い支配力あるいは影響力を持つ主体は何かを問うときに、まず検討されなければならないのは共同体理論における共同体であろう。共同体理論は、(アフリカなどの)前近代的伝統社会にあって、その農業生産力を規定するものは、広義の土地所有関係であり、それは「共同体」による土地の占取関係だとしている(赤羽 1971：大塚 1969)。もちろん共同体論にはここで述べる脆弱性という問題意識はない。しかし、農村社会において最も基底にあるのは「本源的」な土地所有関係であり、土地占取の「あり方」が社会関係、社会制度を通して農業生産を規定するといった視点は、土地資源へのアクセス権のあり方を分析の中心に据える脆弱性概念と重なるところがある。

しかしながら、共同体理論は、農民の多生業性やブリコラージュ性が明らかになりつつある現代アフリカの農業社会を前にすると、あまりにも土地の所有形態に強く規定された硬直的理論のようにみえる。資源へのアクセス手段が多様であることはアクセス・チャネルの多さを意味し、土地占有権を相対的なものとする。それ故、共同体理論で措定されている土地占取主体としての共同体は、現実には存在しないか、存在しても資源のアクセス権を支配する決定的な主体とは見なし得ない状況が明らかになってきている。

またアフリカにおける「共同体」による土地占取関係にみられる土地占取のあり方の問題、すなわち「共同体」、それをここでは土地占有主体と呼んでおくが、それが持つとされる土地に対する権利の「弱さ」も、共同体理論で措定されている「共同体」の脆弱性論への適用を難しくしている。確かにアフリカ農村社会には、土地占取主体ともいうべき草分け筋のエスニック集団が存在する。しかしその占取の内容は、土地の管理権ともいうべき性格のもので、農民を一方的に追い出すことのできる排他的な権利ではない[5)]。そのためアフリカでは土地に対する権利が重層的に存在し、一つの主体に所有権の帰属を認めがたいといった議論が多くなされるのである (Berry 2001)。

4.2. コモンズ論と脆弱性論

土地に対する権利が重層的に存在する地域の脆弱性について考える場合、脆弱性とコモ

ンズ論との関係性についてもふれておく必要があろう。

前節での議論から分かるように、アフリカ社会における土地の占有関係をめぐる重層性は、ハーディンの「コモンズの悲劇論」が前提としている「オープン・アクセス」が各主体に保障されている重層性ではない(Hardin 1968: 井上 2004: 佐藤 2002)。権利の重層性の中で各権利主体は、お互いに他の主体の権利の存在を意識せざるを得ない状況にある。土地へのアクセス権を主張できる主体が複数あり、そのアクセスを実現するためには常に他の主体と交渉するか了解を得ることが必要とされる重層性である。

このような複数の主体間での交渉や了解が前提とされるような資源アクセスが、相互干渉となって一部の主体による過剰な資源利用を抑制していることは事実である。複数の主体が関与する地域レベルのコモンズをローカル・コモンズと呼ぶとすれば、アフリカにおけるローカル・コモンズは、異常気象による不作や虫害、あるいは経済環境の急変などに際し人々の生活に不可欠な利用対象財になっていることを多くの研究が明らかにしている。異常な旱魃や虫害に直面し、深刻な食糧不足や家畜の損失に直面した農民や牧畜民は、ローカル・コモンズの利用をめぐって通常年とは異なる相手と密接な交渉をすることが必要となる。

脆弱性論の視点から言えば、交渉の必要性こそ、脆弱性の程度と資源へのアクセス権とを結びつける重要な役割を果たしているといえる。コモンズの悲劇を起こすオープン・アクセスでもなく、成文化された統制管理でもない、交渉を必要とするアクセスのあり方は、脆弱性の程度をローカル・コモンズへのアクセス権の強弱に反映させることができるという点でユニークなあり方だということが言える。

しかしこのユニークなコモンズ利用のあり方が資源の自制的利用メカニズムの一つだとしても、佐藤(2002:208)が指摘しているように、それが今後とも存続しうる理由はどこにもない。その事例の一つは後の森林破壊のところで示すとおりである。

4.3. 共同性、共食性と脆弱性

共同体論で述べてきたように、アフリカでは土地に対する「共同体」の権利は弱く、またコモンズ論ではローカル・コモンズへのアクセスが、交渉を通して行われているというユニーク性を持っていることを述べてきた。だとすると、土地占有主体として「共同体」に象徴される集団に代わって資源へのアクセスに関して大きな力と影響力を持っているのは何なのか、また交渉において重要な役割を果たすのは何であるのか検討しておく必要があろう。

そこで考えられるのが、世帯や拡大家族の重要性であり、またそのレベルにおける相互協力関係の重要性である。

アフリカの農村社会をつぶさに観察すると、土地の占有や耕作に見られる協力関係、生産物の収穫や貯蔵にみられる共同労働や協力関係、さらには食事をともにする共食関係など、生産や消費行動に際して多様な共同性が存在することが分かってくる。

もちろん、それらの共同性は地域により社会により異なる形を持っている。しかしそれらの共同性を構成している単位として、世帯や拡大家族が基礎集団になっていることが多い。世帯と拡大家族の中でどちらの方がより資源へのアクセス権の主体となっていること

が多いかという点に関しても、農村によって事情は異なっているのであるが、いずれにしろ、土地占有集団はこの種の共同性を担うには大きすぎる集団であるということは言うことができるであろう。

したがって本稿では様々な活動の場における協同性や共同性の存在を確認し、それらの協同性や共同性の活動最小単位として、個人を取り巻く、より直近の上位集団である世帯とそれから構成される拡大家族の両方を現代アフリカにおけるアクセス権の主体として措定しておきたい。

また、世帯や拡大家族レベルで観察される共同労働や共食関係を含む様々な協力関係が、ローカル・コモンズへのアクセスにあたっての交渉力と密接な関係にあることも述べておかなくてはならない。脆弱性の程度がローカル・コモンズへのアクセスの交渉に意味を持つと言ったが、脆弱性の程度が他の主体に理解されるには日常的な相互理解が不可欠である。その意味で日常的な協力関係は、個人や世帯の脆弱性の程度を相互に知り合うために最も有効な関係であると言えるのである。これらの協力関係の解明があってはじめて、各主体の脆弱性の程度とローカル・コモンズへのアクセス交渉力との関係があきらかになるという意味で、この解明は極めて重要なことである。

5. 脆弱性増大の事例分析

前章で述べたような理由から、世帯と拡大家族の脆弱性問題を中心にして、具体的な調査結果をもとに世帯や拡大家族の脆弱性について考察してみたい。以下では、ナイジェリアとブルキナ・ファソ、そしてザンビアで行った農村調査の結果から考察する。ナイジェリアでは食料生産農民エビラ人の農村社会を取り上げ、経済不況に基因する脆弱性増大の問題を検討し、ブルキナ・ファソの村では出稼ぎ先の政治的変動が村の農家の脆弱性増大につながった例を、そしてザンビアの村では、政治的変動が森林保護区への入植を許し人々の共有資源を破壊して脆弱性を増大させた例と、「過激な死」による個人および世帯レベルの脆弱性増大の例について考察する。

5.1. ナイジェリアの E 村でみられた脆弱性増大

調査地 E 村の概要については島田(2007)に詳しく述べておいたのでここでは割愛する。年間降水量は 1200mm 程度であり、根栽作物ヤムやキャッサバの他、トウモロコシ、モロコシの栽培がおこなわれている。ヤム、キャッサバ、トウモロコシなどの食料作物生産が自給水準を下回るということは殆ど無く、後で述べる二つの村に比べ自然的条件の悪化による脆弱性増大の危険性は極めて低い。

しかし、この村の住民であるエビラ人は国内政治の中ではマイノリティで、この村がある中部ナイジェリアは経済的にも後進地域に属する。このことが村人の社会経済生活に大きな影響を与えてきた。

この村の人々は 1930 年代から南部のココア栽培地帯に出稼ぎに出かけ、その地で農業労働者や食料生産農民として働きはじめた。若くしてココア生産地に出かけ老いて故郷に帰るという循環的出稼ぎは、植民地末期には確立し、1960 年の独立後もしばらく続いていた。しかし 1970 年代に入り原油生産によるオイル・ブームが訪れると、村からの出稼ぎにも変

写真 1: 共同労働グループ

写真 2：耕地に広がる浸食

化が生じ、人々は出稼ぎ先を都市にも増やし、職業も多様化させた。都市に出かける人も増え、非農業関係の職に就く人が増えてきた。

この時を同じくして村の耕作形態に変化がみられた。農民同士で行う共同労働が激減し、キャッサバの栽培面積が急増してきた。これらの変化は、オイル・ブームに伴う一連の変化、すなわち初等教育の拡充、高学歴化、出稼ぎ形態の変化、非農業関係の就業増大などと密接な関連をもっていた。若者たちの農業離れの傾向は、1980 年代に入り経済が不況になってもしばらく衰えることはなかった。村に滞留せざるを得なくなった若者たちは、相変わらず求職活動をつづけ、省力化が可能なキャッサバ栽培を拡大した。

キャッサバの栽培面積が拡大する過程でみられるようになった、キャッサバの連作や作付け方法の乱れは、一部の畑で土壌浸食を引き起こし、高さ 2m を越える浸食谷が発達した。を放棄するという対応策をとったが、すでに幾つかの畑は浸食が進んで耕作不可能になってしまった。

オイル・ブーム期に始まった若者たちの農業離れが、共同労働の衰退や耕地の荒廃を招き、食糧生産地の生産基盤を切り崩すまでになっている。この生産条件の悪化は、資源アクセスの点からみて明らかにこの地の農家世帯の脆弱性を増大させたといえる。

5.2. ブルキナ・ファソの Y 村で考えた脆弱性

この調査地の概要については島田(2001)の論文で明らかにした。年間平均降水量が 700mm 前後でしかも年変動が大きいこの地域の農業は、モロコシとヒエが主穀であり、平年作の年でも翌年の収穫直前にミレットを購入している世帯が少なくなかった。(国際農林水産業研究センター 2000)例えば 1998 年、32 戸の内 27 戸が「平年作以上」であったと評価した年にもかかわらず、この年でも自家消費分の穀物が翌年の雨季まで充分であった農家は 12 戸にすぎなかった。

写真 3：Y 村の穀物倉庫

このような地域の農家世帯にとって、隣国コート・ジボワールへの出稼ぎは食糧不足を補うために必要な行動であった。農家世帯の構成員の約半分が隣国に出かけていた。そのうちの 2/3 の人が出稼ぎ先で土地を購入し家族を住まわせていた。平年作でも自家消費分が不足する世帯

にとって、隣国の家族からの送金は不可欠なものになっていた。
年間降水量が少なく穀物生産が自給水準を下　　　　回り、そのうえ気候の変動幅が激しいサバンナ地帯のこの村の人々は、より雨量が多く気候変動も少ない気候帯の森林地帯に村人を送り込み、食糧不足問題を解決していたことになる。アドガー(2000)も、出稼ぎが世帯の脆弱性緩和に役立つことがあることを述べている。
ブルキナ・ファソからコート・ジボワールへの出稼ぎが本格化したのは 1970 年代末以降である。1969 年にガーナが外国人を追放し、1970 年代にナイジェリアが外国人を追放すると、ブルキナ・ファソ人は出稼ぎ先をコート・ジボワールに変えた。そして 1970 年代前半までには、ブルキナ・ファソからの最大の出稼ぎ先はコート・ジボワール南部のコーヒーやココア生産地域となっていた。出稼ぎ民の中には、やがてコート・ジボワールで土地を取得し、より生産性の高いコーヒーやココアの生産を行う者も出てきていた。
しかし、ブルキナ・ファソの出稼ぎ民がコート・ジボワールでコーヒー、ココア生産に乗り出し、現地に定着するようになったことが、新たな問題に飛び火することになった。2000 年に行われたコート・ジボワールの大統領選挙で、候補者の一人であるワタラ(Dramane Alassane Ouattara)が、対立候補から、「ブルキナ・ファソ人であって大統領になる資格はない」と攻撃された。そしてこのことがきっかけとなり、コート・ジボワールの各地でブルキナ・ファソ人人排斥運動が勃発した。たくさんのブルキナ・ファソ人が土地を奪われ、自国に戻ることになった。
この一事は、自然環境のリスクが大きい乾燥サバナ帯を出て、南の湿潤地帯で土地を手に入れ、より安定した自然環境のもとでリスクの少ない生産拠点を構築したブルキナ・ファソの農家世帯が、結果的により大きなリスクを背負い込んでしまった例を示している。このリスクは出稼ぎ民のみが直面しているものではなく故郷の村落社会をも捲きこむ深刻な問題となった。仕送りが減ったばかりか多くの人が土地と職が不足する故郷の村や近くの町に戻ってきたからである。
モシの農民たちは、皮肉にも、自然環境によって引き起こされる脆弱性増大を緩和させようとして、逆に政治的変動に左右される出稼ぎシステムを作り、それによって脆弱性増大の問題を抱えることになったといえるのではなかろうか。これは狭義の脆弱性のみでは理解できない、政治経済的状況の変化が脆弱性増大に関与している事例といえよう。

5.3.　ザンビアの C 村で考えた脆弱性

C 村の概況については島田(2007a、2007b)について述べておいたので、ここでは C 村で観察された脆弱性増大に関係する 2 つの事例について述べるにとどめておきたい。
一つは C 村の東隣にあった森林保護区（ムヤマ森林保護区）への人々の流入による森林破壊の問題である。1964 年の独立から 1991 年まで続いた統一民族独立党(UNIP: United National Independence Party)政権の時代には、人々は森林保護区の中に入ることを控えていた。そこで樹を伐採することも畑を耕すことも禁止されており、それを破った者は容赦なく逮捕されたからである。
しかし、1990 年代の政治変動が、人々と森林保護区との関係に変化をもたらした。1991 年に UNIP から複数政党民主主義運動(MMD: Movement for Multiparty Democracy)へ政権が

移ると、一部の伝統的支配者や村長たちは地方における政治的発言力を高めてきた。そんな中の 1994 年､この地域を支配する首長が森林保護区内への入村を許可したという噂が広まった。それには、植民地時代に白人に奪われた森林保護区に対する自らの正当な権利の主張という説明もつけ加えられていた。

この噂を根拠に多くの人々が森林保護区内に入って行った。国の森林保護政策に変更はなかったが、この森林保護区の森は瞬く間に伐採され、2006 年に訪問したときには、岩山と一部の平地を残しほとんどが耕地となっていた。森林保護区内への入植と開墾は、首長の任命を受けた村長の差配のもとで秩序立って行われた。入植者たちは、森林保護区で新しく村長になった人たちに入村料なるものを支払っていた。おそらく、村長たちも首長に何がしかの許可料を支払っていたと思われる [6)]。

写真 4:森林保護区のミオンボ林

写真 5: 「開拓」された森林保護区

C 村からも、もっと大きな耕地や換金作物生産に有利な低湿地(ダンボと呼ぶ)を求める農民たちが多くこの森に入っていった。1995 年の 2 代目村長の死もこの動きに拍車をかけた。村長の死は土地の汚れや地力の衰えを示すとの理由で、あるいは新村長の自民族（レンジェ）中心主義を嫌って何人もの村人が森林保護区に移っていった。

こうして森林保護区にあった立派なミオンボ林 [7)] は急速に破壊された。C 村の人々にとって、ミオンボ林は様々な食料や薬草などの宝庫であった。特に農業生産が失敗した年には、かけがえのない資源の供給源であった。それが岩山を残してほとんど切り開かれたのであるから、C 村の人々の飢饉時の脆弱性は増大したといえる。

自然資源が､このような政治的理由であっけなく破壊されることは、コモンズ論との関係で興味深い事例を示している。つまり植民地支配下で決められた森林保護区という線引きのもと一定の統制力が働いていたローカル・コモンズの利用形態が、そのルールの前提が壊されると同時に一気にフリー・アクセスの状態に転換し、文字通り「コモンズの悲劇」が実現してしまったと理解することができよう。

もう一つの事例は「過剰な死」による脆弱性増大の例である。C 村では 1990 年代末以降、一部の世帯で子供と働き盛りの壮年層の死が急速に増えてきた。それらがどれほど HIV/エイズの拡大と関連があるのか証明はできないので、ここではそれを「過剰な死」と呼んでおくが、その「過剰な死」を抱える世帯では、農業労働力の減少と、孤児の養育という問題に直面した。

農業生産の中で中心的役割を担う若者を相次いで病気で失った世帯では､それまで続けてきた拡大家族単位での共同耕作を廃止し、より小回りの利く世帯グループ単位での共同

耕作に切り替えた。それは、拡大家族内で起きている「過剰な死」の影響を、拡大家族内全体に波及させることを防ぐ効果は持っていたといえる。しかし、その後の経緯をみていると、一部の「過剰な死」を抱える世帯はその後も壮年者の死亡が続き、結局世帯としての農業生産が危ぶまれる状態になってきている。拡大家族単位の脆弱性緩和機能に依存できなくなった世帯の脆弱性は急速に悪化している。

写真 6：拡大家族総出の耕起作業

農村部における拡大家族内での孤児吸収力はかなり高いことが分かった。孤児といえども 7、8 才になれば農業労働や家事労働の重要な働き手として活動する。このため、養育する世帯にとっても孤児を抱えることが即「従属人口」の増大につながるわけでもないという理由もある。

C 村で「過剰な死」が観察された 3 世帯では、孤児となった子どもの養育は、すべて拡大家族内の世帯で行われていた。近年ザンビアでは親族以外の孤児養育の例が増えていると言われているが、この村では見られなかった。しかし 3 世帯のうちの 1 世帯では、孤児の養育をめぐり親族間で争いが生じ、養育者を変えるという事例がみられた。これをみると、拡大家族内で孤児の養育を行うことはこの村の世帯でも早晩難しくなるケースが出てくるのではなかろうかと危惧される。

孤児を引き受けることを即「従属人口」の増大と捉える必要はないと述べたが、それは見方を変えれば、孤児に対する強制的な労働従事が行われる可能性があることを示唆している。父や母の死は、孤児にとって過酷な生活をもたらすことになり、孤児養育問題は、世帯単位での脆弱性増大の問題としてではなく、個人の脆弱性増大の問題として捉えるべきであろう。

6. おわりに

アフリカの農村社会の脆弱性といった問題を考えるため、脆弱性の定義、さらに誰にとっての脆弱性であるかという脆弱性の主体の問題についてまず明らかにした。その後で、3 カ国における現地調査の結果をもとに、どの様な要因でどの主体に脆弱性増大が見られたのかを考察してみた。

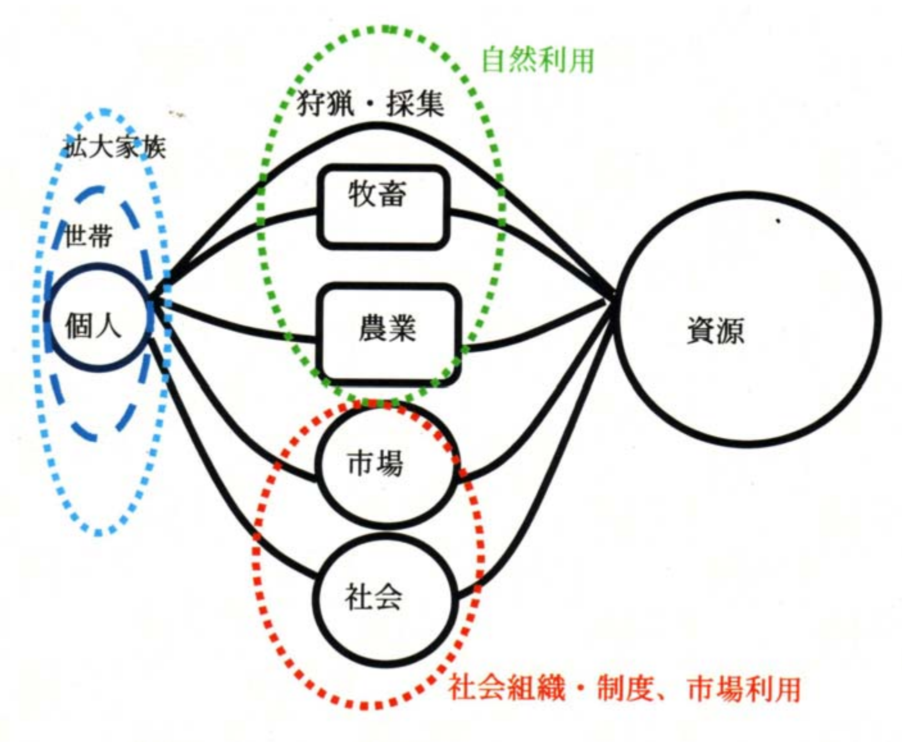
その結果、より確かな資源へのアクセスを求め脆弱性を回避する行動が、別の要因で逆に脆弱性増大を招来している事例や、「過剰な死」の例で見られたように、未経験の事態に遭遇し、伝統的方法でかなり有効に対処しつつも、その対処方法では限界に来ていることなども明らかとなった。

資源へのアクセスの確かさには、農業や狩猟・採集活動のように直接自然資源へ働きかけることで実現できるものから、社会組織や制度を通して間接的に実現できるものまで様々である（第 1 図参照）。本稿で述べた個人、世帯、社会集団という異なる主体は、それら多くの方法の中から、脆弱性増大を避ける方法を選び取り、資源へのアクセスを確かなものにしようと活動している。にもかかわらず、そのような活動が、思わぬ別の要因によ

って脆弱性増大のきっかけを作っているという複雑さがみられることが明らかとなった。

今後は、主体それぞれにとっての脆弱性増大の要因、プロセスをより明確にし、つぎに各主体の脆弱性増大が他の主体の脆弱性にとってどの様な影響を与えるのか、その影響のプロセスも含めて明らかにする必要がある。

このような農村社会の脆弱性のあり方が明らかになることによってはじめて、アフリカ農民や農村社会が直面している深刻な問題を、彼らが置かれている人間－環境システムの中での歴史的文脈の下で理解できるといえるのではなかろうか。



第 1 図　資源へのアクセス手段

注

1) 1997 年に科学研究費でアフリカの農村社会の脆弱性に関する研究を本格的に開始した。「アフリカの農業生産の危機に関する研究－『脆弱性』増大の視点から－」（1997 年－1998 年度・基盤研究(C)(2)）および「アフリカ小農および農村社会の脆弱性増大に関する研究」（1997 年－1999 年度・基盤研究(A)(2)）。この研究の延長線上で、著者は現在総合地球環境研究所における『社会・生態システムの脆弱性とレジリエンス』研究に参加し、脆弱性に関する研究を続けている。

2) Bassett, T. J. and Zueli, K. B. 2003. The Ivorian savanna: Global narratives and local knowledge of environmental change. in (Zimmerer, K. S. and Bassett, T. J. eds. 2003: 115-136). これはかつて *AAAG* に掲載された下記の論文をかなり改訂して再録したものである。Bassett, T. J. and Zueli, K. B. 2000. Environmental discourses and the Ivorian Savanna. *Annals of the Association of American Geographers* 90-1: 67-95.

3)この点でスウィフトの請求権は、個人を主体として考えたセン（Sen）のエンタイトルメント概念が想定している権利(Sen, A., 1981)よりも対象が広いといえる。センのエンタイトルメント概念が合法性に強く縛ら

れている点でもスウィフトの請求権の概念より対象が限定的であるといえる。

4) 小農や小作、農業労働者といった社会集団に焦点をあてて脆弱性を論じたワッツ＆ボール(Watts & Bohle 1993)は、社会の権力構造や階級構造の中で小農は脆弱な集団であると考えた。その場合に世帯単位としての小農も脆弱であることが想定されている。つまり社会における同じ属性を持つ個人の脆弱性は似ていることを前提に、個人の脆弱性の延長線上に社会集団の脆弱性が考えられている。このような彼らの脆弱性理解が、構造主義的で多様性を覆い隠しているとしてベリー(Berry 1984)やリチャーズ(Richards 1983)などから批判されている。

5) コート・ジボワール南部において 2000 ブルキナ・ファソ人排斥運動のように、「地元民」が「よそ者」を追い出すことはある。しかし、それは多くの場合、特年に起きた地元の土地占有集団による別に政治的緊張が高まった時に起きたわけで、平常な状況で起きることは少ない

6) この点は確認されていないが、別の森林保護区において環境省が不法侵入者の強制退去を決定した時に、首長がそれに非協力的な対応をして逮捕されるという事件が起きている。首長が積極的に関わっているケースもあると思われる。

7) マメ科ジャケツイバラ亜科の樹木が優占する林で、代表的な樹種が方名でミオンボと呼ばれることからミオンボ林と呼ばれる(大山　2002)。

引用文献

赤羽裕　1971.　『低開発経済分析序説』　岩波書店.

井上真 2004. 『コモンズの思想を求めて:カリマンタンの森で考える』　岩波書店.

大塚久雄 1969.　『共同体の基礎理論』　（大塚久雄著作集　第七巻）　岩波書店.

大山修一　2002. 市場経済化と焼畑農耕社会の変容－ザンビア北部ベンバ社会の事例－.　掛谷誠編　『アフリカ農耕民の世界:その在来生と変容』3-49. 京都大学学術出版会.

国際農林水産業研究センター 2000. 『砂漠化の評価と防止技術に関する総合的研究』　（環境庁地球環境研究総合推進費　平成 11(1999)年度研究成果報告書）国際農林水産業研究センター.

佐藤仁 2002 『希少資源のポリティックス：タイ農村にみる開発と環境のはざま』　東京大学出版会.

島田周平 1985.　書評：静かなる暴力－北部ナイジェリアにおける食糧、飢饉、小農－.　アジア経済　26-12: 82-87.

島田周平 1999. 新しいアフリカ農村研究の可能性を求めて－ポリティカル・エコロジー論との交差から－.　池野旬編　『アフリカ農村像の再検討』205-254. アジア経済研究所.

島田周平 2001. モシ農村のポリティカル・エコロジー. アジア・アフリカ地域研究 1: 21-36.

島田周平 2007. 社会的脆弱性の分析試論. 梅津千恵子編 『社会･生態システムの脆弱性とレジリアンス』(平成 18 年度総合地球環境学研究所 PR 研究プロジェクト報告) 112-122.　総合地球環境学研究所.

島田周平 a　2007.　『アフリカ 可能性を生きる』　京都大学学術出版会.

島田周平 b　2007.　『現代アフリカ農村－変化を読む地域研究の試み－』　古今書院.

Adger, W. N. 2000.　Social and ecological resilience: Are they related? *Progress in Human Geography* 24-3: 347-364.

Bassett, T. J. 1988. The political ecology of peasant-herder conflicts in the northern Ivory Coast. *Annals of the Association Geographers* 78: 453-472.
Berry, S. S. 1984. The food crisis and agrarian change in Africa: A review essay. *African Studies Review*, 27-2: 59-112.
Berry, S. S. 2001. *Chiefs know their boundaries: Essays on property, power, and the past in Asante 1986-1996.* Portsmouth: Heinemann.
Blaikie, P. 1985. *The political economy of soil erosion in developing countries*. London: Longman.
Bryant, R. L. and Bailey, S. 1997. *Third world political ecology*. London: Routledge.
Chambers, R. 1989. Editorial introduction: Vulnerability, coping and policy. *I.D.S. Bulletin* 20-2: 1-7.
Dercon, S., Hoddinott, J., Krishnan, P. and Woldehannna, T. 2008. Collective action and vulnerability: Burial societies in rural Ethiopia. *CAPRi Working Paper* 83, Washington: IFPRI.
Food and Agriculture Organization 2004. *HIV/AIDS, gender inequality and rural livelihoods: The impact of HIV/AIDS on rural livelihoods in Northern Province, Zambia*. Rome: FAO.
Foster, G. and Williamson, J. 2000. A review of current literature on the impact of HIV/AIDS on children in sub-Saharan Africa. *AIDS* 14*(suppl 3)*: S275-S284.
Hardin, G. 1968. The tragedy of the commons. *Science*, 162:1243-1248.
Osbahr, H. Boyd, E. and Martin, J. 2007. *Resilience, realities and research in African environment* (Report of Workshop 18 June 2007, University of Oxford) Oxford.
Richards, P. 1983. Ecological change and the politics of African land use. *African Study Review*, 26-2: 1-72.
Sen, A. K. 1981. Poverty and famine: An essay on entitlement and deprivation. Oxford: Clarendon Press.
Sneddon, C. S. 2000. 'Sustainability'in ecological economics, ecology and livelihoods: a review. *Progress in Human Geography,* 24-4: 521-549.
Swift, J. 1989. Why are rural people vulnerable to famine? *I.D.S.Bulletin* 20-2: 8-15.
Watts, M. 1983. *Silent violence; Food, famine and peasantry in Northern Nigeria*. Berkley: University of California Press.
Watts, M. J. and Bohle, H. G. 1993. The space of vulnerability; the causal structure of hunger and famine. *Progress in Human Geography*, 17-1: 43-67.
Wolde Mariam, M. 1986. *Rural vulnerability to famine in Ethiopia 1958-1977*. London: Intermediate Technology Publications.
Zimmerer, K. S. 1994. Human geography and the "new ecology": The prospect and promise of integration. *Annals of the Association of American Geographers*, 84-1: 108-125.
Zimmerer, K. S. and Bassett, T. J. eds. 2003. *Political ecology: An integrative approach to geography and environment- development studies*. New York: Guilford Press.

本論文は、日本地理学会 E-Journal　GEO　第 3 巻 2 号（http://wwwsoc.nii.ac.jp/ajg/ejgeo/）から転載したものである。

ザンビア、チボンボ県のある村における小規模灌漑の変遷

児玉谷　史朗
一橋大学大学院社会学研究科

本稿はチボンボ県のある村における小規模灌漑の変遷をたどることで、小規模灌漑発展の要因を探ると共に、環境や資源への灌漑のインパクトを考察する手がかりにしようとするものである。

灌漑はアフリカにおける農業増産と食料安全保障実現の方途として、また農業の「持続可能な集約化」として重視されている。しかし灌漑が持続可能で、環境の観点から健全であるかどうかは自明ではなく検証を要する。

ザンビアにおいても灌漑の振興が「持続可能で環境的に健全な農業」促進の一環として政策文書に明記されている。ザンビアではダンボ等の低湿地で地下水を利用した「伝統的灌漑」が 10 万 ha に及ぶと推計される。

調査地である C 村では 1990 年代初めまでに多くの農民が、畑地での天水農業によるトウモロコシの栽培とダンボにおける野菜の栽培を 2 本柱として組み合わせた農業を営んでいた。ダンボにおける野菜栽培は高い地下水位を利用し、バケツでの給水という灌漑によっていた。畑地でのトウモロコシ栽培とダンボでの農業は労働力や土地の点で補完的であり、ダンボ利用の農業は干ばつ等のショックの影響を受けにくい農業経営を可能にしていた。1980、90 年代には経済不振と構造調整政策の影響で都市部の雇用や所得が悪化しており、これも一因として C 村には村外からの流入者が多く、人口が増加していた。

1990 年代半ばに農産物と投入財の流通が自由化された。流通自由化によりトウモロコシの価格は変動するようになり、農民はトウモロコシ生産による収入を事前に計算しにくくなった。トウモロコシに比して化学肥料の価格が相対的に上昇し、農民にとってトウモロコシ生産の収益は悪化した。このため農民はトウモロコシ生産を補完する収入源を模索するようになり、炭焼き、トウモロコシの取引、小店舗の経営等様々な試みをした。この一環としてダンボの耕作も拡大した。

2001 年に Total Land Care というＮＧＯが村に来て、足踏みポンプの導入と畦と水路を持つ灌漑プロットの造成を柱として村民のグループに資金援助・技術指導を行い、普及をはかった。約 10 名の農民がグループを結成して足踏みポンプの導入と新しい灌漑を始めた。これは次の点で小規模灌漑の新段階であった。(1)バケツ灌漑からポンプ灌漑への移行。揚水能力が増大し、水のコントロールを伴ったより本格的な灌漑となった。(2)灌漑プロットの造成でより集約的な農業が導入された。(3)従来より栽培作物の種類が増加した。特に乾季作のトウモロコシは農産物自由化による季節的価格変動にも対応した新しい取組である。

足踏みポンプの導入により灌漑用水需要が増加したが、足踏みポンプを導入した農家の数が限定的であるため、灌漑用水需要の総量は急増しなかったかもしれない。ＮＧＯの支援を受けて新しい灌漑農業を導入するにはグループを結成する必要があり、グループに加入した（できた）農民とそれ以外の農民との間で農業生産や所得の格差が拡大した可能性

が大きい。
　2005 年頃からエンジン・ポンプを購入する農家が増え始め、2008 年の時点では 10 戸以上の農家がエンジン・ポンプを所有するに至っている。エンジン・ポンプを所有する農家のほとんどは足踏みポンプを所有する農家であり､灌漑用水需要の増大に対応するために、足踏みポンプから移行したものと考えられる｡2008 年になると IDE というＮＧＯが村でドリップ式灌漑の講習会を開催するなどして、新たな灌漑の普及と農民グループの結成を支援している。
　エンジン・ポンプ購入の背景には、2000 年以降のザンビア経済の回復に伴い、通貨クワチャが対ドルで増価した結果、輸入品が相対的に割安になったことが関係していると見られる。それでもエンジン・ポンプの価格は足踏みポンプの 3 倍近くであり、足踏みポンプと異なってガソリン代等の維持費がかかるため、エンジン・ポンプを購入できるのは、村の中でも裕福な農民に限定されると考えられる。
　具体的な揚水能力と灌漑用水使用量の計測は行っていないが、エンジン・ポンプは足踏みポンプより揚水能力が大きいので、灌漑用水使用の増大につながることは間違いない。エンジン・ポンプ導入に伴う変化の一つとして、従来ダンボ耕作地の灌漑に限定されていたものが、アップランドの畑の灌漑にも拡大したことが挙げられる。
　ポンプ灌漑の水は井戸から取水しているが、村長から割り当てられた土地内であれば、井戸を自由に掘ることができる。したがってダンボの土地にアクセスできる限りは、地下水の利用には制限や規制がない。川をダムでせき止めて取水する場合は、川の流域の村民および他の村との協議が必要であり、一定のコントロールがある。今後水利用に関する慣習法等によるコントロールについてさらに調べる必要がある。

ザンビア南部州におけるグェンベ・トンガのウシ飼養
－2008 年度調査報告－

岡本雅博
総合地球環境学研究所

要旨

本報告は、2008 年に実施したグェンベ・トンガのウシ飼養に関する現地調査の概要である。調査の結果、グェンベ・トンガがウシ飼養を受容した時期は比較的近年であること、現在では婚資はウシと現金になってきていること、ウシ飼養は牛耕に使用されるなど農耕に有用であるが、放牧地と耕地とのあいだには競合関係がみられること、ウシは基本的には個人が所有するが母系親族集団が共有する場合があることなどが明らかになった。

１．調査の目的

ザンビアの南部州は、同国のなかでもウシ飼養のもっとも盛んな地域のひとつである。図１に示したごとく、南部州は西部州、東部州についでウシの頭数が多い地域となっている[1]。南部州を居住域とするバントゥ語系民族集団のトンガ（Tonga）は、文化的・言語的にみて、南部州の高原地帯に住む高地トンガ（Plateau Tonga）とザンベジ川中流域のかつてのグェンベ渓谷周辺に居住するグェンベ・トンガ（Gwembe Tonga）[2]に大別できる。ウシ飼養に関していえば、高地トンガは、同じく南部州を居住域とするイラ（Ila）と並んでザンビアでも名高いウシ持ちの民族として知られるが（Colson 1951）、グェンベ・トンガではウシ飼養はそれほど盛んではなく、近年になって普及した（Cliggett 2005）。

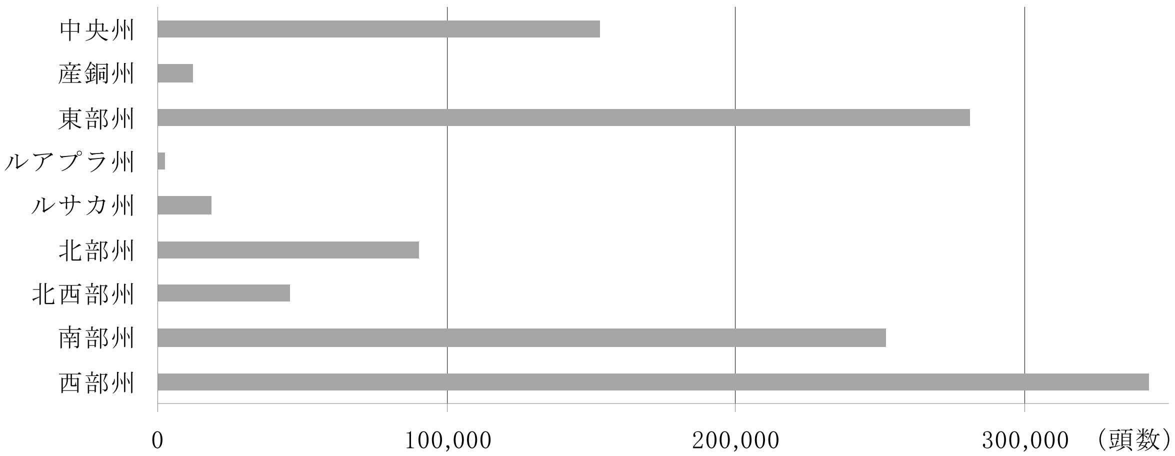


図１　ザンビアにおける州ごとのウシの頭数（2002 年）
（Central Statistical Office 2004 をもとに作成）

[1] 西部州はロジ（Lozi）、東部州はチェワ（Chewa）、ンゴニ（Ngoni）などの民族集団の居住域となっており、それぞれウシと農業とを組み合わせた生業形態がみられる。
[2] グェンベ・トンガは、渓谷トンガ（Valley Tonga）とも呼ばれる。

こうした状況を踏まえたうえで、現在のグェンベ・トンガにおけるウシ飼養の実態を把握し、そしてその変遷を明らかにすることを目的として、現地調査を実施した。

２．調査の概要

現地調査では、2008 年 11 月から 12 月にかけて、ザンビア共和国の首都ルサカおよび南部州において政府諸機関での家畜飼養に関する文献資料の収集および聞き取り調査、ならびに調査地域の概観調査、農家世帯での聞き取り調査を実施した。おもな調査内容は以下のとおりである。

（１）首都ルサカ

① 政府中央統計局　ザンビアの家畜飼養に関する統計資料の収集。

② ザンビア大学　旧ローズ・リヴィングストン研究所（現ザンビア大学社会調査研究所）発行の文献資料の収集。

（２）南部州

① 農業省獣医畜産局南部州事務所（チョマ県）　南部州における家畜飼養の概況と疾病に関する資料の収集および職員への聞き取り。

② 農業省獣医畜産局シナゾングェ県事務所　南部州シナゾングェ県における家畜飼養の概況と疾病に関する資料の収集および職員への聞き取り。

③ チョマ博物館　トンガの歴史・文化に関する民族学的展示の見学および文献資料の収集。

④ シナゾングェ県広域概観調査　車輛を用いて、調査サイトA、B、C[3]のほか、カリバ湖、マンバ炭鉱、カンダブゥエ炭鉱などの概観調査。

⑤ 調査サイトＡ[4]に位置するシアネンバ村（シナゾングェ県）に滞在し、同村および周辺村の農家を訪問し、家畜飼養に関する聞き取りおよび参与観察。

３．調査結果の概要

現地調査の結果明らかになった諸点のうち、特にサイトＡにおける家畜飼養に関する事項を以下に列挙する。

（１）グェンベ・トンガにおいてウシ飼養が盛んとなったのは 1950 年代のカリバ湖建造にともなう強制移動の以降である。それまでのグェンベ渓谷では、ツェツェバエの被害があったこともあり、ウシの数は少なく、主要な家畜はヤギであった。

（２）ヤギからウシへという飼養する家畜種の変化は、婚資（*kusela*）の変遷に如実にあ

---

[3] 南部州の高地に位置するチョマ県からカリバ湖岸の低地であるシナゾングェ県までは、農業生態的・社会経済的に多様であるため（櫻井 2008）、レジリアンス・プロジェクト（総合地球環境学研究所のプロジェクト「社会・生態システムの脆弱性とレジリアンス」）では、カリバ湖岸の平坦地にサイトＡ、高地に至る斜面地・丘陵地にサイトＢ、高地にサイトＣと、3 つの調査区を設定している。

[4] サイトＡを今回の主たる調査地とした理由は、サイトＡがサイトＢ、Ｃと比較してウシの飼養頭数がもっとも多いとみられたからである（櫻井 2008）。

らわれている。すなわち婚姻に際して、夫方親族から妻方親族に支払われる婚資は1950年代まではヤギと現金が主流であったが、現在ではウシと現金（場合によってはあわせてヤギも）へと変化した。

（３）飼養されているウシの利用法として、もっとも重要なのは牛耕に用いることである（写真１）。しかしながら、去勢ウシの数が足りない世帯も多く、そうした世帯では雌ウシを牛耕に用いるケースもみられる。獣医局のスタッフによれば、雌ウシを牛耕に使用する例はザンビアでも稀であるという。

写真１　トウモロコシ畑の牛耕

写真２　収穫後のトウモロコシ畑でのウシの放牧
（点在する樹木はアカシア・アルビダ）

（４）ウシの放牧域や飼料は季節的に変化する。すなわち集落周辺のブッシュでの放牧のほかに、乾季のはじめになるとトウモロコシやワタの収穫後の耕地で刈り跡放牧がおこなわれ、また6月から8月頃には、肥料効果を意図して耕地に人為的に残されたマメ科高木のアカシア・アルビダ（*Acacia albida*）の実が飼料となる（写真２）。しかしながら、放牧地の面積および飼料の絶対量は十分ではないとみられ、そのことが人びとのミルクの利用の制限要因となっていると考えることができる。

（５）農耕がおこなわれる雨季のあいだは、ウシやヤギによる作物への食害が大きな問題となる場合が多い。そのため雨季の期間には、耕地の周囲をアカシア・アルビダなど有棘樹の枝を張りめぐらせて、家畜除けの囲いを作っている。

（６）また家畜の耕地への侵入を防ぐために、村長のイニシアチブのもと、村（集落）を単位として、家畜の放牧時には牧童の同行を義務づける時期を設定している。その時期は、トウモロコシの播種がはじまる 11～12 月頃から、ワタの収穫が終了する 7 月下旬までである。

（７）ウシを食用のために屠殺することは、葬式の場合などを除いては、ほとんどない[5]。ウシを現金に変えたいときは、知人に売却するか、もしくはルサカなどから来た買い付け人に売ることが多い。いっぽうヤギは、食用のために屠殺することも多く、またシナゼゼの町にはヤギの屠殺場が設けられている。

（８）たいていの場合、ウシは個人によって所有されている。しかしながら婚資として妻方に贈与されたウシは、妻の母系親族集団[6]によって共有されることがある。そのようなウシは、「親族のウシ」（*ngombe lya mugowa*）と呼ばれ、母系親族のなかで何かあったときに処分することがある。

４．むすびにかえて

今回の現地調査で、グェンベ・トンガにおけるウシ飼養の概況を把握することができた。これまでレジリアンス・プロジェクトにおいて、ウシ飼養についてのインテンシブな調査は実施されてはこなかった。しかしながら、現在のグェンベ・トンガの生業および社会生活みる限り、ウシ飼養のしめる比重は決して小さいとはいえない。本プロジェクトの課題であるグェンベ・トンガの社会がもつ「レジリアンス」の解明にむけて、ウシ飼養の実態解明にむけたさらなる調査をすすめてゆきたい。

参考文献

Central Statistical Office. 2004. *Agricultural and Pastoral Production Structural Type and Post harvest Data for Small and Medium Scale Farmers*. Lusaka: Central Statistical Office.

Cliggett, Lisa. 2005. *Grains from Grass Aging, Gender, and Famine in Rural Africa*. New York: Cornell University Press.

Colson, Elizabeth. 1951. The Role of Cattle among the Plateau Tonga. *Human Problems in British Central Africa / The Rhodes-Livingstone Journal 11*.

櫻井武司 2008「ザンビア南部州における農家家計の資産保有状況－調査対象村の 2007 年度センサス結果から－」『社会・生態システムの脆弱性とレジリアンス－平成 19 年度 FR1 研究プロジェクト報告』総合地球環境学研究所

[5] 高地トンガでは成女式（*nkolola*）のときにウシを屠殺する習慣がひろくみられるが、現在のグェンベ・トンガでは成女式は一般的ではない。

[6] 母系制の社会システムをとるトンガでは、ムゴワ（*mukowa*）と呼ばれる母系クラン・リネージの存在が認められる。

ザンビア南部州におけるヒューマンネットワークの概要

石本雄大
総合地球環境学研究所

要旨

本研究の目的は、ザンビア南部州で暮らすトンガの人々が築く日常のネットワークを明らかにすることである。また、こういった日常の人間関係が形成される状況についても報告する。

調査地で観察される主なヒューマンネットワークには、親族ネットワーク、地縁ネットワーク、教会ネットワーク、学校ネットワーク、レクリエーションにおけるネットワーク、現金獲得上のネットワークがあった。

またヒューマンネットワークの形成には、新たなネットワークの構築がなされる場合とネットワークの再構築がなされる場合とが考えられた。前者には婚姻、移住、就学、就業など、後者には婚姻、移住、離婚、卒業、離職、所属教会の変更、村の独立などが考えられた。本稿では、親族ネットワークの構築および再構築に強くかかわる婚姻に焦点を当て、ヒューマンネットワークの形成について考察した。その結果、近隣村の成員同士の結婚が多いこと、村の属す旧地縁集団の出身者同士の結婚が高い割合を占めることが明らかになった。

1. はじめに

Fig. 1 のようなヒューマンネットワークは日常生活の中で築かれる（以下、図は全て英文報告書を参照）。そして、その中の一部は、生態的もしくは社会的問題が生じた際の解決手段として利用される。そのため、ヒューマンネットワークはレジリアンスの構成要素の１つであると考えられる。

ネットワークは問題発生時の状況に応じ選択されるため、毎回同じものが活用されるとは限らない。そのため、非常時に活用されるヒューマンネットワークについて議論する前にまず、ネットワークの全体像を把握することが重要である。本研究の目的は、不安定な生態環境である半乾燥熱帯に位置するザンビア南部州で暮らすトンガの人々が築く日常のネットワークを解明することである。そして、こういった日常の人間関係が新たに構築される状況および再構築される状況についても報告する。

また、本研究においてヒューマンネットワークという語は、人々の間に成立するつながりの構造と、そのつながりの間に発生する行為やモノの流れ（やりとり）を意味する。本年度は前者のつながりの構造について記すこととし、後者の行為やモノの流れについては来年度以降に報告することとする。

2. 調査概要

調査地は、ザンビア南部州シナゾングウェ地域[*1]の低平坦地に位置するサイトA、中間の傾斜地に位置するサイトB、高平坦地に位置するサイトCであった。いずれのサイトにおいても住民の大部分はトンガの人々であった。Fig.2 に調査村を示した。他のプロジェクトメンバーとの合同調査村を赤印、報告者が追加した調査村を青印で表した。

調査期間は乾季中、6 月末から 10 月末までであった。調査方法は直接観察およびインタビューであり、一部のインタビューには質問票を用いた。主な調査項目は、ヒューマンネットワークの種類、各ネットワークの特徴、婚姻、出身地であった。

3. ヒューマンネットワーク概観

調査地で観察される主なヒューマンネットワークには、親族ネットワーク、地縁ネットワーク、教会ネットワーク、学校ネットワーク、レクリエーションにおけるネットワーク、現金獲得上のネットワークがあった。本稿ではこれらの特徴を順に記述していく。

3-1. 親族ネットワーク

本節では調査地域において大多数を占めるトンガの人々の親族組織の特徴を記述する。具体的なネットワークについては、第 4 章において婚姻の事例を取り上げる。

トンガの人々は、Fig.3 で示したようにグウェンベ・トンガとプラトー・トンガとに大きく分けられた。サイト A およびサイト B の人々は主にグウェンベ・トンガであり、サイト C の人々は主にプラトー・トンガであった。

更に小さい集団としては、クラン（以下トンガ語で*mukowa*）が挙げられる。*mukowa*の名には、ウシ、サル、ヤギ、シマウマ、イヌといった動物名や、カボチャの葉や種子といった植物関連の名があった[*2]。グウェンベ・トンガおよびプラトー・トンガにまたがる*mukowa*も多かった。同一クランの成員には、年長者と年少者の間にはオジーオイ[*3]の関係が、同年代の者の間にはアニーオトウトの関係が成立していた。

トンガ人の婚姻制度は、一夫多妻制であり、夫方居住であった。また、子は基本的に父親の名を姓として使用していた。一方 *mukowa* は、母親のものを継承していた。

土地相続では、子が父の土地を基本的に受け継いでいた。しかし、土地が不足している場合には、父方だけでなく母方の親族からも土地を譲り受ける場合があった。

3-2. 地縁ネットワーク

カリバダム建設に伴う強制移住、および、その後に自主的に行われた再移住により、地縁ネットワークには大幅な変化が生じた。ここでは代表的地縁ネットワークである村組織を取り上げる。 まず、調査地域における村の特徴を、次に各サイトにおける村成立の特徴を記述していく。

[*1] 本稿ではシナゾングェ県および隣接するチョマ県をさす。
[*2] トンガ語でウシ *muwiinde*、サル *muchinba*、ヤギ *mulea*、シマウマは *mugonka*、イヌ *mukuli*、ワニは *muetwa*、ウサギは *musanje*、カボチャの種子は *mutanga* であった。
[*3] 年長の男性は *aisha*、年少の男性は *mujuwango* と呼ばれていた。

調査地域において、村の特徴は大きく 5 つ挙げられる。①複数クランの人々が混住すること、②自治組織の単位となること、③未利用地は村へ属し、村長や村委員会により使用の承認が行われること、④道路整備等の共同労働を行われること、⑤井戸建設や食料援助の際の受給単位となることである。

村成立の特徴は Fig. 4 を見ると、1957 年のカリバダム建設開始後にサイト A で新村が急増し、その後サイト B やサイト C でも村が増加していたことがわかる。Fig. 4 の村の成立年とは、伝統的首長によって村長を置くことが承認された年のことである。即ち、村の成立年以前からその土地に村人が住んでいた場合もある。またこの図では、サイト B およびサイト C において、調査地以外の村の情報が記されていない。これは、サイト B およびサイト C では、調査地以外の村について十分な調査を行うことができなかったためである。

サイトごとの村数の増加の経緯を述べる。サイトAでは、ダム建設の際に現在のカリバダム内の土地から多くの村々が移住を強制され、新村を作った。移住前に近接していた村々は、今もなお、旧地縁集団（*Chilonga, Dangwe, Landani, Njola*）に属している。同様にダム建設前からこの地域に存在する村々も独自の集団名（*Buleya*）を持っていた[*4]。

Fig. 5 は、サイト A の村々をその旧地縁集団ごとに色分けした図である。村長もしくは副村長の家屋の緯度経度データを地図上に示した。強制移住以前から存在していた *Buleya* の村々は、特にナゴンベ川沿いに集まっており、それ以外の集団はその周囲に形成されたことが分かる。また、*Chilonga* や *Landani* は比較的散在していることが明らかになった。

サイト B は、広大な未利用地が広がっていたため、サイト A に設立された新村の土地条件が悪化するとサイト B へ再移住してくる者が相次ぎ、複数の村の出身者により構成される新村の設立がなされた。 サイト C には、カリバダム建設以前から村が存在していたが、サイト A に設立された新村の土地条件が悪化すると、サイト B と同様に再移住者が相次いだ。

3-3. 教会ネットワーク

調査地域では、大部分の人々はキリスト教徒である。ここでは、調査地域におけるキリスト教教会系の特徴を記述していく。

調査地域には複数の宗派の教会が混在していた。Pentecostal、Seventh-Day Adventist、United Church of Zambia、New Apostolic Church などである。教会は大きな町だけでなく地方の村々にも建立されているが、Fig. 6 のように、教会が一つもない村、複数の宗派の教会がたてられている村があった。多くの人々は週末に礼拝に行くが、一部の人は信仰深くなく教会に通っていなかった。人々は、複数の宗派の中から選ぶため、必ずしも最寄りの教会に通うというわけでない。また、夫婦はおおむね同じ教会へ通っていた。教会は礼拝の場を提供するだけでなく、大きな町の教会は医療及び教育の施設を持つこともあった。

それぞれの宗派が、広い地域から多くの支部の参加する大規模な集会を年に 2, 3 回開催していた。例えば New Apostolic Church では、大規模な Good Friday（４月）, Harvest（８

[*4] ただし、*Buleya* に属す村の中にも、ダム建設以前に設立されたものがある。Fig.4 および Fig.5 の A6 は A8 から、A40 は A1 から独立した。

月）、中規模な meeting of comity（１０月）を数日間に渡り開催していた（Fig. 7）。その他にも、少数の支所のみで小規模に催す音楽祭（Fig. 8）など、複数のイベントを開催していた。これらの集会のため、歌の練習、会の準備、当日の食事・宿泊をともにするので同じ教会のメンバーは親交が深まる。

3-4. 学校ネットワーク

小学校は複数の村に対して 1 校建てられているため、児童は村を越えての知人・友人を獲得する（Fig. 9）。また、児童だけでなく、運営を支援する親同士のつながり（PTA）もできる。特に Community スクールは近隣の村人によって資金の工面がなされるため、政府系の学校よりも親同士のつながりが強いことも考えうる。また、高校は数が少なく大きな町にしかないので、生徒は寄宿生活を送る。 例えば、シナゾングェ県では、Maamba に 1 校しかない。そのため、生徒は小中学校よりも広域に友人を得ることができる。

3-5. レクリエーションにおけるネットワーク

本稿では、選手だけでなく、観戦などでより多くの人が係るサッカーを取り上げる。

乾季中、シナゾングウェ・ディストリクトの各村[*5]が参加するカップ戦が行われていた。まず収穫後 4 月末から 9 月は各地区（1 地区 10 チーム弱）で総当たりのリーグ戦が行われ、そのご上位 2 チームが 10 月からトーナメント戦に参加していた。

同一チームの選手・応援団ともに結束が固まっていた。同時に、頻繁に相手チームの関係者とも顔を合わせることとなり親交が生まれていた。また、トーナメント戦では自らの村のチームが敗退してしまった場合にも同地区のチームを応援に出かけるため、他の村の成員であっても知人となる場合、親密となる場合があった。

3-6. 現金獲得活動上のネットワーク

現金獲得活動におけるヒューマンネットワークは、地元で活動する企業での就業、都市への出稼ぎ労働、域内での商業活動の際に形成されていた。

調査地域で活動する企業には、農業関連企業、道路工事を行う建設会社、鉱山会社、煮干大の小魚カペンタを出荷する会社などがあった。また、出稼ぎ労働は、南部州の都市（チョマ、リビングストン）、首都ルサカ、まれにコッパーベルト州でも行われていた。商業活動には、綿花・オクラや魚の買い付け業者への販売、野菜・魚・林産物の地方市場における販売、商店経営、トラック運送業などがあった。

4. ヒューマンネットワーク形成

ヒューマンネットワークの形成には、新たなネットワークの構築がなされる場合とネットワークの再構築がなされる場合とが考えられた。前者には婚姻、就学、就業などが考えられた。移住も新たな地縁関係の獲得という意味では前者に含まれるであろう。後者には、離婚、卒業、離職、所属教会の変更、村の独立などが考えられた。移住も、元々住んでい

[*5] 小さい村では複数の村で１つのチームが、町では複数のチームが構成されていた。

た地域での地縁関係を考えると後者に含まれるといえる。また、婚姻は、婚姻前から血縁関係にあった場合では、前者というより、後者に含まれると考えたほうが適切かもしれなかった。本稿では、親族ネットワークの構築および再構築に強くかかわる婚姻に焦点を当て、ヒューマンネットワークの形成について考えていきたい。

4-1. 結婚のきっかけ

全調査村の全ての夫婦に、結婚のきっかけ、二人はどのように出会ったかについて聞き取り調査を行った。主要な解答として、親戚、隣人、同じ学校の生徒、同一教会のメンバーとして出会い、結婚に至ったとの答えが多かった。また、その他に市場、サッカー場、伝統的ダンスの場にて出会ったという答えも見られた。つまり、3 章で紹介したネットワークを利用し、姻戚関係というネットワークの構築が行われたことが明らかになった。この聞き取り調査については、今後調査村間で比較分析を行う必要がある。

4-2. 通婚圏

婚姻によってヒューマンネットワークの構造がいかに形成されているか考察するため通婚圏についての分析を行った。夫婦のそれぞれの出身地を、まず調査村との近接の度合いについて、次に旧地縁集団ごとの関係について分析を行った。ここでは、ダム建設前からサイト A に存在していた地縁集団 *Buleya* である Siameja、Nagombe、Chande と、建設時に新村をつくった集団 *Chilonga* である Sianemba、Mambova、Siansima A を取り上げた。

Fig. 10 は、夫婦の出身地と調査村との近接度合いについて分析したものである。Fig. 10-1 は、夫と妻の出身地がいずれも SiteA である場合には Village of Site A とし、いずれかの出身地が Site A 外の場合には Other Area として、その夫婦の数を比較した図である。Village of Site A（夫婦の出身地が Site A の場合）は全体の約 57－80％と多かった。Fig. 10-2 は、夫婦の出身地がいずれも Site A である場合、出身地と調査地との近さはどの程度であるかを比較した図である。RN は調査村および隣接村、NBO は調査村から一つおいて隣の村、OSA はサイト A のそれ以外の村を表す。夫婦の出身地が RN である場合が約 44－77％であり、NBO の場合も含めると約 52－84％であった。つまり、今回分析した村においては、近隣村の成員同士の結婚が多いことが明らかになった。

Fig. 11 は、夫婦の出身地がいずれも Site A である場合に、それぞれ旧地縁集団のいずれに属するかについて比較した図である。B は *Buleya* を、C は *Chilonga* を、D は *Dangwe* を、L は *Landani* を、N は *Njola* を表し、&はそれらの地縁集団の夫婦の組み合わせを表す。Fig. 11-1 より *Buleya* の村では *Buleya* 同士の夫婦が約 38－56％と最も多く、Fig. 11-2 より *Chilonga* の村においても *Chilonga* 出身同士の夫婦が約 31－37％を占め最多であった。その結果、今回分析を行った村においては、その村の属す旧地縁集団の出身者同士の夫婦が最も高い割合を占めていることが明らかになった。

地域レジリアンスの解明に向けた生態･社会の変化と人間活動に関するデータ統合の概念的アプローチ
―南部州における共同研究から―

吉村充則[1]，石本雄大[2]、梅津千恵子[2]、岡本雅博[2]、真常仁[3]、田中樹[4]、松村圭一郎[5]、宮嵜英寿[2]、山下恵[6]

[1]リモート･センシング技術センター、[2]総合地球環境学研究所、
[3]京都大学大学院農学研究科、[4]京都大学大学院地球環境学堂、
[5]京都大学大学院人間環境学研究科、[6]近畿測量専門学校

要旨

我々は、これまで社会-生態的な脆弱性とレジリアンス、さらに人間活動との関係を明らかにする取り組みを続けてきた。本稿では、ザンビア南部州のプロジェクトの集中調査地において異なる研究者が収集した社会-生態学的な変化と人間活動に関するさまざまなデータを使った地域レジリアンスの解明に向けたデータ統合にについて、その概念をとりまとめた。

1.　はじめに

ここでは、社会的事象と生態的事象を相互に関連付ける。また、現在我々が行っている調査についての相互関連性についても検討した。

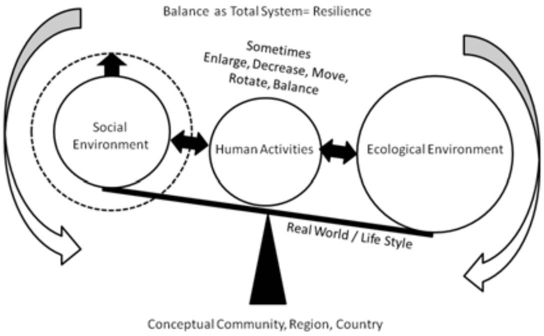
2.　地域レジリアンス

社会･生態の変化と人間活動の関係をまとめたものを図－1 に示す。図では、社会･生態と人間活動の 3 つが一本の’やじろべえ’上に位置し、それぞれが独立して、大きくなったり小さくなったり、あるいは右によったり左によったりしながら存在している。そして、それらは互いに影響しあい、この’やじろべえ’を構成し、全体が実際に我々の生活している空間や社会をあらわす。また、この’やじろべえ’は、レジリアンスを考える際の単位となる。我々は、その最小単位が地域にあるとし、村レベルの調査を基本として、そこに住む人々のネットワーク土地利用戦略に関する調査などを行っている。レジリアンスの最小単位を定義すると、そこには’やきろべえ’のシステム外から加わる力の存在に気付く。例えば、気候変動は、その地域で起きているわけでは必ずしもないが、地域に対して大なり小なり影響を及ぼしている。また、政府や国際機関の存在も、規制や援助といった面から地域に対して影響を与える。このように’やじろべえ’システムがレジリアンスを考えるひとつの概念である。

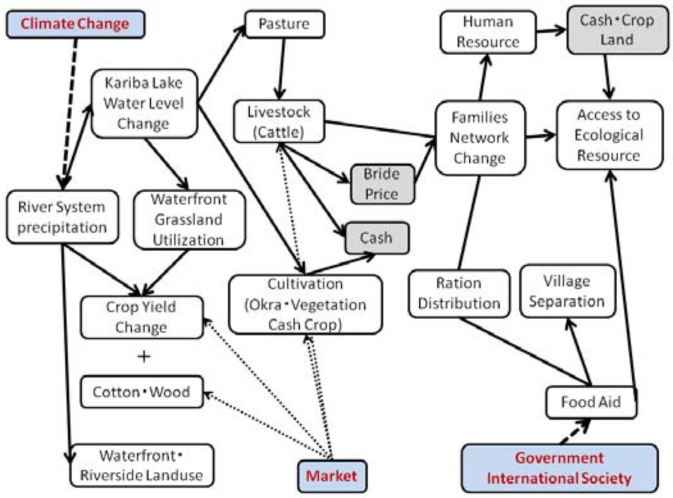
3.　収集データの相互関係

これまで我々はプロジェクトの集中調査地である南部州において、さまざまな調査を実施してきた。図－2 では、さまざまな調査を相互関連といった観点からとりまとめた。図－1 の’やじろべえ’に外から加わる力が図－2 の赤字･薄青色ボックスに対応する。主に、

図の左側が生態的要因で右側が社会的要因である。生態的要因は、気候変動の影響などを受け、それは対象地域の土地利用に影響を及ぼし、農作物の収量に変化をもたらす。農作物の収量変化は、地域の人々の現金獲得に影響をもたらし、それは、国際機関や国が行う食料安全政策に対しても間接的な影響を与える。これらの要因は現金によって相互に結びつけることができる。また、現金は、農作物だけでなく家畜にも影響を及ぼす。



図－１　社会-生態環境と人間活動に基づく
レジリアンスの概念



図－2　収集データの相互関係

4.　まとめ

本稿でまとめた地域レジリアンス構築に向けたデータ統合の概念は、関連する調査の多くが実行中であり、まだ十分な解を導き出すに至っていない。引き続きフィールド調査に基づくデータの収集と蓄積を継続するとともに､データ統合･収集データの相互関係といった観点から議論をしていきたいと考えている。そのためにも、個々の調査のさらなる充実と客観データの収集に努めることが重要である。

村落レベルでの生業活動追跡のための時空間データ収集

山下恵[1]，宮嵜英寿[2]
[1]近畿測量専門学校， [2]総合地球環境学研究所

植生被覆や土地利用/土地被覆は、様々な空間スケールでの自然環境変動と人間社会活動が反映された、その時その時の地表の状態である。したがって、地表の変化を時間的・空間的にモニタリングすることは、社会-生態システムにおける脆弱性、回復性を把握する上で重要となる。空中写真や人工衛星画像には、広域性・同時性があり、地表の状態をモニタリングする上で強力なツールとして広く活用されている。しかしながら、地表の状態を正しく理解するためには、それらを裏付けるための現地の状況や生業に関するデータが必要不可欠である。

そこで我々は、村人の生業活動を村落レベルから地域レベルに渡って時間的空間的に追跡することを目的とし、現地調査から空中写真・衛星画像までの異なる空間スケールデータを時系列で収集している。ここでは、空間スケールは、1 カ村の各世帯が農耕を行う約数キロ四方から、村落コミュニティを形成する 5-10km 四方、さらには村落コミュニティの集まりとなる地域数 10km 四方範囲までを設定し、村落レベルを共通の空間スケールとして、現地調査および空中写真・衛星画像解析を開始した。また、時間スケールについては季節変化と経年変化を考慮し、1970 年代から 2000 年代までおよそ 10 年間隔で撮影された空中写真および衛星画像、ならびに 2001 年以降に撮影された雨期・乾期・収穫期の衛星画像を入手している。

現地調査の対象サイトは、南部州のシナゾングウェ地区に設置した 3 地区(5 ヵ村)で、カリバ湖畔に近い低地から、丘陵地、標高 1000m 以上の高地までの異なる地形上に位置している。現地調査では、2007/2008 年雨季と 2008 年乾季に耕作地として利用された土地の境界を GPS で測定し、各々の耕作地について作物名、土壌、肥料、地形的特徴、土地の履歴等々の聞き取りを行った。そして、現地調査結果に基づき、2007/2008 年の雨季・乾季の作物別耕作地分布図を作成した。現地調査による耕作地分布図と衛星画像との重ね合わせた結果、位置精度は十分であることが確認できた。現地調査は、来年度も引き続いて実施していく。

空中写真は、ザンビア測量局が所有する 1970 年、1980 年、1991 年 3 時期の現地調査対象サイトをカバーする範囲で合計 227 枚を購入した。空中写真の撮影縮尺は約 1:30,000 であった。これら空中写真を用いることで、数 m の解像度を持つ数値地形モデルおよび正射画像の作成、さらには縮尺約 1:10,000 相当の地形図の作成が可能となる。

2009 年度は、現地調査による雨季・乾季の作物別耕作地分布図、空中写真・衛星画像解析による地形および耕作地分布図に、世帯調査や家畜、放牧地に関するデータを統合していきたいと考えている。

ザンビアにおける食糧安全保障体制の構築過程
―早期警戒システムと災害対応機関の歴史と現状―

松村圭一郎
京都大学大学院人間・環境学研究科

2008 年度の調査概要と研究成果の要約

2008 年度は、8 月～9 月にザンビアの首都ルサカおよび南部州において、①ザンビアにおける食糧安全保障体制の構築過程、②政府・国際機関・援助団体などが行う旱魃対応や食糧援助に関する資料収集、③政府と NGO による食糧援助の配付現場の現地調査を行った。

① ザンビアの食糧安全保障体制の構築過程に関する調査

FAO や DMMU などの行政資料によると、ザンビアでは 1980 年代初頭から、FAO やドナー諸国の支援のもとで、旱魃など自然災害への早期警戒システムの整備が進められてきた。外部からの資金提供によって、いくつもの組織が設立され、運用されてきたが、資金援助がストップすると、いずれの組織も解消されたり、十分に機能しなくなってきたことがわかってきた。

② 政府・国際機関・援助団体などが行う旱魃対応や食糧援助に関する調査

前年度の調査で収集した資料（2004－07）に引き続き、2007／08 シーズンにおけるシナゾングウェ地区での食糧援助実施状況（配付量・対象世帯数等）の資料を収集した。2007 年度には、政府系の援助として 3 月と 10 月に、2008 年度は 8 月から 9 月にかけて食糧援助が実施されていた。また国際 NGO である World Vision (WV)についても資料を収集し、2007 年 10 月からあらたな援助プログラム（C－FAAM）が実施されていることがわかり、対象地区と世帯数のリストを入手した。

③ 政府とNGOによる食糧援助の配付現場の現地調査

今回の調査期間中に、政府による食糧援助が実施されていたこともあり、穀物の運搬から配付者リストの作成、配付にいたる援助食糧の一連のプロセスについて、現地調査を行った。その結果、現場レベルのさまざまな課題があきらかになり、政府のガイドラインとは異なる運用の実態もわかってきた。

今後の課題と調査計画

2009 年度は、これまでの調査結果をふまえながら、さらにシナゾングェ地区における食糧援助がローカル社会にどのようなインパクトをもたらしているかを現地調査にもとづいてあきらかにする。とくに、食糧援助の配付によって、村の分裂が進んできた事態に注目し、どのような背景で村の分裂が起きているのか、そうした状況の変化が農村社会のレジリアンスといかなる関係にあるのか、注目して調査を進めたい。

事前と事後のリスク対処戦略
―ザンビア東部・南部州の自給的農民はいかに行動しているか？―

Thamana Lekprichakul
総合地球環境学研究所

ザンビア東部州と南部州では、小規模農民が生活のかなりのリスクにさらされており、生活水準の激しい変動を伴う結果となっている。この結果、彼らは複雑なリスク対処戦略の組み合わせを発達させ、これによって危機の前にリスクを回避したり、移転したり、減少したりし、またショックを経験した後に厚生への影響を緩和し、防御している。旱ばつ、マラリア、家畜の疾病、洪水、家長の死亡が 2001 年から 2006 年までの過去６年間で小規模農民が経験したものとしてトップ６災害に挙げられたものである。その中でも旱ばつは、小規模農民にとって最もダメージが大きい災害と報告されている。

世帯はリスクが発生する前にそれに対処する方法をいくつか持っている。リスク回避、リスク転移、リスク減少は３つの主要な戦略である。通常最も良く使われるリスク対処の方法として、この研究ではリスク減少に焦点を当てる。リスク減少は多様化、自給化、差別化などによって達成される。その中でも、差別化は低リスク・低リターン型の生業システムでは実行に限界がある。一方、食料生産の自給化は、基本的で最も典型的な戦略である。市場の不在または不完全性は自給的戦略の存在に貢献しているかもしれない。加えて、東部州と南部州の農民は、生業の多様化、作物の多様化、圃場の多様化、資産の多様化、家畜の多様化等さまざまな多様化の戦略を取っている。

東部州と南部州の小規模農民が取るこれら事前的多様化戦略には違いがある。南部州に比較して、東部州では、世帯の規模が大きく、賃金労働やその他のビジネスからの収入機会があり、送金や仕送りをしてリスクを分散しており、野菜や果物を売り、多様な資産を所有し、家畜の種類も多様である。南部州での農家の作物の種類は、比較的市場リスクの低い穀物生産が中心となっており受動的である。一方東部州では、ダウンサイドリスク（可能損失額）に弱い換金作物を重要視している。多様性をスペクトラムとして捕らえ、垂直的多様性を１極とし、水平的多様性をその対極とすると、南部州農民のリスク対処行動は完全な垂直的多様性に近く、一方東部集農民の多様性は高い収益が可能な換金作物による多様性に主眼を置いた水平的多様性に近いと言えよう。

東部州と南部州農民の事後的対処戦略も、また明らかに異なっている。東部州では、リスクに対処するために別の収益機会に従事することと、インフォーマルな保険機能によって収入を平準化する戦略を用いている。南部州では、耐乏生活の増加とインフォーマルな保険機能によって対処していた。耐乏生活の採用が資産の平準化戦略を示唆するものなのか明らかではない。その動機についてはさらなる調査が必要である。南部州小規模農民の事後的危機対処戦略の計量化は、東部州と比較して正確性に乏しいことに気をつけなければならない。ショック対応戦略の中で「不明・その他」のカテゴリーに回答したサンプルの多さから、回答ミスの可能性が指摘される。

タミルナドゥ州沿岸郡における農業の多角化―時空的分析

K.Palanisami[1], C.R.Ranganathan[1], S.Senthilnathan[1], 梅津千恵子[2]
[1]Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, India
[2]総合地球環境学研究所

沿岸地域の社会・経済システムは脆弱で天候の変動に影響を受けやすい。気候変動の影響にもより脆弱であろう。自然資源の減少と人口増加による食料需要の拡大に直面する社会にとって、漁業を含めた農業の集約化が、農業の将来的な成長にとって唯一の方策である。農業の集約化は作付けの変化や多角化によって達成される。小規模農家にとって重要な戦略であり、リスク管理の方法と考えられる。インドでは１９８０年初頭に農業の多角化が進展した。市場での機会の発展を捉えて、農民は高収益作物への転換を急速に行ってきた。作物の多角化には、食料と栄養の確保、収入の拡大、貧困緩和、雇用機会の創出、土地と水資源の賢明な利用、持続的農業開発と環境の改善等、多くの便益がある。

本稿の目的は、タミルナドゥ州の沿岸郡における作物の多角化を検討し、地域の農業の持続的発展のための将来的多角化のオプションを政策提言することである。タミルナドゥ州の沿岸９郡(Kancheepuram, Cuddalore, Nagapattinam, Thanjavur, Pudukottai, Ramanathapuram, Tirunelveli, Thoothukudi and Kanniyakumari)の作付データ (1980-81, 1985-86, 1990-91, 1995-96, 2000-01, 2005-06)を用いて分析を行った。分析に選んだ作物は、米、ソルガム、メイズ、さとうきび、綿、らっかせい、とうがらし、バナナ、雑穀である。多角化の分析には改良エントロピー指標 (Modified Entropy Index) を用いた。指標は 0.319 から 0.864 まで変化を見せた。Kanniyakumari 郡では多角化指標の最大の増加を経験し、Toothukudi 郡では最大の減少を経験した。Toothukudi 郡と Kancheepuram 郡では、過去２５年間に多角化ランキングの１位と２位を占め、平均多角化指標は、それぞれ 0.827 と 0.746 であった。Kanniyakumari 郡ではこの期間、多角化ランキングの上昇があった。Palanisami et al. (2009)による沿岸郡の気候変動に対する脆弱性の研究では、Ramanathapuram 郡と Nagapattinam 郡が最も気候変動に脆弱であると報告された。この２郡の多角化指標は、それぞれ 0.403 と 0.413 であった。このことから作物多角化と気候変動に対する脆弱性には負の関係があることが考えられる。レジリアンスとは一般的には、レジスタンスのレベルもしくはショックからの回復を指す。沿岸郡の場合、降雨量の変動は通常のショックであり、洪水や旱魃その他の自然災害を伴う。この地域での典型的なレジスタンスは、過去３０年に渡る、沿岸部での作付体系の変化であろう。多角化が減退している地域では、レジリアンスメカニズムによるリスク削減のため、農業技術や農業経営多角化の役割が重要であろう。

インドタミルナドゥ州の最脆弱農業気候ゾーンにおける降雨量不足保険支払い

S.Senthilnathan[1], K.Palanisami[1], C.R.Ranganathan[1], P.K.Aggarwal[2] ,梅津千恵子[3]
[1]Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India
[2]Indian Agricultural Research Institute, New Delhi, India
[3]総合地球環境学研究所

天候保険は農民によって採択されるレジリアンス戦略である。天候保険は農民を農作期の悪天候による収量の減少から保護するメカニズムである。インドでは、降水量やその他の気候要因の変動によって最近一般的になってきた。本稿では、ニュデリーに拠点を持つインド農業保険会社の保険料制度を基本として、各作物に対する初期保険料を計算する方法を提示する。タミルナドゥ農業大学とタミルナドゥ農業省が共同で出版した作物生産ガイド(2005) に提示される選択された作物の生育ステージと、インド気象局(IMD)３０年間の降水量データを用いて分析された。選択された作物のそれぞれの生育ステージへの支払いシステムを提示した。降水量の上限は、郡の参照気象ステーションの３０年間の年平均積算降水量に対応し、一方降水量の下限は作物の不作を回避するために必要とされる各作物の水需要量と同じとした。この方法により、天候に基づく作物保険は、降水量の不確実性に対するレジリアンス・メカニズムとして機能する。

レジリアンスプロジェクト第５回ワークショップ

日時：　平成２０年６月２８日（土）9:30-18:00　６月２９日（日）10:00-15:40

場所：　総合地球環境学研究所　講演室

〒603-8047　京都市北区上賀茂本山 457 番地 4

Tel.　075-707-2206 Fax.075-707-2106

６月２８日（土）

9:30-10:00　受付

10:00-10:20　開会の挨拶・レジリアンスプロジェクトの経過説明

「社会・生態システムの脆弱性とレジリアンス」

梅津　千恵子　（総合地球環境学研究所）

10:20-15:20　個別発表プログラム　（発表１５分、質疑　５分）

（司会　真常）

10:20-10:40　Coping and Adaptation Processes under Economic Liberalization and Agro-ecologic Changes by Smallholders in Central Kenya

Matheaus Kioko KAUTI　（Graduate School of Environmental Studies, Tohoku Univ.）

10:40-11:00　Framework for an Agent-Based Model of Agricultural and Land Use Decision-Making.

Tom EVANS　（Department of Geography, Indiana University）

11:00-11:10　休憩

11:10-11:30　The Challenge of Resilience and Adaptation to Erratic Rainfall in Rural Zambia

Chileshe L. MULENGA

（Institute of Economic and Social Research, University of Zambia）

11:30-11:50　Field Report of Intensive Survey: Progress and Challenges

Thamana LEKPRICHAKUL　（RIHN）

11:50-12:00　集合写真

12:00-13:00　昼食

（司会　島田）

13:00-13:20　ザンベジ川上流域の氾濫原におけるロジの生業複合の可塑性

岡本　雅博　（京都大学大学院アジア・アフリカ地域研究研究科）

13:20-13:40　脆弱性の緩和に向けた生業多様化の実現
—ザンビア農村部における出稼ぎ労働の役割に注目して—
伊藤　千尋　（京都大学大学院アジア・アフリカ地域研究研究科）

13:40-14:00　ザンビア南部における小農世帯の脆弱性と生計戦略
—高地トンガ民の農外経済活動に着目して—
成澤　徳子　（京都大学大学院アジア・アフリカ地域研究研究科）

14:00-14:20　エスカープメント・トンガの生業
中村　哲也　（京都大学大学院アジア・アフリカ地域研究研究科）

（司会　吉村）

14:20-14:40　ザンビア降水量変動の初期解析
佐伯　田鶴　（総合地球環境学研究所）

14:40-15:00　ザンビアにおけるメイズ生産性に関する地域・季節変動について
下野　裕之　（岩手大学農学部）

15:00-15:20　異なる農業生態系下でのメイズの生育と自然環境要因に対する土地利用戦略
—生業活動の時空間的追跡の可能性—
宮嵜　英寿　（総合地球環境学研究所）
山下　恵　（学校法人　近畿測量専門学校）
真常　仁志　（京都大学大学院農学研究科）
田中　樹　（京都大学大学院地球環境学堂）
吉村　充則　（(財)　リモート・センシング技術センター）

15:20-15:30　休憩

15:30-17:30　テーマごとの進捗状況報告と今年度の研究計画　（司会　梅津）

テーマ I　環境変動下での人間活動と生態レジリアンス
真常　仁志　（京都大学大学院農学研究科）

テーマ II　不確実な環境に対する世帯とコミュニティーの対応
櫻井　武司　（和光大学経済経営学部）

テーマ III　脆弱性増大のポリティカル・エコロジーとレジリアンス
島田　周平　（京都大学大学院アジア・アフリカ地域研究研究科）

テーマ IV　社会-生態システムに対する統合解析
吉村　充則　((財) リモート・センシング技術センター)

インド　インドグループの研究進捗状況と計画について
久米　崇　（総合地球環境学研究所）

総合討論

17:30-18:00　テーマ会議　（各テーマで）

６月２９日（日）

10:00　-12:00　　プロジェクト関係者で全体会議　（司会　梅津）

１．プロジェクトの全体構想と出版に向けて　（約４５分）

２．研究者間、テーマ間連携について　（約４５分）

Dev info 講義　（山下）

３．中間評価に向けて：何をどこまで提示するのか？　（約４５分）

12:00-13:00　　昼食

13:00-15:00　　総合討論　（司会　梅津）

15:00-15:10　　休憩

15:10-15:40　　プロジェクトの事務手続きについて確認

・出張手続き

・立替請求

・前途資金

・レンタカー借上げについて

15:40　　閉会

レジリアンスプロジェクト第 **6** 回ワークショップ

日時：　平成 20 年 12 月 5 日（金）12:30-15:30　12 月 6 日（土）10:00-15:40
場所：　総合地球環境学研究所　セミナー室３・４
〒603-8047　京都市北区上賀茂本山 457 番地 4
Tel. +81-75-707-2242　Fax.+81-75-707-2506

12 月 5 日（金）
12:30-13:00　　受付

（総合司会　久米　崇）
13:00-13:20
開会の挨拶・レジリアンスプロジェクトの経過説明
「社会・生態システムの脆弱性とレジリアンス」
梅津　千恵子　　（総合地球環境学研究所）

個別発表プログラム　（発表１５分、質疑　５分）

13:20-14:20　セッション１　　司会　梅津
13:20-13:40　　ザンビア南部州におけるヒューマンネットワーク
石本　雄大　（総合地球環境学研究所）
13:40-14:00　　環境変化を考慮に入れた社会脆弱性研究
島田　周平　　（京都大学大学院アジア・アフリカ地域研究研究科）
14:00-14:20　　ザンビア・セントラル州 C 村の荒廃と近代的農法の導入
半澤　和夫　　（日本大学生物資源科学部）

14:20-14:30　　休憩

14:30-15:30　セッション２　　司会　吉村
14:30-14:50　　ザンビアの災害対応体制と食糧援助の実態
松村　圭一郎　（京都大学大学院人間・環境学研究科）
14:50-15:10　　村落レベルの生業活動追跡のための時空間データ収集
山下　恵　（学校法人　近畿測量専門学校）、宮崎　英寿　（総合地球環境学研究所）
15:10-15:30　　2007－2008 年雨季の気象データ解析
菅野　洋光　　（(独）農業・生物特定専業技術研究機構　東北農業研究センター）

第 25 回レジリアンス研究会　　（地球研講演室）
16:00-17:15　　干ばつ対処：南アフリカ、そして南部アフリカ地域
坪　充（鳥取大学乾燥地研究センター・准教授）

12 月 6 日（土）

10:00-11:00　セッション３　　司会　真常

10:00-10:20　力学と構造安定性からみたレジリアンス

久米　崇　　（総合地球環境学研究所）

10:20-10:40　ペタウケ県の試験地の植生について

三浦　励一・竹中祥太朗（京都大学大学院農学研究科）、　Elias Tembo　（ZARI）

10:40-11:00　Ex Ante and Ex Post Shock Coping Strategies: Evidences From Southern and Western Province

Thamana LEKPRICHAKUL　（総合地球環境学研究所）

11:00-11:10　休憩

11:10-12:10　セッション４　　司会　島田

11:10-11:30　Prevalence of undernutrition and overnutrition in Zambia: A re-examination

Thamana LEKPRICHAKUL　（総合地球環境学研究所）

11:30-11:50　中央州の村における小規模灌漑の変化について

児玉谷　史郎　　（一橋大学大学院社会学研究科）

11:50-12:10　ザンビア南部州農家家計の資産保有とレジリアンス

櫻井　武司　（和光大学経済経営学部）

12:10-13:10　昼食

13:10-14:40

テーマごとの総括と展望　（司会　梅津）

テーマ I　環境変動下での人間活動と生態レジリアンス

真常　仁志　　（京都大学大学院農学研究科）

テーマ II　不確実な環境に対する世帯とコミュニティーの対応

櫻井　武司　　（和光大学経済経営学部）

テーマ III　脆弱性増大のポリティカル・エコロジーとレジリアンス

島田　周平　　（京都大学大学院アジア・アフリカ地域研究研究科）

テーマ IV　社会-生態システムに対する統合解析

吉村　充則　　((財）リモート・センシング技術センター)

14:40-15:40　総合討論

15:40　ワークショップ閉会

レジリアンス・プロジェクト第7回　白浜ワークショップ

日程：　2009年2月20日～21日

会場：　KKR 白浜美浜荘

〒649-2211 和歌山県西牟婁郡白浜町 1564-2

TEL 0739-42-3383

プログラム

2月20日（金）

14:00　開会　梅津千恵子（総合地球環境学研究所）

【セミナーセッション】（司会：岡本雅博）

14:10－15:10 「水稲冷害早期警戒システム－東北日本における冷害と農業」

菅野洋光（東北農業研究センター）

15:10－16:30 「『会津農書』にみる危険への心がまえ」

佐々木長生（福島県立博物館）

16:30－16:40 休憩

【個別研究セッション】（司会：島田周平）

16:40－17:15 「ザンビア農村で生活するハンセン病回復者のヘルスケアシステム」（仮）

姜　明江（京都大学大学院アジア・アフリカ地域研究研究科）

17:15－18:00 「木を挽く農耕民」（仮）

中村哲也（京都大学大学院アジア・アフリカ地域研究研究科）

19:00－　懇親会

2月21日（土）

【個別研究セッション】（司会：宮嵜英寿）

08:30－09:00 「ザンビア南部州グェンベ・トンガの家畜飼養」

岡本雅博（総合地球環境学研究所）

【理論研究セッション】（司会：久米　崇）

09:00－10:00 「プロジェクト発表会およびプロジェクト評価委員会での質問と対応について」

梅津千恵子（総合地球環境学研究所）

10:00－10:30 「南部州における調査連携とデータ統合」

宮嵜英寿、石本雄大、岡本雅博（総合地球環境学研究所）、山下　恵（近畿測量専門学校）

10:30－10:40 休憩

10:40－11:10 「レジリアンス概念の変遷と今後の課題」

梅津千恵子（総合地球環境学研究所）

11:10－11:50 「レジリアンス概念についてのアンケート報告」

久米　崇（総合地球環境学研究所）

11:50－13:00 昼食

13:00－15:00 総合討論

15:00 閉会

平成20年度レジリアンス研究会要旨

第22回レジリアンス研究会

日時：2008年4月11日（金） 15:00-16:15
場所：地球研講演室
タイトル： 急激な環境変動下の社会生態レジリアンス–ザンベジ河上流渓谷氾濫原における気候変動への適応
講演者： Dr. Lawrence Flint（地球研招へい研究員、ENDA）
使用言語：英語

［要旨］

近年、食料、水、繊維、エネルギーの需要拡大を満たすため生態システムからいまだかつてない供給を求めるようになった。これらの需要は生態系のバランスに圧力を与え、自然環境が許容量を取り戻す能力を減少させ、生態系サービスを供与する能力を弱体化させた。社会経済開発と環境持続可能性との間に明らかな緊張関係が存在している。

生態系の財とサービスの減少を引き起こした直接的な原因は、生息地の変化、外来種の侵入、枯渇、汚染や気候変動と変化などである。これらのプロセスは社会生態的レジリアンス喪失の脅威を与え、環境と社会経済変化の双方に対する感度を高める。

本報告では、社会経済の脆弱性とレジリアンスを検討する科学的方法、特にこれら広範囲の問題に対する学際的アプローチについて議論する。また、脆弱性に対する社会経済レジリアンスと適応の本質を分析する。レジリアンスに影響を与えている政治経済、社会文化的ネットワークとダイナミズムについて歴史的、現代的生産の文脈の中で議論することによって説明される。

経済活動と「河川文明」を擁する人間の居住地域である氾濫原生態システムを研究の対象とする。事例として現在生物物理的、社会経済的変化を示しているザンビア西部ザンベジ河上流渓谷のBulozi「自然」氾濫原に焦点を当てる。この氾濫原は現在のLozi民の祖先が居住し、彼らは生態財とサービスを氾濫原から得、強力で活気に満ちた政治経済を生み出してこの地域を独占し、余剰食料を使って軍を擁し経済的機会を享受した。

今日、Buloziは低開発の地域とされており、この状況は気候の変動によって悪化しているが、この要因は長い年月の間に社会的に蓄積された脆弱性に対して追加の要因となるのみである。本報告ではBuloziの脆弱性の原因とレジリアンスを高めるための適応的能力を議論する。

人々の外的内的圧力に対して適応し、社会生態システム(SES)のバランスを維持する能力は、在地的「所有」の立場から問題に対処する能力に依存している。同時に、社会生態システム(SES)のバランスを保全しながら、社会が生活水準を向上する機運、

コントロール、動機を再び取り戻すためには、現在の生産行為を修正し、生産活動を多様化する彼らの能力に依存している。

第23回レジリアンス研究会

日時：2008年6月18日（水） 15:00-16:15
場所：地球研講演室
使用言語：英語
講演者：Chileshe L. Mulenga （ザンビア大学社会経済研究所・研究員）
タイトル： HIV/AIDSと頻繁な干ばつ下での世帯とコミュニティのレジリアンス
 –ザンビア・チパタのムワミ・アドベンティスト病院地域住民の事例
キーワード： 農村、世帯、コミュニティ、HIV/AIDS、頻繁な干ばつ、貧困、老年層、若年層と社会化

［要旨］

農村地域コミュニティは社会経済や生態系のショックに対し、世帯とコミュ二 ティの２つのレベルで対応する。世帯やコミュニティレベルでの対応は、社会文 化的基盤としての世帯の結束やコミュニティの存続を目的としている。ザンビア 地方におけるHIV/AIDSの高罹患率は、世帯やコミュニティ全体の存続に深刻な影 響を及ぼしている。最近の雨期の乾燥化による不作によりこの状況はさらに悪化 しており、食料不足や資産の損失を引き起こしている。すでにHIV/AIDSによって 負荷を与えられた世帯とコミュ二ティは近年の頻繁な干ばつでさらに貧窮の度合 いを深めている。

ムワミ・アドベンティスト病院診療域の世帯とコミュ二ティでは、HIV/AIDSの脅威と頻繁な干ばつに耐えるために社会・文化的な変革が求められている。若年層の適切な社会化と頻繁な干ばつに耐えうる農業生業システムへの移行が、世帯とコミュ二ティのレジリアンスにとって必要である。

HIV 孤児の社会化へは問題が多くあり、その原因は保護者が圧倒的に老齢の祖母であり、保護者自身がサポートを必要としていることに加え、女性であることが女性と男性の社会的役割分担により、孤児を若い男性と社会化させることを困難にしている。また、老齢の保護者は身体的に弱く長距離を歩けないことから、地域での生活に必要な野生果実、根菜類、食用昆虫、小動物の知識を効率的に伝達することが出来ない。農業による生業システムを変えることは他の農業システムに関する知識と経験不足のため同様に困難である。貧困のため補助なしに技術的な解決策を取ることは難しい。

HIV 感染を防御する若年層の社会化、頻繁な干ばつに耐えうる生業システムが農村地域の世帯とコミュニティのレジリアンスにとって非常に重要である。

第24回レジリアンス研究会
日時：2008年7月17日（木）　15:00-17:00
場所：地球研講演室
講演者：　Tom Evans（インディアナ大学，地理学科；地球研招へい研究員）
タイトル：エージェントベースアプローチによる世帯レベルの森林伐採と植林のモデリング：ラオス，米国，ザンビアにおけるケーススタディーより
使用言語：英語

［要旨］
　社会・生態システムは本質的に複雑であり，それらの振る舞いを統制するマルチ空間スケールにおける動力によって構成される．これらのシステムの重要な部分は，どのように人間が相互作用するのか，これらの相互作用がどのように人間の振る舞いを変えるのか，そしてそれらの動きがどのように生物物理学的な環境に影響を与えるのかという点である．エージェントベースモデルはこれらの種類のシステムダイナミクスを詳細に分析するための道具である．本セミナーでは，特に森林伐採と植林という土地被覆変化について，社会生態システムにおける世帯レベルでの行動を研究したエージェントベースモデル(ABMs)の過去の適用結果について議論する．これらのABMsは，ある世帯がどのように土地利用を決定するのか，そして，その決定が分析対象の地域スケールにおけるマクロレベルの結果にどのような影響をもたらすのかを分析することに用いられている．エージェントベースアプローチはこのような種類の研究に有効である．なぜなら，ABMsはアクターとアクターの不均質の相互作用を特定するようにデザインされているからである．
　この研究を実演するために，次の一連の研究結果を用いて例題が議論される予定である．それは，1）米国中西部における植林プロセス，2）ラオスにおける焼き畑農業からゴムプランテーションへの変遷，3）ザンビアにおける気候変動に対する適応に関する研究のためのプロトタイプモデル，この3つである．本セミナーでは，GISそして社会生態システムのスケール依存性を用いて，物理的な環境に対する結合アクターの異なる方法についても議論する．本発表における全体的な目的は，ローカルレベルアプローチのこれらの種類の研究における利点と不利点，地球規模変化の人的側面に関する世帯ベース研究の新たな方向性について議論することである．

第25回レジリアンス研究会

日時：2008年12月5日（金）　16:00-17:15
場所：地球研講演室
使用言語：日本語
講演者：坪　充（鳥取大学乾燥地研究センタ，准教授）
タイトル：干ばつ対処―南アフリカ、そして南部アフリカ地域

［要旨］

アフリカで最も深刻な自然災害は、餓死をも引き起こす干ばつである。1974 年から 1975 年にかけてサヘル地域で起きた干ばつ災害の犠牲者は、32 万 5 千人に達し、1984 年のエチオピアとスーダンでは 45 万人もの死者が出た。アフリカ南部地域では、1992 年に大干ばつが発生し、作物生育期の降雨不足のため、ジンバブエでは食料不足となり、さらに政府の不手際な政策により損失が拡大した。この危機的な災害から、干ばつ災害の防止・軽減のために干ばつ発生の事前および事後の災害管理の重要性が高まった。南アフリカは、干ばつ管理の最先端国の一つで、国や地方自治体の災害管理の統合的な運営システムを推進するために国家災害管理センターを設置しており、季節降雨を予報する気象局と連携することで干ばつ管理の強化を図っている。南アフリカのみならず南部アフリカ開発共同体（SADC）地域では、干ばつ災害を緩和するための運営上のシステム作りは、まだ初期段階にあり、干ばつ早期警戒システムの開発が急がれる。

第 26 回レジリアンス研究会

日時：2009 年 2 月 10 日（火）15:00-16:30

場所：地球研講演室

共催：地球地域学プログラム

タイトル：アフリカにおける人間の安全保障－「常」と「非常」の狭間で

講演者：峯陽一(大阪大学グローバルコラボレーションセンター（GLOCOL）准教授)

［要旨］

人間の安全保障の考え方は、UNDP（国連開発計画）の 1994 年版『人間開発報告書』で最初に打ち出され、2003 年の緒方セン報告書によって拡張された。人間の安全保障は国家安全保障を相対化する枠組みであり、人々とコミュニティの下からのエンパワーメントを重視すると同時に、多国間組織に対して、脆弱な人々を保護する特別な役割を与えようとする。人々の不安全は、暴力的紛争、経済危機、自然災害、感染症の流行といったリスクの顕在化、すなわち唐突で深刻な下降によって引き起こされている。アフリカの多くの社会は、飢饉をはじめとする災害に歴史的に対処してきたが、状況はきわめて複雑になってきている。アフリカにおいては、構造的かつ長期的な貧困と状況的かつ緊急の貧困とが、歴史的に収斂しつつあるのである。今回の問題提起は実証的な事例研究ではなく、アフリカにおける人間の安全保障の観点から国際協力の政策的な枠組みを再考し、アフリカ史を読み直し、アマルティア・センのエンタイトルメント理論を再評価しようとするものである。

平成20年度 E-04（梅津FR2）研究活動一覧

2008	4	5	6	7	8	9	10	11	12	1	2	3
レジリアンス	15:00-16:15	13:30-15:00	15:00-16:15	15:30-16:45					16:00-17:15		15:00-16:30	
研究会	4月11日	5月12日	6月18日	7月17日					12月5日		2月10日	
	（第22回）	Agent-based model	（第23回）	（第24回）					（第25回）		（第26回）	
コアメンバー会議		＊5/17	＊6/29		＊8/26			＊11/7	＊12/5		＊2/10	
ワークショップ			6/28-29 WS						12/4-5 WS		2/20-21WS	
			9:00-17:00						9:00-18:00			
レジリアンス勉強会	＊4回 4/12	＊5回 5/23	＊6回 6/14	＊7回 7/12								
FR2報告書							FR2報	告書原稿締切		1月末製本	HP 掲載	
予算計画	平成21年度				特別予算申請		（追加予算申請）		（追加予算申請	H21予算計画		
	概算要求(4/7)				8月18日		10月7日		12月19日	雇用計画		
プロ関連行事												
	（IS申請 4/8）					特別予算	HydroChange2008		プロジェクト			（FSヒアリング）
	ISヒアリング4/18					ヒアリング9/11	10/1-10/3		研究発表会			3月3日
							京都ガーデンパレス		12月10-12日			
地球研行事			First Farmers出版	地球研フォーラム					コープイン京都		評価委員会	
			6月23日	7月5日		RIHN国際シンポジウム					2/19-20	
			芝蘭会館	京都国際会館			10/22-10/23					
フィールド調査日程							地球研					
真常	4/22 – 5/17							11/9-12/1	12/7 – 12/25			
田中									（12/3-12/17）			
宮嵜	8/31- 4/24	（8ヶ月滞在）			8/18 – 9/18			10/25 – 12/18				3/16 – 4/27
野呂（M2）	4/22 – 5/17						10/4 – 10/25					
三浦	4/22 – 5/17											
柴田												
竹中（M1）	4/22 – 5/17											
安藤（M1）	4/22 – 5/17						10/4 – 10/25	11/9 – 12/25				3/1 – 3/17
宮下（M1）								10/25 – 12/18				
櫻井					8/25 – 9/6							
菅野					8/25 – 9/6							
下野					8/25 – 9/6							
山内										1/13 – 1/18		
島田												
半澤					8/25 – 9/8							
児玉谷					（8/25 – 9/8）							
荒木												
岡本								11/8 – 12/10				3/5 – 4/5
石本			6/19 – 10/30（4.5ヶ月滞在）								2/17-3/7	
成澤（D2）												
伊藤（D1）					（8/6-3月まで）							
中村（D1）								10/13 – 12/5				
姜（M2）	2/18 – 8/2（5.5ヶ月滞在）											
吉村				7/2 – 7/11	（Beijin）						（Beijin）	3/17 – 3/22
佐伯												
山下											（Beijin）	3/19 – 3/22
松村					8/26 – 9/27							
梅津					8/31 – 9/6	（India）			12/13-12/25		（Copenhagen）	3/9-3/14
Lekprichakul		5/5 – 5/24								1/12 – 1/30		
久米					8/31 – 9/6	（India）			12/13-12/25	1/21 – 2/1	（India）	
Kakungu						9/13 – 9/22	地球研					
Palanisami												
Ranganathan							9/27 – 10/6	地球研				
Flint（招へい）	2/4 – 5/3	地球研										（FSヒアリング）
Evans（招へい）	4/25 – 7/31	地球研							（12/13-12/25）			
Mulenga（招へい）		4/30 – 7/31	地球研									

Vulnerability and Resilience of Social-Ecological Systems – FY2008 FR2 Project Report
Project E-04 (FR2)
Project Leader: Chieko Umetsu

February 2009

Edited by Chieko Umetsu
Inter-University Research Institute Corporation, National Institutes for the Humanities
Research Institute for Humanity and Nature
457-4 Kamigamo Motoyama, Kita-ku, Kyoto 603-8047, Japan
Tel: +81 (0)75 707 2100
Resilience Project HP: http://www.chikyu.ac.jp/resilience

社会・生態システムの脆弱性とレジリアンス – 平成２０年度ＦＲ２研究プロジェクト報告
プロジェクトE-04 (FR2)
プロジェクトリーダー　梅津　千恵子

2009 年 2 月

大学共同利用機関法人　人間文化研究機構　総合地球環境学研究所
〒602-0878 京都市北区上賀茂本山 457-4 番地
Tel: +81 (0)75 707 2100
レジリアンスプロジェクトHP: http://www.chikyu.ac.jp/resilience