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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

FY2006 PR Project Report

平成１８年度 PR 研究プロジェクト報告

Project 1-3PR
プロジェクト１－3PR

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March 2007
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TABLE OF CONTENTS

目　　次（和文掲載分）

Preface

The RIHN pre-research (PR) project in FY2006 “Vulnerability and Resilience of Social-Ecological Systems” has just completed the one-year preparatory stage.

During the fiscal year 2006, many project members visited Zambia and discussed with many people including farmers, university professors, researchers, and government officials and conducted preliminary surveys. With the cooperation of local villagers and government officials, we obtained a permission to use a plot of fallow land for our field experiment during our project and started soil analysis. Also, two graduate students have started living in villages in the Southern Province before the cropping season and collecting detailed information regarding agricultural production, labor migration, drought responses. Geographical information based on ground truth survey is under way. In March 2007, the MOU was signed between RIHN and Zambia Agricultural Research Institute (ZARI) as a major research partner. We are also preparing household survey with the Central Statistical Office in this spring.

The year 2006 was the time we strongly realized the globalization process. The economic boom in China and Korea has increased the copper demand and price significantly. And as a result of the copper boom in Zambia, Kwacha appreciated from 4,670ZK in August 2005 to 3,500ZK in June 2006. How the expansion of trade and the exchange rate shock might be affecting the small-scale farmers is an important issue. Recently India and China are emerging as an important trade and investment partners for Africa. Some people mention new “Africa’s Silk Road”.

Our project has just finished the stage of pre-research study and is moving into the stage of full research project. We appreciate 1-3PR members for their efforts for the preliminary research and field surveys. We also appreciate kind support by the evaluation committee members, director, program directors, administrative staff and the colleagues of RIHN for making this exciting research program possible.

March 2007

Chieko Umetsu
1-3PR Project Leader
Research Institute for Humanity and Nature

P1－3PR

Vulnerability and Resilience of Social-Ecological Systems

Project Leader： Chieko UMETSU Short name： Resilience Project

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

1. Purpose of Research

1.1 Research Objectives

A. Background and objective

A vicious cycle of poverty and environmental degradation such as forest degradation and desertification is a major cause of global environmental problems. Especially in semi-arid tropics (SAT) including Sub-Saharan Africa and South Asia where a majority of the poor concentrates, poverty and environmental degradation widely prevails. People in this area largely depend on rainfed agricultural production systems and their livelihoods are vulnerable against environmental variability. Environmental resources such as vegetation and soil are also vulnerable against human activities. In order to solve this “global environmental issues”, a key is a quick recovery or a resilience of human society and ecosystems from impacts of environmental variability. Thus in this project we consider society and ecology as one social-ecological system and try to perform empirical analysis for its resilience in semi-arid tropics.

B. Objectives of Research

The objective of the research is 1) to consider impacts of environmental variability through vulnerability and resilience of human activities in semi-arid tropics; 2) to study factors affecting social-ecological systems and the recovery from impacts and shocks; 3) to analyze factors that form the ability of household and community to recover and the role of institution for resilience; and 4) to identify the factors affecting resilience of social-ecological systems and the ways to enhance resilience of rural people in semi-arid tropics against environmental variability.

1.2 Research Organization, Contents and Methodologies

A. Research organization

In order to achieve our objectives, we focus on four themes. Each four themes interlink each other and thus provide comprehensive assessment of resilience of social-ecological systems. Under the supervision of theme leader, respective researchers will participate in sub-programs. Not as ordinary discipline based research groups, we organized theme based research organization. Most researchers involve more than one sub-program, thus making it possible to realize flexible research organization.

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.

First two themes consider site specific or village level analysis and those studies are extended to temporal as well as spatial analysis in the third and forth themes for larger scales. We invited appropriate experts in the respective fields such as agronomy and soil science, agricultural and development economics, anthropology, geography, climatology, and remote sensing. The time scale of the analysis is from 1960s to the present when the changes in social and natural environment have been

accelerated.

B. Research areas

The study areas of the project are the countries in semi-arid tropics (SAT) (Figure 2). The large population in SAT live in rainfed agricultural areas and their marginal livelihood is critically depends on fragile and poorly endowed natural resources. The main research area is Zambia in Southern Africa, in addition to Burkina Faso in West Africa, and India in South Asia. In Zambia, drought prone Eastern and Central Provinces are our target research areas.

C. *Research contents and methodologies*

Theme I: Ecological Resilience and Human Activities under Variable Environment (Theme Leader: Hitoshi SHINJO)

This theme tries to capture the interaction between ecological resilience and human activities under fluctuating environment. In theme I-1, to evaluate the components, capacity and succession of ecological resilience, we will monitor spatial and temporal changes of soil conditions, e.g. organic materials and fertility related properties, succession of grass/shrub/tree communities, micro-climatic condition in above-ground and soil, and degradation of land that are expected to happen during the process of conversion from stable fallow woodland to agricultural land. In theme I-2, the influence of ecological resilience on human activities are revealed by comparison of some soil properties, which is related to ecological resilience, under different landscape, e.g. valley, slope and plane land, the types and histories of land use, and succession stages of agro-ecology.

Theme II: Household and Community Responses to Variable Environment (Theme Leader: Takeshi SAKURAI)

Rural households in the semi-arid tropics have developed various kinds of risk-management and risk coping mechanisms to respond unpredictable rainfall. In order to serve for the integrated analysis of socio-ecological systems, the theme II investigates rural households' strategies against the erratic rainfall in four interrelated sub-themes. Theme II-1 is to measure the risky event objectively, that is, rainfall. Theme II-2 concerns with the endowments of resources available to households including physical, natural, human, financial, and social capitals. Theme II-3 is devoted to the analyses of households' behaviors: risk-management before the rain, adjustment during the rainy season, and risk-coping after harvest. And finally in theme II-4, households' resilience in risky environment is evaluated in terms of income-smoothing, consumption-smoothing, and nutritious status.

Theme III: Political-Ecology of Vulnerability and Resilience: Historical and Institutional Perspective (Theme Leader: Shuhei SHIMADA)

This theme tries to focus on the institutional aspects of social resilience in the area of semi-arid tropics. Social resilience undergoes change along with social, political and economic change and also with ecological change. It is important to understand both in the context of local history and physical settings. Theme III-1 tries to consider the change of economic policy and its impact on agricultural production and land use. Theme III-2 analyzes changes in socio-political and their impacts on land use. Theme III-3 investigates historical changes of drought responses and crop failures and the role of social institution to mitigate such situations.

Theme IV: Integrated Analysis of Social-Ecological Systems (Theme Leader: Mitsunori YOSHIMURA)

The primary goal of this theme is to clarify the relationship between ecological vulnerability, resilience and human activities through investigations of changes in land use and multi-level social/ ecological systems. Theme IV-1 analyzes continent scale climate monitoring to understand the mechanism of the formation of drought. Theme IV-2 investigates land use change and its impact on ecological system such as forest degradation and vegetation change using multi-temporal aerial photographs and satellite imageries. Theme IV-3 considers the role of actors of early warning systems and its effects on food security. Finally in theme IV-4 we analyze and evaluate regional resilience with district level data.

2. Common Issues and Discussions

2.1 Objectives of RIHN Project

A. Why do you conduct proposed research as a RIHN project?

As a RIHN project, it is possible to challenge research agenda that has never been accomplished in any other research funds. For our resilience project, those research agenda includes an experiment of forest-clearing, collection of soil quality and rainfall data at the large number of farm households. Since a research of resilience for social-ecological systems requires researchers from many disciplines, it is a great opportunity to conduct interdisciplinary project as a RIHN project.

B. Relations to “global environmental issues” and proposed research

People who rely their production on environmental resources have vulnerable livelihood against environmental variability. In those areas, deforestation, desertification, and soil degradation caused by a vicious cycle of poverty and environment degradation is a critical issue and it is recognized as one of the “global environmental issues.” The recent Environment Ministerial Summit (G-8) held in March 2005 called especially upon the need of research on impacts of climate change particularly in sub-Saharan regions. The proposed research aims at considering the impacts of environmental variability and increasing resilience of people in semi-arid tropics, which is the pressing global environmental issues for international community.

C. Research area and the relations to “global environmental issues”

The proposed research covers areas including Southern Africa region (Zambia), West Africa region (Burkina Faso), and South Asia (India). Those areas are a part of semi-arid tropics (SAT). In the semi-arid tropics (SAT) regions, the livelihood of the people is considered one of the most vulnerable against climate change. People in this area largely depend on vulnerable rainfed agricultural production systems and increasing food security, resilience of livelihood and reducing poverty are an acute issue in this area.

D. How do you utilize the results of the project to help solving “global environmental issues”?

We consider environmental degradation caused by the “vulnerability” of social-ecological systems as “global environmental issues” and the ways to enhance “resilience” of social-ecological systems as a primary goal of solving “global environmental issues”. During the research project, data collection, observation and analysis will be conducted to find out some key indicators to resilience. By using those

indices, our goal is to provide some options of the ecosystems and resources management at the end of the project.

2.2 Methods to realize “integrated” and “interdisciplinary” project

A. Characteristics and problems of methods and organization

We plan to set four themes that interlink each other in various dimensions from household and community level analysis to temporal and spatial level of analysis. Particularly we invite social scientists who are able to work with natural scientists to make use of scientific information and data for social science research agenda. Research group expected to join the project are anthropometrics expert, cultural anthropologist, early warming specialist, public health expert, forest ecologist, and macro economist. We plan to organize workshops in collaboration with other RIHN projects that share common interests and common research areas with us. Joint publication is also another option for collaboration.

2.3 Towards dissemination of the research outcomes

We plan to publish the research results as books and in academic journals and to disseminate the research results not only at the domestic meetings but also at the international research community such as IHDP. We utilize homepage for making research results available to public.

3. Outcome up to now

3.1 Research Activities during the Pre-Research

A. Research organization

- We discussed about the MOU with Zambia Agricultural Research Institute (ZARI) and reached an agreement. The MOU will be signed within FY2006.
- We discussed with researchers and staff members of collaborating institutions: Central Statistical Office, Ministry of Finance and National Planning; Food Security Research Project in Zambia (USAID/MSU); Institute of Economic and Social Research, University of Zambia (INESOR/UNZA); Meteorology Department, Ministry of Communication and Transport; Survey Department, Ministry of Land; Zambia Vulnerability Assessment Committee (ZVAC).

B. Methodologies

During the FY2006, we conducted literature review, field observation and preliminary interview for farmers and identified some research targets that should be included in our resilience study.

C. Results of preliminary field research

- During the field trip to Zambia in June-July 2006, we identified the field experiment site for Theme I near Petauke in Eastern Province. We obtained permission for the use of fallow land from the district administrator as well as villagers. Also a preliminary soil analysis is underway in order to clarify spatial distribution of soil characteristics. Theme I supports Theme II for soil analysis.
- From August 2006, two graduate students are residing in a village in Southern Province for their interview survey on labor migration, drought response and others. They continue to stay in the respective village until the end of cropping season in June 2007. (Theme III)
- In order to know typical land use change patterns in past years, we analyzed multi-temporal satellite imageries as our preliminary analysis. Using NDVI (Normalized Difference Vegetation Index) which introduced by the visible and near infrared bands combination, we extracted typical land cover change

areas. During the field trip to Zambia in August-September 2006 (Theme IV), we conducted ground truth survey to compare the results of preliminary analysis and actual ground conditions. In this year ground truth, we visited some of typical local villages and interviewed farmers where the land use change in the past is quite rapid. Also, we examined the impact of drought from vegetation change at the national level using mid-level resolution multi-temporal satellite imageries. Furthermore, using rainfall data from national meteorological station in Zambia to show the specific rainfall patterns during drought

- During the field trip to Zambia in November-December 2006, we visited a local hospital, health center and obtained information that during the drought the rate of infant birth weight below 2.5kg increase significantly. Also we obtained information of HIV/AIDS prevalence in rural Zambia.
- For human dimensions and human security, we surveyed global food security issues as well as institutions for food aid and early warming systems developed in Ethiopia for comparison.
- We organized a Resilience Seminar "Developing Methods for Institutional Analysis: Institutional Diversity in Resource Management) by Prof. Elinor Ostrom in July 2nd at RIHN and discussed about the institutions of resource management with many researchers who attended the seminar.
- We organized five Resilience Seminars in FY2007 (2 July, 25 July, 2 October, 9 November, February)

3.2 Changes made from the initial plan

- The effects of drought on humans appear especially in infant health status. The information related to their weight, height, and arm circumference is very important.

3.3 Response to comments by Evaluation Committee in March 2006.

- One committee member had a concern about the scale of analysis. However, the main scale of analysis is village/regional level. Only when it is necessary for larger level of analysis, such as climate, we go beyond national level for analysis.
- Also one committee member mentioned about why we have three research fields. By including India and Burkina Faso, we can consider the different formation of resilience depending on population and land endowment in those regions.
- One committee member suggested literature review. We are planning to incorporate review in PR report.

4. Forthcoming activities

A. Goal for Pre-Research

- We are trying to identify further the priorities of research items and make detailed research plan for the FY2007.

B. Activities in FY2006

- Additional survey for Post-Harvest Survey households in Eastern and Southern provinces are under planning. We plan to identify sample villages in Petauke in Eastern Province, and Sinazongwe in Southern Province for intensive household survey by March 2007.
- We produce PR report by March 2007.

C. Problems and Solutions for Research

- We are expecting to find experts of emergency food and rural energy in Japan or in Zambia.
- We plan to consider opening a field station in Zambia for field observation and monitoring.

5. Research Activities from FY2006 to FY2011

5.1 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	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

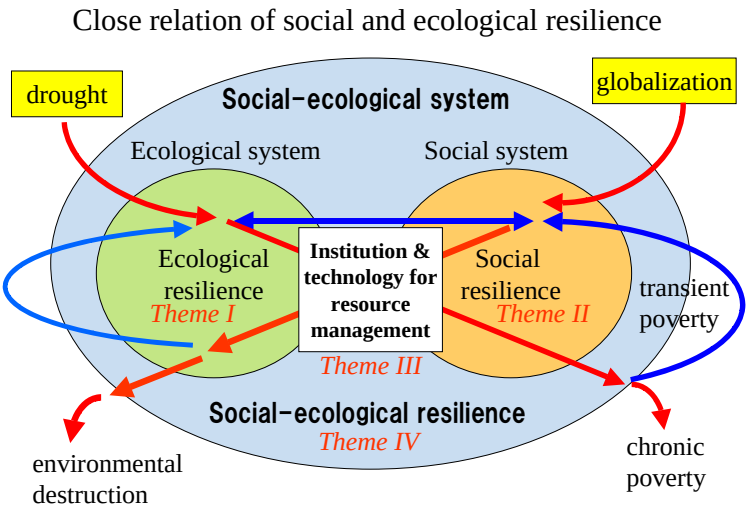
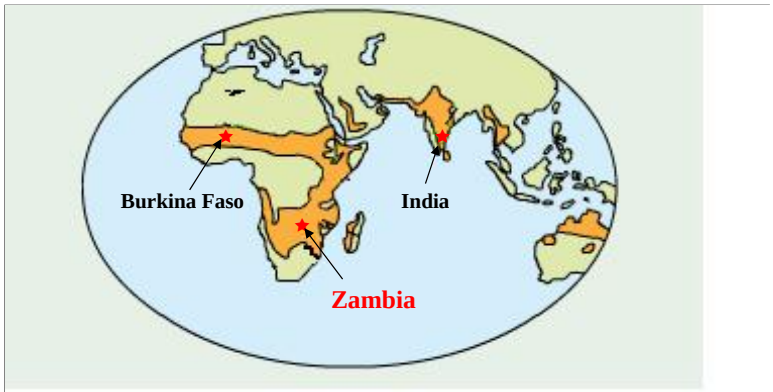


Figure 2. Regions of Semi-Arid Tropics and Study Areas



1-3PR Project Member List (FY2007)

	Name	Affiliation	Department	Title	Field	Role
Leader	Chieko UMETSU	RIHN	Research Department	Associate Professor	resource & environmental economics	Regional analysis, farm survey
A	Shigeo YACHI	RIHN	Research Department	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
○	Ueru TANAKA	Graduate School of Global Environmental Studies, Kyoto Univ.	Terrestrial Ecosystems Management	Associate Professor	agronomy	soil degradation and erosion
	Shozo SHIBATA	Graduate School of Global Environmental Studies, Kyoto Univ.	Landscape Ecology and Planning	Associate Professor	forest ecology	tree/shrub components and its succession
	Reiichi MIURA	Graduate School of Agriculture, Kyoto Univ.	Division of Agronomy and Horticulture Science	Lecturer	botany	grass/herb components and its succession
	Hidetoshi MIYAZAKI	Graduate School of Agriculture, Kyoto Univ.	Division of Environmental Science and Technology	Ph.D. Candidate	soil science	measurement of land plot, crop components
	Moses MWALE	Mt. Makulu Central 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	MS. Candidate	soil science	organic materials and soil fertility
	Theme II					
○	Takeshi SAKURAI	Policy Research Institute, MAFF		Senior Economist	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
	Taro YAMAUCHI	Graduate School of Medicine, The University of Tokyo	Department of Human Ecology	Assistant Professor	human ecology	Assessment of health and nutrition status at individual-, household- and population-level
	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
	Chihiro ITO	Graduate School of Asian and African Area Studies, Kyoto University	Division of African Area Studies	graduate student (MA)	human geography	labor migration in rural area
	Shiro KODAMAYA	Graduate School of Social Sciences, Hitotsubashi University	Division of African Area Studies	Professor	African sociology	agricultural development and social change
	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 (MA)	agricultural economics	socio-economic responses to environmental change
	Theme IV					
○	Mitsunori YOSHIMURA	RIHN	Research Promotion Center	Associate Professor	remote sensing	ecological change monitoring
	Yukiko IITSUKA	The International Peace Cooperation Headquarters, Cabinet Office	Secretariat	Programme Advisor	development studies	early warning system
	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	RIHN	Research Department	Assistant Professor	atmosphere 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	Water Technology Centre	Director	agricultural economics	household survey and analysis
	Akiyo YATAGAI	RIHN	Research Department	Assistant Professor	climatology	monsoon rainfall analysis
	C.R. Ranganathan	Tamilnadu Agricultural University	Department of Mathematics	Professor	mathematics	economic modelling
	B. Chandrasekaran	Tamilnadu Agricultural University	Tamil Nadu Rice Research Institute	Director	agronomy	rice production analysis
	V. Geethalakshmi	Tamilnadu Agricultural University	Department of Agricultural Meteorology	Professor	agriculatural meteorology	monsoon rainfall analysis
	Burkina Faso					
	Kimseyinga Savadogo	University of Ouagadougou	Department of Economics	Professor	economics	household data analysis

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

Shock and Poverty in Sub-Saharan Africa:

The Case of Burkina Faso (Report on Pre-Research in 2006)

Takeshi Sakurai (Policy Research Institute)

Introduction

Risk is the major cause of poverty in Sub-Saharan Africa (Dercon, 2005). It is well known that while rural households are relatively well insured against idiosyncratic shocks via various informal mechanisms, covariate shocks reduce consumption level significantly and its impact can be persistent (Hoddinott and Harrower, 2005 and Dercon, Hoddinott, and Woldehanna, 2005). Even in the case of covariate shocks, households could cope with them by receiving remittance from other regions that are not affected by the same shocks and/or out-migrating to such regions (e.g., forest zone in the case of drought). Most studies on covariate shocks deal with the case of drought, flood, earthquake, commodity price shocks, currency crisis, and so on. But it is not examined what rural households will behave, if transfer, one of the most important insurance against covariate shock, were widely suspended due to covariate shock. This paper focuses on this issue using rarely available panel data from Burkina Faso.

Burkina Faso, a landlocked country in West Africa, is located in the semi-arid zone on the southern edge of the Sahara desert, or in the Sahelian region (Figure 1). Most of the country's territory belongs to the Savanna zone whose annual precipitation varies from 400 mm in the north-east to 1200 mm in the south-west. Agriculture in this country is generally rain-fed, and frequent drought due to erratic rainfall keeps its productivity low and unstable. Since droughts are very frequent in Burkina Faso, rural households are known to be well prepared for them (e.g., Reardon, Matlon, and Delgado, 1988). But the country remains one of the poorest countries in the world: 53.1 percent of the country's rural population is below the poverty line in 2003 (Grimm and Günther, 2006). The poverty has made the rural population rely on external migration (mostly to neighboring Côte d'Ivoire) as well as remittance from the relatives living outside the country (also mostly in Côte d'Ivoire). It is estimated that such revenue constitutes 10 – 20 percent of their total income (Reardon, Matlon, and Delgado, 1988). In other words, rural households in Burkina Faso have diversified their income sources to zones (i.e., the forest zone) and sectors (i.e., non-agriculture) that are not subject to the erratic rainfall in the semi-arid zone. In addition, the regional migration has been contributing to the mitigation of population pressure on the land in Burkina Faso.

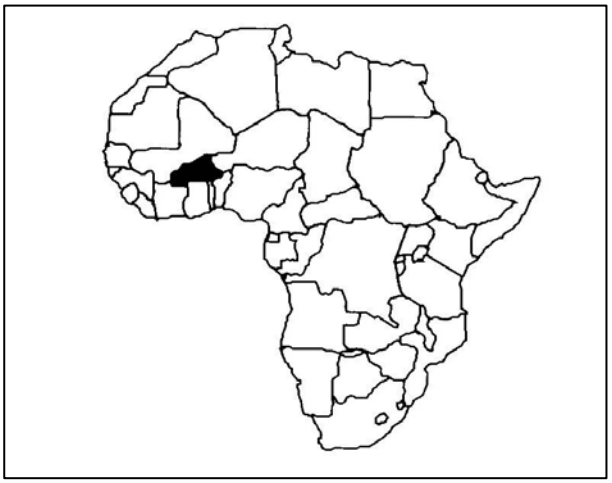


Figure 1 Location of Burkina Faso

However, in September 2002, a military rebellion took place in Côte d'Ivoire. As a result, a considerable number of Burkinabés living in Côte d'Ivoire were obliged to return to

their home and the total number is officially estimated to be some 350,000 as of July 2003. That is, the crisis in the neighboring country has imposed unexpected income reduction because the sources of remittance and migration income have been lost. In addition, the returnees from Côte d'Ivoire have caused unexpected population pressure on rural Burkina Faso. This kind of covariate shock has been rarely investigated in the literature. Hence, this paper investigates empirically the effect of the covariate shocks due to the Ivorian crisis on the welfare of rural households in Burkina Faso.

Study Site and Data

The study site is eight villages shown in Figure 2, where Japan International Research Center for Agricultural Sciences (JIRCAS) and University of Ouagadougou (UO) have been conducting household survey since 1999.[1] They spread over the four major agro-ecological zones in Burkina Faso: the northern Sudanian zone, the southern Sudanian zone, the northern Guinean zone, and the southern Guinean zone. They differ significantly in the level of annual precipitation, and accordingly households' technological choice and risk management are different.

Thirty-two households were selected in each village in the following way. First, a village census was carried out in 1998, and village households were stratified based on the ownership/adoption of animal traction technology. Then, the number of sample households of each stratum is determined proportionally to the total number of households in each stratum so that the sample size of each village is fixed at thirty-two households. As a result, the number of sample households amount to 256 spread over the eight villages in the four agro-ecological zones.

Then, from 1999 they were surveyed repeatedly for five years so as to construct a panel dataset. The interview was conducted three times a year; after harvest in February, at the end of the dry season in May, and after planting in September. In the middle of the survey period, the civil war in Côte d'Ivoire took place unexpectedly in September 2002. Therefore, this paper uses the panel dataset to explore the impact of the crisis. However, this paper focuses on the case of two villages in the southern Sudanian zone (village 3 and village 4 on Figure 2) since they are known to have been relying on remittance significantly. Since these villages belong to the same agro-ecological zone and share the main market, influence of such factors need not be taken into account in the analyses.

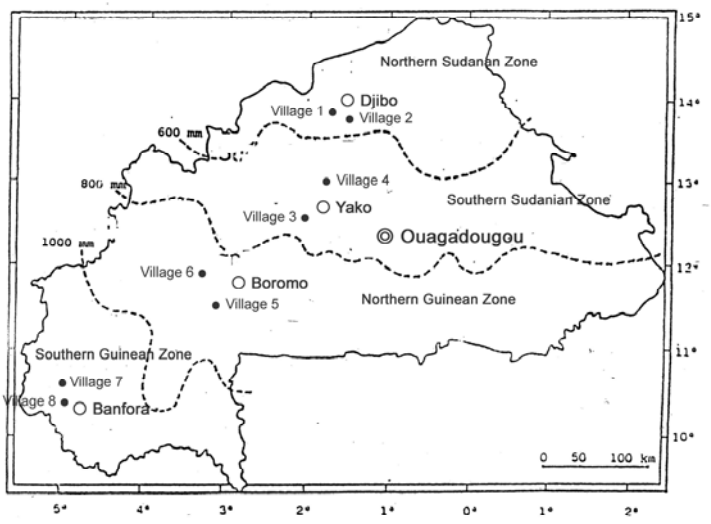


Figure 2 Study Site

[1] Among these eight villages, six villages (villages 1 and 2 in the northern Sudanian zone, villages 3 and 4 in the southern Sudanian zone, and villages 5 and 6 in the northern Guinean zone) are those where ICRISAT (International Crop Research Institute for the Semi-Arid Tropics) conducted household survey from 1980 to 1985. JIRCAS/UO chose them as the study site to see how they have changed in twenty years.

Analytical Framework

Rural households in Burkina Faso are considered to have two kinds of covariate shock as a result of the Ivorian crisis. One is an increase in household size because of accepting returnees from Côte d'Ivoire. The other is a decrease in household income due to the suspension of remittance from Côte d'Ivoire. This paper assumes that these shocks are exogenous to the households as they are caused by the Ivorian crisis. As a result, household's income per capita should decline due to the increase of household size and the decrease of remittance and migration income. To cope with the shocks, rural households will increase non-agricultural income, sell livestock, increase remittance from other sources, and increase agricultural production in the short-run. If such efforts are successful, household consumption per capita will not be affected, i.e., consumption is smoothed. Therefore, the first objective of this paper is to examine if rural households in Burkina Faso are insured against this kind of covariate shocks.

The analytical framework presented above can be expressed in the following econometric model.

$$A_{iy} = \mathrm{A}\,(R_{iy}, GI_{iy}, \mathbf{X}_{iy}, \mathbf{Y}_y) \quad (1)$$

$$N_{\mathrm{is}} = \mathrm{N}\,(R_{is}, GI_{sy}, \mathbf{X}_{is}, \mathbf{S}_s, \mathbf{Y}_y) \quad (2)$$

$$L_{\mathrm{is}} = \mathrm{L}\,(R_{is}, GI_{sy}, \mathbf{X}_{is}, \mathbf{S}_s, \mathbf{Y}_y) \quad (3)$$

$$GB_{\mathrm{is}} = \mathrm{G}\,(R_{is}, GI_{sy}, \mathbf{X}_{is}, \mathbf{S}_s, \mathbf{Y}_y) \quad (4)$$

The sub-script *i* stands for household *i*, *y* stands for harvest-year *y*, and *s* stands for season *s*. Harvest year starts from harvest season, then goes through dry season, and ends in planting season. Season in the model corresponds those three seasons. Dependent variables are: *A* is household's total cropped area, *N* is the value of net non-agricultural income per capita including both self-employment and non-agricultural employment, *L* is the value of net livestock sales per capita, and *GB* is the value of remittance from those who living in Burkina Faso. Since cropping is once a year, yearly data is used for equation (1), but otherwise seasonal data is used as seasonal variations are large. All the values are deflated by local food price index constructed by the survey data, and are in 2004 price. Among explanatory variables, household level exogenous shocks are captured by the following two variables. *R*: total number of returnees in a period (either a year or a season), and *GI*: the real value of remittance received from those who living in Côte d'Ivoire in a year (in current season and the previous two seasons). Explanatory variables include the vector of household's characteristics and assets (**X**) and the vector of harvest-year and season dummies (**S** and **Y**).

Then, as for the consumption smoothing, two models are considered. One is a reduced form, which is the same as above:

$$E_{is} = \mathrm{E}\,(R_{is}, GI_{sy}, \mathbf{X}_{is}, \mathbf{S}_s, \mathbf{Y}_y) \quad (5)$$

where *E* is the natural logarithm of real expenditure per capita divided by the poverty line.[2] The expenditure excludes durables, investment, and production inputs.

Table 1 Demographic Impact of the Ivorian Crisis

[2] This poverty line is nor the official poverty line provided by Institut National de la Statistique et de la Démographie (INSD) nor rural poverty line given by Deuxieme Programme National de Gestion des Terroirs (PNGT 2), but rather is calculated following the method and data given in appendix of Savadogo et al (2006). Hence, the poverty line is 2832 FCFA per month per capita in 2004 price. This is based on the observed prices of a 2283 calorie food component and regional level estimate of the share of non-food expenditure. Savadogo et al (2006) estimates 3487 FCFA per month per capita in 2004 price for the national level rural poverty line.

Harvest Year	Number of Working-Age Returnees in a Year	Number of Working-Age Adults	Number of Household Members
2000/2001	0.49 (0.78)	4.24 (4.20)	11.6 (9.91)
2001/2002	0.67 (1.00)	4.53 (3.93)	12.0 (9.69)
2002/2003 (after the crisis)	1.27 (1.96)	5.66 (4.42)	13.6 (10.6)
2003/2004 (after the crisis)	1.40 (2.65)	6.01 (4.61)	14.2 (11.6)

The numbers are mean number of persons per household, and the standard deviations are in the parentheses.

Table 2 Impact of the Ivorian Crisis on Transfer

Harvest Year	From Non-Household Members Living in Côte d'Ivoire	From Non-Household Members Living in Burkina	From Household Members Living Away from Home[1]
2000/2001	254 (471)	89.7 (339)	-34.1 (126)
2001/2002	239 (312)	36.9 (279)	-38.2 (83.0)
2002/2003 (after the crisis)	208 (326)	64.7 (273)	-24.7 (79.0)
2003/2004 (after the crisis)	172 (346)	76.2 (220)	-16.3 (36.2)

The numbers are real value of net transfer per capita per month in FCFA, and the standard deviations are in the parentheses.

[1] They are living in Burkina Faso.

Results

Household Level Shocks and Poverty

First, the shocks are to be confirmed among sample households. Table 1 presents the demographic changes before and after the Ivorian crisis. It is clear that after crisis a household received more than one working-age (age between 16 and 60) adult on average every year, and it increased household size significantly. Note that the number of working-age returnees is used as an exogenous shock variable because the change of household size includes other cases: for example, returnees under the age of 16, new-born babies, marriages, deceased, etc. Table 2 summarized the changes of net transfer during the survey period. Net transfer from non-household members living in Côte d'Ivoire, which is another exogenous shock in this study, declined significantly after the crisis.

Figure 3 Poverty Over Time

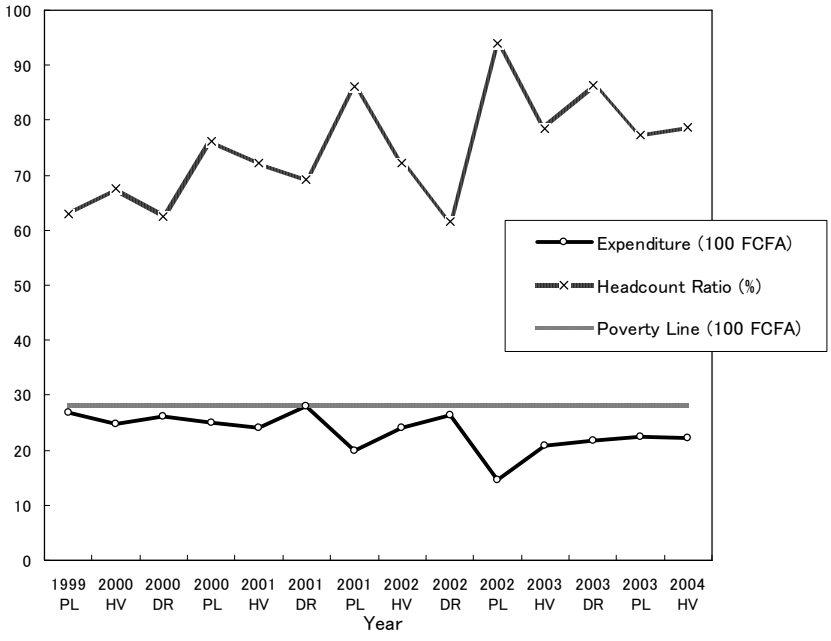


Table 3 Determinants of Household's Total Cropped Area

Explanatory Variables \ Dependent Variable	Total Cropped Area (ha)	Cropped Area per Capita (10^{-1} ha)	
Exogenous Shocks			
Transfer from Côte d'Ivoire[1]	0.75 (3.50)	3.64 (2.55)	
Number of Working-Age Returnees[2]	0.70 (0.37) *	0.09 (0.12)	
Household Assets			
Real Value of Livestock Holdings per Capita	6.06 (3.16) *	3.43 (2.16)	
Household Demographics			
Household Size	0.23 (0.11) **	-0.03 (0.03)	
Working-Age Male Rate (Number/HH size)	-5.57 (4.22)	-7.16 (3.03)	**
Working-Age Female Rate (Number/HH size)	-1.47 (3.75)	0.72 (2.27)	
Number of Working-Age Deceased[2]	-0.73 (0.78)	0.78 (0.46)	*
Household Head's Characteristics			
Change of the Sex during the Last 1 Year[3]	1.16 (1.07)	-0.84 (1.11)	
Household Head's Age (10)	-3.38 (2.95)	-0.72 (0.74)	
Household Head's Age Squared (10^2)	0.28 (0.32)	5.08 (5.40)	
Household Human Capital			
Adult Male Total Education Score[4]	-9.80 (8.50)	6.21 (5.17)	
Adult Female Total Education Score[4]	3.02 (5.03)	2.71 (1.48)	*
Adult Male Highest Education			
Alphabetization of Local Language (dummy)	0.16 (0.98)	-0.18 (0.96)	
Primary School (dummy)	-0.42 (1.51)	-1.06 (0.86)	
Secondary School or Higher (dummy)	2.15 (2.47)	-2.36 (1.41)	*
Adult Female Highest Education Level			
Alphabetization of Local Language (dummy)	2.65 (4.50)	-0.09 (1.63)	
Primary School (dummy)	0.40 (1.50)	-0.08 (0.69)	
Secondary School or Higher (dummy)	0.01 (2.25)	1.64 (2.11)	
Harvest Year Dummies			
Year 2001/02	0.42 (0.65)	0.44 (0.48)	
Year 2002/03	-0.48 (0.64)	-0.52 (0.42)	
Year 2003/04	0.15 (0.61)	0.66 (0.50)	
Constant	12.97 (7.07) *	7.80 (2.50)	***
Number of Observations	62 hhs * 4 years	62 hhs * 4 years	
R^2	0.42	0.20	
Hausman Test	30.1	0.0	
Estimation Method	fixed effect	random effect	

Standard errors are in parentheses. *, **, and *** indicate that the coefficient is estimated at significance level 10%, 5%, and 1% respectively.

[1] Real value in 2004 price per capita per year; [2] Total number during the past 1 year; [3] Change from male to female takes 1, change from female to male takes -1, and no change takes 0, respectively; [4] If he/she completed alphabetization the score is 1, if he/she completed primary school the score is 2, and if his/her education level is higher than secondary school the score is 3. Then total score is divided by household size to obtain Total Education Score.

On the other hand, net transfer from non-household members living in Burkina Faso includes the cases within village, from near-by villages, and from cities in Burkina Faso, does not show a clear trend. It may be because households try to increase transfer from those people to cope with the reduction of transfer from Côte d'Ivoire. Almost all the cases of transfer from household members are within Burkina Faso, and as shown in the last column of Table 2, sample households are net givers on average. But the amount of net giving

declined after the crisis although it is much smaller than that received from non-household members. From Tables 1 and 2, it is clear that the Ivorian crisis has caused shocks to rural households in Burkina Faso.

Did the shock affect households' welfare? Figure 3 shows the trend of average real expenditure per capita per month in 2004 harvest season price. There are significant seasonal and annual fluctuations, but the expenditure seems to be declining after the crisis, namely since 2002 planting season.

As noted in footnote 2, poverty line estimated for the sample households is 2832 FCFA per month per capita in 2004 price, and the sample households on average were always below the poverty line. In fact, poverty headcount ratio is always quite high, ranging from 0.63 (in 2000 dry season) to 0.94 (2002 planting season), as shown in Figure 3 . The headcount ratio also shows significant seasonal and annual fluctuations, but there seems to be an increasing trend over time. Hence, Figure 3 suggests that the Ivorian crisis have increased poverty among rural households in Burkina Faso.

In the next sections, the relationship between the shocks and the poverty will be formally investigated.

Household Coping with Shock

As shocks due to the Ivorian crisis are really observed, the next question is how rural households cope with them. To answer it, equations (1) – (4) are to be estimated. Table 3 is for household total cropped area. As expected, the number of working-age returnees has a positive impact on the household cropped area; one-adult returnees increases 0.7 hectare of area under cultivation. But the number of returnees does not change cropped area per capita. On the other hand, transfer from Côte d'Ivoire does not have any significant effect on either household total cropped area or cropped area per capita. It means that agricultural production does not substitute for the reduction of remittance.

Table 4 shows the regression results for other coping behaviors. First, the reduction of remittance from Côte d'Ivoire significantly increases non-agricultural income. Second, working-age returnees urge households to obtain transfer within Burkina Faso. That is, both non-agricultural income and domestic remittance are households' coping strategies in the case of the Ivorian crisis. But they work differently: while non-agricultural income is to compensate the loss of transfer income, domestic remittance is used in the case of demographic shock. On the other hand, livestock sales are not a response to such shocks, probably because livestock price declined after the crisis. Moreover, there is little role of human capital in those coping behavior, even in the case of non-agricultural income. It is because most of the non-agricultural income is from informal, small-scale self-employment like street vendors and vegetable production in the garden, which may not require a lot of education.

Table 4 Determinants of Household's Coping Behavior

Explanatory Variables \ Dependent Variable	Non-agricultural Net Income[1]	Net Livestock Sales[1]	Transfer within Burkina Faso[1]
Exogenous Shocks			
Transfer from Côte d'Ivoire[2]	-0.33 (0.20) *	0.25 (0.38)	-0.76 (0.79)
Working-Age Returnees Rate (Number/HH size)	0.46 (0.31)	-0.28 (0.65)	4.27 (2.34) *
Household Assets			
Real Value of Livestock Holdings per Capita	0.11 (0.13)	0.07 (0.42)	0.90 (0.75)
Crop Production in the Previous year[3]	0.23 (0.12) **	0.15 (0.21)	-0.04 (0.48)
Household Demographics			
Household Size (10^2)	-0.95 (0.68)	0.19 (1.14)	-3.94 (2.08) *
Working-Age Male Rate (Number/HH size)	-0.06 (0.30)	0.13 (0.62)	-0.55 (1.63)
Working-Age Female Rate (Number/HH size)	-0.06 (0.25)	-0.03 (0.50)	1.21 (1.20)
Working-Age Deceased Rate (Number/HH size)	-0.73 (0.40) *	0.98 (3.42)	6.04 (6.31)
Household Head's Characteristics			
Change of the Sex during the Last 1 Year[4]	-0.44 (0.15) **	-0.25 (0.21)	2.09 (2.05)
Number of years of age gap, if it exists	-0.55 (0.29) *	0.28 (0.28)	0.66 (1.48)
Household Human Capital			
Adult Male Total Education Score[5]	-0.09 (0.34)	1.65 (0.66) **	-0.04 (1.66)
Adult Female Total Education Score[5]	0.06 (0.05)	-0.14 (0.18)	0.01 (0.64)
Adult Male Highest Education			
Alphabetization of Local Language (dummy)	0.00 (0.08)	0.33 (0.32)	0.13 (0.79)
Primary School (dummy)	-0.01 (0.07)	-0.20 (0.21)	0.28 (0.59)
Secondary School or Higher (dummy)	-0.19 (0.17)	-1.63 (1.00)	0.46 (0.88)
Adult Female Highest Education Level			
Alphabetization of Local Language (dummy)	-0.15 (0.14)	-0.48 (0.46)	-0.22 (1.08)
Primary School (dummy)	0.02 (0.05)	-0.04 (0.16)	0.45 (0.53)
Secondary School or Higher (dummy)	0.06 (0.09)	0.03 (0.19)	4.82 (2.21) **
Harvest Year /Season Dummies			
Year 2000/01	-0.23 (0.07) **	-0.02 (0.15)	0.77 (0.35) **
Year 2001/02	-0.13 (0.07) **	-0.12 (0.13)	1.21 (0.32) ***
Year 2002/03	-0.08 (0.06)	-0.18 (0.14)	0.90 (0.28) ***
Year 2003/04	-0.12 (0.07) *	-0.17 (0.14)	0.72 (0.27) ***
Planting Season	-0.06 (0.04) *	-0.04 (0.07)	-0.53 (0.25) **
Harvest Season	-0.21 (0.03) **	0.10 (0.08)	-0.42 (0.26) *
Constant	0.42 (0.17) **	0.33 (0.32)	1.17 (0.66) *
Number of Observations	62hhs * 12seasons	62hhs * 12seasons	62hhs * 12seasons
R^2	0.17	0.08	0.11
Hausman Test	45.2	67.7	15.1
Estimation Method	fixed effect	fixed effect	random effect

Standard errors are in parentheses. *, **, and *** indicate that the coefficient is estimated at significance level 10%, 5%, and 1% respectively.

[1] Real value in 2004 price per capita per month (10^4 FCFA); [2] Total amount of remittance received per capita in real value during the last one year (10^4 FCFA); [3] The product of household's cropped area per capita in the previous year and annual rainfall in the previous year (10^3 ha*mm); [4] See footnote 3 of Table 3; [5] See footnote 4 of Table 3.

Table 5 Determinants of Household Welfare (Reduced-form Models)

Dependent Variable / Explanatory Variables	Expenditure[1] Full Sample		Expenditure[1] Asset-Poor[2]		Expenditure[1] Asset-Rich[2]	
Exogenous Shocks						
Transfer from Côte d'Ivoire [4]	0.53 (0.23)	**	1.11 (0.51)	**	0.61 (0.26)	**
Working-Age Returnees Rate (Number/HH size)	0.07 (0.32)		0.09 (0.38)		0.32 (0.44)	
Household Assets						
Real Value of Livestock Holdings per Capita	0.20 (0.11)	*	0.29 (0.56)		0.05 (0.14)	
Crop Production in the Previous Year[5]	0.25 (0.08)	***	0.21 (0.13)		0.20 (0.10)	*
Household Demographics						
Household Size (10^2)	0.06 (0.33)		-3.01 (0.92)	***	-0.20 (0.61)	
Working-Age Male Rate (Number/HH size)	0.41 (0.28)		0.16 (0.40)		-0.61 (0.40)	
Working-Age Female Rate (Number/HH size)	0.80 (0.24)	***	0.74 (0.36)	**	0.50 (0.35)	
Working-Age Deceased Rate (Number/HH size)	1.30 (0.67)	*	-0.25 (0.74)		1.86 (0.59)	***
Household Head's Characteristics						
Male (dummy)	0.27 (0.13)	**	0.20 (0.31)		1.24 (0.27)	***
Age (10^2)	-0.88 (0.53)	**	-7.73 (4.44)	*	8.55 (2.00)	***
Age Squared (10^4)	0.69 (0.42)		7.17 (4.34)	*	-8.42 (1.87)	***
Household Human Capital						
Adult Male Total Education Score[6]	-0.19 (0.23)		-1.15 (2.04)		0.13 (0.23)	
Adult Female Total Education Score[6]	0.22 (0.07)	***	0.15 (0.07)	**	0.71 (0.38)	*
Adult Male Highest Education						
Alphabetization of Local Language (dummy)	0.11 (0.11)		(dropped)		0.16 (0.35)	
Primary School (dummy)	0.14 (0.08)	*	0.18 (0.34)		-0.05 (0.12)	
Secondary School or Higher (dummy)	0.00 (0.12)		0.07 (0.57)		0.44 (0.13)	***
Adult Female Highest Education Level						
Alphabetization of Local Language (dummy)	0.05 (0.12)		(dropped)		0.00 (0.16)	
Primary School (dummy)	-0.04 (0.06)		-0.06 (0.11)		0.12 (0.08)	
Secondary School or Higher (dummy)	-0.01 (0.15)		-0.02 (0.19)		(dropped)	
Rainfall (10^- mm) in the Previous Year	0.12 (0.03)	***	0.12 (0.05)	**	0.11 (0.04)	***
Harvest Year /Season Dummies						
Year 2000/01	0.17 (0.07)	**	0.17 (0.13)		0.09 (0.09)	
Year 2001/02	-0.10 (0.05)	**	-0.09 (0.07)		-0.13 (0.06)	**
Year 2002/03	0.16 (0.10)		0.23 (0.17)		0.10 (0.12)	
Year 2003/04	-0.34 (0.05)	***	-0.23 (0.08)	***	-0.33 (0.07)	***
Planting Season	-0.24 (0.04)	***	-0.21 (0.06)	***	-0.24 (0.05)	***
Harvest Season	-0.07 (0.03)	**	-0.05 (0.05)		-0.05 (0.04)	
Constant	-1.44 (0.33)	***	0.61 (1.18)		-4.08 (0.73)	***
Number of Observations	67hhs * 14seasons		30hhs * 14seasons		30hhs * 14seasons	
R^2	0.20		0.23		0.23	
Hausman Test	24.0		38.9		1240	
Estimation Method	random effect		fixed effect		fixed effect	

Standard errors are in parentheses. *, **, and *** indicate that the coefficient is estimated at significance level 10%, 5%, and 1% respectively.

[1] The dependent variable is natural logarithm of real per capita expenditure per month divided by the poverty line; [2] Asset poor households are those whose real livestock value per capita was less than 1,290 FCFA as of the harvest season of 2000, and asset rich households owned more livestock than 1,290 FCFA; [3] Natural logarithm of household total real income per capita per month except for that from own agricultural production (10^4 FCFA); [4] Total amount of remittance received per capita in real value during the current period (10^4 FCFA); [5] See footnote 3 of Table 4; [6] See footnote 4 of Table 3.

Impact on Household Welfare

The important question is if the rural households smooth consumption by using the coping strategies as analyzed above. In order to see the impact of the exogenous shocks on household welfare, equation (5) is estimated. The results are presented in Table 5. The regression is done using full sample and sub-samples respectively. The sub-samples are asset-poor and asset-rich, which are obtained based on the initial livestock holdings (as of the harvest season in 2000) because livestock is known to be an important asset to cope with shocks in Burkina Faso. The Table clearly shows that the reduction of remittance from Côte d'Ivoire significantly decreased household expenditure per capita. The impact is much larger for the asset-poor households than the asset-rich household, as expected. However the number of working-age returnees does not have a significant impact on household expenditure. Moreover, both crop production and rainfall previous year significantly increase household expenditure regardless of asset level. This implies that sample households' welfare significantly depends on agricultural production, which is affected annual rainfall level. That is, they are subject to another covariate shock due to the rainfall.

Although education shows little role in coping behavior as discussed above, it has certain influences on the consumption level. First of all, adult female's total education score has a positive significant effect on household per capita expenditure. This is observed both in asset-poor households and in asset-rich households, but the impact is larger among asset-rich group. Second, a household has an adult male whose education level is secondary school or higher, welfare level of such a household is significantly higher. But it is only in the case of asset-rich households. That is, higher education level is more effective if assets are available.

Conclusions

The civil war in Côte d'Ivoire has caused an increase in household size due to returnees and a decrease in remittance received in rural Burkina Faso. The impact of the two kinds of shock on household's coping behavior is investigated first. The number of working-age returnees increases household cropped area and augments remittance received from those who living in Burkina Faso. But it does not have a significant impact on non-agricultural income. On the other hand, the reduction of transfer from Côte d'Ivoire significantly increases non-agricultural income, but has effect neither on household total cropped area nor on remittance within Burkina Faso. However, livestock sales are found not to be a response to such shocks. It means that agricultural production and remittance within Burkina Faso do not substitute for the reduction of remittance from Côte d'Ivoire, but rather are to cope with demographic shock. On the other hand, rural households in Burkina Faso compensate the loss of transfer income with non-agricultural income.

In spite of those coping behaviors, this study demonstrates that the households do not fully smooth consumption against the reduction of remittance form Côte d'Ivoire. The impact is much larger for the asset-poor households than the asset-rich household, as expected. And the significant fluctuation of household expenditure per capita due to the variability of annual rainfall is observed regardless of asset level. On the other hand the number of working-age returnees does not have a significant impact on household expenditure.

References

Dercon, S. “Risk, Poverty and Vulnerability in Africa,” Journal of African Economies, Vol. 14, No. 4, 2005, pp. 483-488.

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

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

Grimm, M. and I. Günther, “Growth and Poverty in Burkina Faso: A Reassessment of the Paradox,” Journal of African Economies, Vol. X, No. Y, 2006, pp. xxx-xxx.

Reardon, T., P. Matlon, and C. Delgado. “Coping with Household-level Food Insecurity in Drought-Affected Areas of Burkina Faso,” World Development, Vol. 16, 1988, pp. 1065-1074.

Savadogo, K., Y. Bambio, O. Combary, A. Ouédraogo, and A. Tiemtore. Les Conditions de Vie, les Revenus et la Pauvreté des Ménages Ruraux au Burkina Faso en 2005: Resultats de l’Enquête Intermediaire 1 du PNGT 2, Deuxième Programme National de Gestion des Terroirs, Ouagadouguo, 2006.

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

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Introduction

The nutritional status and growth and health status of children are useful indicators to assess the ability of a population to adapt to the environment and the extent of this adaptation. These indicators enable measurement and evaluation of the overall nutritional and health status of young children. Additionally, they enable identification of subgroups of the child population that are at increased risk of faltered growth, disease, impaired mental development, and death.

There are several factors that influence the nutritional status of children, including the poverty status of mothers and poor diet and environmental conditions of the households. These factors can impair growth in children and result in decreased body weight or height. Moreover, in addition to the cross-sectional survey, a long-term survey monitoring child growth enables assessment of the impact of poverty and environmental destruction, as well as the resilience of the population and that of the community residing in it.

This report presents a brief summary of the growth and nutritional status in Zambian children; the data provided is based on the report of Living Conditions Monitoring Survey (LCMS) 2004, with special focus on southern and eastern provinces of Zambia. Subsequently, I propose a methodology for conducting a longitudinal survey that monitors child growth and nutritional status in rural villages in the eastern and southern provinces of Zambia.

1. Overview of the child growth and nutritional status in Zambia based on the data from Living Conditions Monitoring Survey (LCMS) 1991–2004

Currently, two types of datasets on the nutritional status of Zambian children are available. They are derived from the national surveys: Zambia Demographic and Health Survey (ZDHS) and Living Condition Monitoring Survey (LCMS). The latest report of the individual survey published by ZDHS (ZDHS 2001–2002, Central Statistical Office 2003) was in 2003 and that by LCMS (LCMS 2004, Central Statistical Office 2005) was in 2005. In this article, more recent data (LCMS 2004) has been adopted to review the growth and nutritional status of Zambian children.

The LCMS-2004 survey included anthropometric measurements of children under the age of five for assessment of the nutritional status of children. Table 1 shows the variations in the malnutrition indices of children (aged 3–59 months) in urban and rural areas

and in individual provinces. While similar variations were observed in underweight and growth stunting among provinces; there were no variations in wasting. Overall, 50% of the children aged between 3 and 59 months showed growth stunting, 20% were underweight, and 6% showed growth wasting.

Table 1. Incidence of stunting, underweight and wasting of children aged 3-59 months by province, Zambia, 2004

	N	Stunting (%)	Under-weight (%)	Wasting (%)
All Zambia	1,229,519	50	20	6
Province				
Central	125,563	48	22	7
Copperbelt	159,141	44	16	4
Eastern	193,176	59	20	5
Luapula	121,740	64	26	4
Lusaka	132,731	40	18	8
Northern	172,851	55	25	6
North Western	77,470	49	19	10
Southern	162,858	40	16	6
Western	83,989	45	21	6

At the provincial level, there were significant variations in the nutritional status of children. With regard to “stunting,” there was 40% stunting in the southern province, which was identical to that observed in Lusaka and was the least among the 9 provinces. In contrast, the stunting rate in the eastern province was 59%, which was the second highest among all the provinces. A similar tendency was observed with regard to the “underweight” status: the southern province had the lowest rate, while that in the eastern province had an intermediate rate. In other words, at a provincial level, children in the southern provinces were relatively taller and heavier as compared to the average height and weight, whereas those living in the eastern provinces were shorter and lighter.

This tendency was observed to be consistent during the 6 surveys that were conducted between 1991 and 2004 (Fig. 1). Except for 1996, the rate of “stunting” has been higher than the average rate in the eastern province while it has been lower than average in the southern province. The rate of “stunting” increased from 1991 to 2004, whereas the rate of the

“underweight” status tended to decline and that of “wasting” remained stable in this period (Fig. 2).

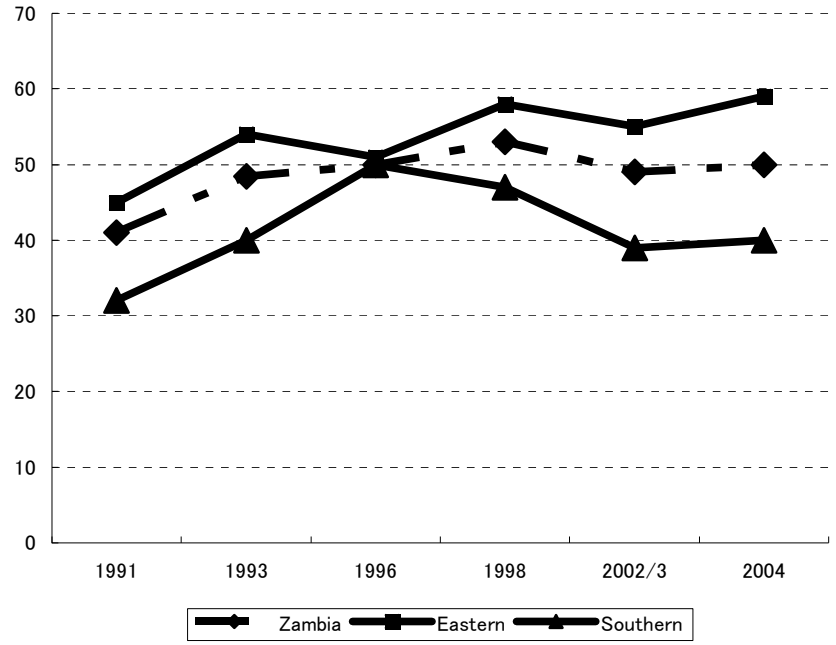

Fig.1 National and provincial trends in distribution of child malnutrition (Stunting)

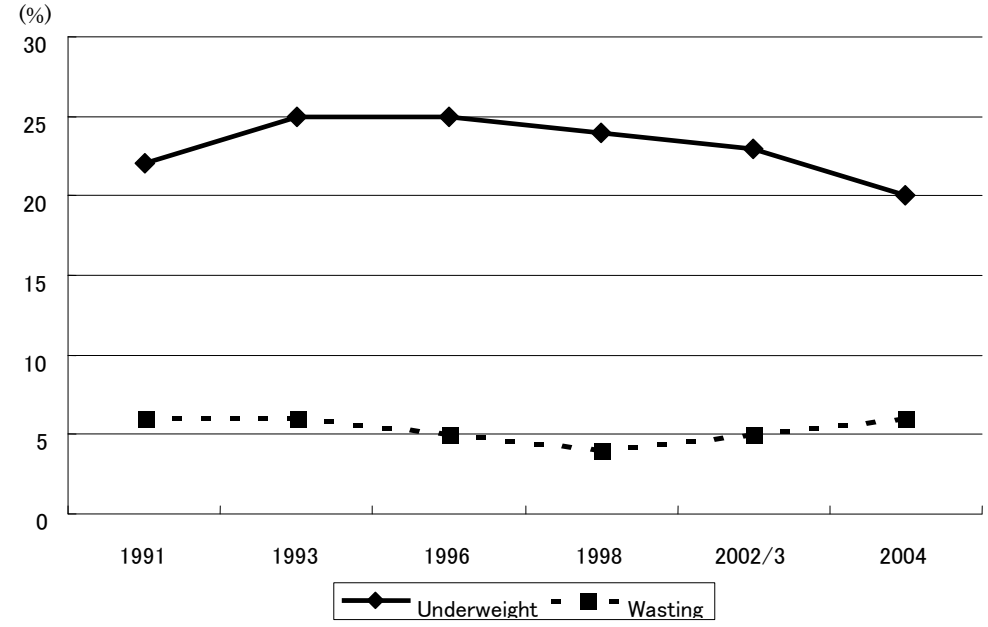

Fig. 2 National trends in distribution of child malnutrition

(Underweight and Wasting)

In summary, 50% of the children aged between 3 and 59 months showed growth stunting (extremely short for their age), 20% were underweight (low weight for their age) and 6% showed growth wasting (low weight for their height). The stunting levels in the eastern

province are greater than the national average, while it was low in the southern province. Overall, the nutritional status of Zambian children were considered poor because only 2.3% of the children fell below –2 SD for each of the three indices including “stunting,” “wasting,” and “underweight” in the reference population (WHO 1983, 1995). From 1991 to 2004, the data from six cross-sectional surveys did not show any evidence of the impact of drought. A village-level intensive longitudinal monitoring survey is required to assess the impact of drought on the growth and nutritional status of children.

2. Longitudinal monitoring survey on growth and nutritional status

This survey aims to monitor the nutritional status of local villagers by measuring their physical dimensions (e.g., height, weight, and so on) on a regular basis and in a longitudinal manner in order to investigate the food shortage that occurs due to drought and its impact on health and human security of locals living in villages in the eastern and southern provinces of Zambia.

The study would involve all residents ranging from the infants to the elderly individuals from two or three rural areas in the eastern and southern provinces. All participants will be provided with detailed information regarding the procedures involved and the purpose of conducting the survey, and informed consent will be obtained from all the participants. The sample size in each province (comprising few villages) is expected to range from several hundreds to a thousand.

1. Baseline survey

Japanese experts simultaneously conduct anthropometric measurements in the field annually (Yamauchi 2007). Ideally, the measurements are performed on the same date or at least in the same month.

Measurements:

1) Infants (aged 0–2 years, unable to stand-up independently): body length (in the lying position), weight, and upper arm circumference (UAC).

2) Children (aged 2–18 years): height, weight, UAC, waist and hip circumferences, and skinfold thickness (in the triceps and subscaplar regions).

3) Adults (aged >18 years): height, weight, UAC, waist and hip circumference, and skinfold thickness (in the triceps and subscaplar regions).

2. Growth monitoring survey

Well-trained local health assistants conduct anthropometric examination according to the standard protocol (Weiner and Lourie 1981) on a weekly or biweekly basis.

Measurements:

1) Infants (aged 0–2 years, unable to stand-up independently): body length (in the lying position), weight, and upper arm circumference (UAC).
2) Children (aged 2–18 years): height, weight, and UAC.
3) Adults (aged >18 years): weight and UAC (The height of the adults is assumed to be stable).

3. Indicators and analyses

The three standard indices of physical growth that describe the nutritional status of children are defined as follows:
1. Height-for-age (chronic malnutrition)—Stunting
2. Weight-for-height (current malnutrition)—Wasting
3. Weight-for-age (chronic and current malnutrition)—Underweight

Stunting (Height-for-age) is a condition reflecting the cumulative effect of chronic malnutrition. Wasting (Weight-for-height) is defined as failure to gain weight in relation to the height. This can occur as a result of recent illness that causes a sudden loss of appetite and subsequent loss of muscle and fat in a child. In fact, this is a short-term effect. Underweight (Weight-for-age) is defined as low weight in relation to the age. It is a composite index for weight-for-height and height-for-age; thus, it does not distinguish between acute malnutrition (wasting) and chronic malnutrition (stunting). A child may be regarded as underweight for his/her age because he/she shows growth stunting, growth wasting, or both. Therefore, weight-for-age is a good overall indicator of the nutritional status of a population.

A number of indicators have been developed to express the various types of malnutrition that affect growth of children. However, those selected for this survey are the most commonly used indicators. According to the recommendations by the World Health Organization (WHO 1983, 1995), the nutritional status of children will be compared with an international reference population (Kuczmarski et al 2002) defined by the U.S. National Center for Health Statistics (NCHS) and accepted by the U.S Center for Disease Control (CDC).

4. Expected outcomes

-General nutritional status of children and adults as compared to the international reference population.
-Growth retardation during seasons of drought and periods of food shortage.
-Inter-household variations in the nutritional status and growth level of children during both normal and drought/food shortage periods.
-Identification of high-risk gender and age groups.
-Associations between the coping strategies/socio-economic status of the household and the

nutritional status and growth of the child.
-Development of a national standard growth curve in Zambia.

5. Potential issues
-Building growth and nutritional status monitoring system
-Hiring and training of local health assistants
-Procurement of equipments for anthropometric measurements: stadiometer, scale, and measuring tape (one each for a village)
-Batteries for digital scales (preferred to beam scales)
-The types of equipments used during ZDHS and/or LCMS?

References

Central Statistical Office (2003) Zambia Demographic and Health Survey 2001-2002, Lusaka, Central Board of Health.

Central Statistical Office (2005) Living Conditions Monitoring Survey Report 2004, Lusaka, CSO printing Press.

Kuczmarski RJ, Ogden CL, Guo SS et al. (2002) 2000 CDC growth charts for the United Status: methods and development. Vaital Health Stat 11, 246, 1-190.

Weiner JS and Lourie JA (1981) Practical Human Biology. London, Academic Press.

World Health Organization (1983) Measuring change in nutritional status. Geneva, World Health Organization.

World Health Organization (1995) Physical status: the use and interpretation of anthropometry. Geneva, World Health Organization.

Yamauchi T (2007) Modernization, nutritional adaptability and health in Papua New Guiena Highlanders and Solomon Islanders. In Health Change in the Asia-Pacific Region: Biocultural and Epidemiological Approaches, ed. R Ohtsuka and SJ Ulijaszek, Cambridge, Cambridge University Press.

Framework for monitoring complex social vulnerability

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As Chambers (1989: 3) said "coping strategies (of the poor) vary by region, community, social group, household, gender, age, season and time in history", the degree of vulnerability also varies. Watts and Wolde Mariam tried to understand the complex structure and causes of increased vulnerability in Northern Nigeria and Ethiopia respectively in a regional and community level referring to historical backgrounds (Watts 1983; Watts and Bohle 1993; Wolde Mariam 1986). In the study, Watts shows how capitalist development in Northern Nigeria has weakened peasant household and increased their exposure to market fluctuation. Wolde Mariam also demonstrates how Ethiopian peasant farmers are made vulnerable to famine by the socio-economic and political forces. These studies show how peasant farmers, as a social group have become vulnerable to famine or market development.

Swift (1989), on the other hand, focused on household and individual level's vulnerability. He proposed new analysis of vulnerability based on a classification of assets into investments, stores and claims, which successfully showed us the richness of households' portfolios. African farming families mobilize it skillfully to deal with new and different stresses and shocks. The concept of entitlement by Sen (1981) also has contributed to the study of vulnerability of individual and household level. Many gender studies have revealed that the vulnerability of women and children in a household is much severe than that of men. And they note the necessity to see more carefully the intra-household power structure by which women and children are deprived of access to land and assets.

This shows that different actors and groups, such as individuals, households, and village societies have different processes of increased vulnerability. Each processes of increased vulnerabilities have strong linkage although, the vulnerabilities of different actors and groups have not increased coincide with each other, but rather they sometimes have increased independently. In fact, different level's vulnerabilities increase at the same time but it sometimes happens that security of some people in a society have deteriorated while the security of the society as a whole have improved.

So it is very important to see the social vulnerability differently by each level of groups, such as individuals, households, and village societies. After scrutinized each level's vulnerability, we can get the total view of multi-layered disposition of vulnerabilities. At this point, we can start to analyze the relationship between social vulnerability and ecological vulnerability.

References

Chambers, Robert (1989) Editional Introduction: Vulnerability, coping and policy, in (Chambers, Robert ed. Vulnerability: How the poor cope, *I.D.S. Bulletin* 20(2)), pp. 1-7.

Food and Agriculture Organization (2004) *HIV/AIDS, gender inequality and rural livelihoods: The impact of HIV/AIDS on rural livelihoods in Northern Province, Zambia*, FAO, Rome,.

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,.

Pryer, Jane (1981) When breadwinners fall ill: Preliminary findings from a case study in Bangladeshi in (Chambers, Robert ed. Vulnerability: How the poor cope, *I.D.S. Bulletin* 20(2)), pp. 49-57.

Sen, A., (1981) Poverty and famines: an essay on entitlement and deprivation, Clarendon, Clarendon Press, Oxford)

Swift, Jeremy (1989) Why are rural people vulnerable to famine? in (Chambers, Robert ed. Vulnerability: How the poor cope, *I.D.S. Bulletin* 20(2)), pp. 8-15.

Watts, M. (1983) Silent violence: Food, famine and peasantry in Northern Nigeria, Berkley, Univ. of California Press.

Watts, Michael J. and Bohle, Hans G. (1993) The space of vulnerability,; the causal structure of hunger and famine, Progress in Human Geography, 17-1, pp. 43-67.

Wolde Mariam, Mesfin (1986) *Rural vulnerability to famine in Ethiopia 1958-1977*, London, Intermediate Technology Publications, p.191.

Vulnerability and Coping Strategies in Africa: Literature Review for Research in Zambia

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This paper aims to review some previous studies on vulnerability and coping strategies of communities in Sub-Saharan Africa, in order to acquire basic understanding of theories and issues for the study of vulnerability and resilience of socio-ecological system.

Double impacts of climate change and economic globalization

Leichenko and O'Brien 2002 analyze double impacts of climate change and economic globalization, with identifying winners and losers of the double process. Southern Africa is not exceptional. Combination of environmental and economic changes is altering the context under which farmers in southern Africa cope with climate variability (Leichenko and O'Brien 2002, Eriksen et al. 2005). Southern Africa has been hit by drought more frequently than it used to be. Although it is difficult to determine to what extent this was caused by global climate change, environmental change did affect the context of farming and livelihood of people in southern Africa. Since many countries of Sub-Saharan Africa introduced economic liberalization policies such as liberalization of trade, in the 1990s, African economies are more closely integrated into global economy and the impacts of economic globalization have been felt more directly.

Vulnerability

Vulnerability is a concept that has been used in different research traditions, but there is no consensus on its meaning (Gallopin 2006: 294).

Adger 2000 defines social vulnerability as the exposure of groups to stress as a result of the impacts of environmental change. Social vulnerability in general encompasses disruption to livelihoods and loss of security (Adger 2000). While Adger 2000 defines vulnerability in terms of exposure to stress, later Adger in his review of approaches to vulnerability to environmental change, he concludes that vulnerability is conceptualized as being constituted by components that include exposure to perturbation, sensitivity to perturbation, and the capacity to adapt (Adger 2006; Gallopin 2006). Watts & Bohle 1993 define vulnerability in terms of exposure, capacity and potentiality. Accordingly, the prescriptive response to vulnerability is to reduce exposure, enhance coping capacity, and strengthen recovery potential.

As Cutter 1996 contends the vast majority of vulnerable studies take a political-economic perspective and suggest a causal structure that concentrates on the differential social impacts and abilities to cope with the crisis at hand. Adger 2006 also

maintains that one of the commonalities in vulnerability research in the environmental arena is that vulnerability to environmental change does not exist in isolation from the wider political economy of resource use.

Adger2006 categorizes two major research traditions in vulnerability: vulnerability as lack of entitlements and vulnerability to natural hazards. The latter delineated into three overlapping areas of human ecology/political ecology, natural hazards, and the 'Pressure and Release' model.

Cutter 1996 concludes differently on intellectual traditions and by identifying three distinct themes in vulnerability studies: vulnerability as risk/hazard exposure; vulnerability as social response; and vulnerability of places. The first theme examines the source (or potential exposure or risk) of biophysical or technological hazards. The second focuses on coping responses including societal resistance and resilience to hazards. In the third perspective, vulnerability is conceived as both a biophysical risk as well as a social response, but within a specific areal domain.

Watts & Bohle 1993 define vulnerability by three processes – entitlement (or economic capability), empowerment (political/social power) and political economy (historical/structural class-based patterns of social reproduction). They suggest that the intersection of these tripartite processes produces the social space of vulnerability (Watts & Bohle 1993; Cutter 1996).

Coping Strategies

Eriksen et al. 2005 distinguish three aspects of coping strategies. Coping strategies can be characterized as relating to production (agricultural and economic), social adjustments (reciprocal economic exchange), and biological (changing the diet, reducing consumption).(Eriksen et al. 2005:6)

The coping strategies of small-scale farmers vary between households and also over time (Eriksen et al. 2005:6). Based on the comparative case studies of Kenyan and Tanzanian villages, Eriksen et al. 2005 show that coping strategies have been different each time and in each location (p.8).

Studies on Africa

The majority of the studies on vulnerability and coping strategies of the people in Sub-Saharan Africa are related to drought and food security. Food insecurity and vulnerability to food crises in Africa are the outcome of an interaction between environmental and socioeconomic factors both in the long and short terms (Watts & Bohle 1993).

Bohle, Downing & Watts 1994 explain the social context of hunger and famine and vulnerability to climate change in Zimbabwe by using the model developed in Watts and Bohle 1993. The causal structure of vulnerability is embedded in the human ecology, political

economy and entitlement relations of post-independence Zimbabwe. The patterns of vulnerability are due to: weak macroeconomic performance, inequitable land distribution, and misdirected social policy.

Recurrent drought and structural adjustment, increasing monetization

Bohle et al. 1994 argue that in Zimbabwe, external shocks of recurrent drought in the decade from the mid-1980s and structural adjustment have further stressed vulnerable groups (Bohle, Downing & Watts 1994).

In the analysis of the drought coping strategies of Kenyan and Tanzanian farmers, Eriksen et al. 2005 explain that cash income was an important attribute of most of the favored principal coping activities of the farmers hit by drought. This was partly because the cost of medical treatment, education and other social services was increasing, as a result of policy changes at the national level related to cost recovery of social services, required to qualify for IMF or World Bank assistance (Eriksen et al. 2005: 12).

Changes in macro-economic policy, particularly the structural adjustment programs implemented over the last decade in many parts of Africa, have in some cases impacted negatively o the rural poor. In Kenya the food-security situation has been made more precarious by the effects of reduced subsidies to agricultural, educational and health services, implemented as part of structural adjustment program (Sutherland et al. 1999). Sutherland et al. 1999 also reveal that food security has been adversely affected by rising education and health costs which were caused by reduction of subsidies. Money that could be spent on food or agricultural inputs was used to pay costs associated with medical care and education.

Sutherland et al. 1999 indicate that in semi-arid eastern Kenya the pressure to sell food crops in order to meet other cash needs is great and leaves many households vulnerable (p. 366).

In many countries of Africa macroeconomic performance has been weak, which is a factor causing the pattern of vulnerability.

Low food security level

Sutherland et al. 1999 in their study on Eastern Kenya identified three specific aspects of household food security. One of the aspects is that, even in good years when most households produce sufficient quantities of basic food crops, they still experience a hungry period because they sell some cash for other needs.

Bohle, Downing & Watts 1994 indicate that only 10 to 20% of communal farmers consistently produce a surplus in Zimbabwe. Kinsey et al. 1998 also report that farmers in resettled areas in Zimbabwe can on average expect to experience a shortfall in home-produced food every three or four years.

Eriksen et al. 2005 explain changes their case study villages undergone in their

economy. In one case study site, since the late 1970s households have increasingly purchased staples in addition to growing food themselves. The per capita holding of livestock has fallen dramatically. In both case study sites off-farm income is increasingly important.

Decreased number of livestock

Sutherland et al. 1999 revealed that in Kenya the removal of subsidized government-operated veterinary services, as part of structural adjustment policies, increased the risk of livestock mortality for smallholder farmers. Because livestock operate like a savings account that buffers many households against the effects of drought and crop failure, higher mortality rates further endangered their livelihoods.

Vulnerable groups

In the analysis of drought in Namibia, Devereux and Naeraa 1996 identified three vulnerable socio-economic groups in Namibia: smallholder crop farmers, livestock rearers and commercial farm workers (Devereux and Naeraa 1996).

In the study of drought and poverty in South Wolo, Ethiopia, Little et al. 2006 indicate categories of poor and vulnerable households provided by local respondents:

- Households headed by elderly
- Landless and land-poor households
- Female-headed households
- Household without livestock and without labor
- Households who must share-crop out their farms

Coping strategies in African case studies

Eriksen et al. 2005, in their study on Kenyan and Tanzanian farmers, distinguish three aspects of coping strategies. Coping strategies can be characterized as relating to production (agricultural and economic), social adjustments (reciprocal economic exchange), and biological (changing the diet, reducing consumption).(Eriksen et al. 2005:6)

Biological strategy or indirect entitlement-protecting strategies

Eriksen et al. 2005 identify biological strategy as one of the three coping strategies of farmers in Kenya and Tanzania to drought. This includes changing the diet and reducing consumption.

In the analysis of 1992 drought in Namibia, Devereux & Naeraa 1996 considers indirect entitlement-protecting strategies that include dietary change, consumption rationing and demographic adjustments at the household level. As one of the coping strategies of households toward food shortages rationing of consumption and changes in diet are immediate and universal responses. People ration voluntarily instead of selling their

productive assets, in order to protect their future entitlement to food (Corbett 1988; Devereux & Naeraa 1996).

Also in 1999-2000 drought in South Wollo, Ethiopia, Little et al. 2008 reveal that in many cases, households reduced consumption to two meals per day, ate smaller portions and wild food.

Specialization and diversification

Eriksen et al. 2005 studied household coping strategies with drought at two sites in Kenya and Tanzania. One of their findings is that households where an individual was able to specialize in one favored activity in the context of overall diversification by the household, were often less vulnerable than households where each individual is engaged in many activities at low intensity.

An issue is how abilities to cope with the crisis such as drought are shaped and materialized. Eriksen et al. 2005 reveal how lack of skill, labor and capital and social relations can cause limited access to the favored coping options, thus making some households more vulnerable. Specialization by an individual household member into one activity or a limited number of intensive cash-yielding activities could potentially yield a better income than each household member engaging in several marginal activities. However, high-value activities required a particular skill or capital investment. This was compounded by social relations that led to exclusion of certain groups, especially women, from carrying out favored activities with sufficient intensity.

Sales of assets such as livestock

Devereux & Naeraa 1996 reveal in their analysis of 1992 drought in Namibia that people had to sell some assets to buy food. Apart from livestock, many farming households also sold some of their domestic possessions, including bicycles, radios, and cooking pots (p. 432).

Kinsey et al. 1998 show that, during the 1992 drought in Zimbabwe, over 60% of the farmers in their panel data sold livestock to raise cash to buy food, and just under 40% of the total amount raised came from livestock sales (p. 96). These household efforts were done in addition to the state assistance under which more than 98% of the households received food in 19992-93.

For the 1999-2000 drought in Ethiopia, Little et al. 2006 report that their group interviews showed livestock sales as the main drought coping mechanism for 90% of male and 71% of female herd owners (p.210). The poorest households studied by Little et al., however, did their best to hold on to their very meager assets of livestock. These households took other coping activities such as reducing food consumption in order to avoid selling their few animals. In contrast, the wealthiest households experienced the steepest decline in

livestock during the drought. However, the wealthiest households were able to benefit from an opportunity of post-drought boom in livestock prices by continuing to sell their livestock after the drought.

Sutherland et al. 1999 argue that without appropriate interventions, crises in food availability tend to inhibit household investment in agriculture. Productive assets may be sold off in order to finance food purchases.

Relying on social relations

Social capital is integral to coping capacity (Devereux & Naeraa 1996: Eriksen et al. 2005: 3).

Little et al. 2006 show that in South Wollo, Ethiopia social relations based on kinship are extremely important for many households, especially the poor. In their study sample loans between kinsmen account for almost 50% of informal money borrowing. They find that levels of material assistance between households actually decline during droughts. Better off households are also hit during the droughts and often cannot help relatives as much as during recovery years.

Devereux & Naeraa 1996 show for the 1992 drought in Namibia that among food crop farmers there was a rise in informal transfers between relatives and neighbors. But among livestock rearers informal transfers were limited. This was because the 'rich' people, who could help their 'poor' relatives or neighbors with informal transfers, are very few among livestock rearers. Remittances from relatives living in urban areas were also very limited, because many people have lost their jobs due to a decline in the formal urban economy.

Changes in Zambia

In Zambia economic globalization has since the 1990s affected its national economy more directly than before. This is caused by the shift in economic policies from state controlled economy to more open, market-oriented economy through the introduction of economic liberalization policies.

Liberalization of agricultural marketing is one of the areas which have affected the rural economy. Liberalization has affected different areas differently. The state-controlled marketing concentrated on the marketing of maize. Such areas as Eastern and Northern Provinces expanded maize cultivation during the state-controlled marketing of maize during the 1970s and 1980s, while areas like Gwembe Valley maize was not a major crop for the majority of farmers.

Changes in vulnerability in Gwembe

This section summarizes some findings of Cliggett's recent ethnography on Gwembe people (Cliggett 2005). Cligggett's study gives us an excellent account of historical changes

of farming, social institutions, and access to land and livestock among Gwembe people in the past 40 years.

Increasing incidents of drought

The frequency of drought and hunger is increasing in Gwembe. In the past, two out of every five years were good, and two were adequate; during the other year, crops failed (Scudder 1985). In at least half of the past 25 years, Gwembe people have failed to produce an adequate harvest for the year. In 1992, 1994, 1995 and 2002 the Gwembe Valley suffered the worst four droughts on record (Cliggett 2005: 61).

Population growth

Before construction of Kariba Dam, the Gwembe population was estimated at 86,000 (Scudder 1962). Of these, 52,000 lived on the Zambian side of the river. By 1987 the Zambian population of the Gwembe Valley was approximately 125,000 (Scudder and Habarad 1991 cited in Cliggett 2005).

Changes in farming practices

Before the forced relocation of the Gwembe Tonga people, the majority of the population farmed on the alluvial soils of the Zambezi River. On portions of this land, both dry- and rainy-season harvests were possible. Alluvial gardens on the riverbanks maintained their fertility over time because of annual flooding. When the river communities were moved from the alluvial plains, they were forced to rely on rain-fed agriculture, thus removing one of the primary options for coping with drought (Cliggett 2005: 62).

Ox-drawn plows increased and allowed for cultivation of larger tracts of land. This change in agricultural production hastened the decline of soil fertility and increased erosion (Cliggett 2005: 62). In the 1950s, a few men began clearing bush areas so that they would have larger fields, which they planned to plow with oxen. After relocation in 1959, the preference for ox-drawn plows increased also because people were forced to rely more heavily on cleared fields. Over the past four decades, men have continued to clear new fields because of the decreasing fertility of the land originally cleared at resettlement. Gwembe people do not use fertilizer on their fields.

Ritual institutions and community management of land

Many ritual activities and beliefs, such as neighborhood rain shrines and prophets, were decreasing in popularity since the resettlement. These institutions had influenced the communal management of land and agricultural practices. Resettlement to new areas drastically changed people’s link to their land, resulting in decreased importance, and effectiveness, of the ritual institutions and their leaders (Cliggett 2005: 62-63).

Changes in access to land

Whereas only men had rights to the large cleared fields (because they had done the work of clearing), women as well as men had rights to the alluvial gardens (Colson 1966). The growth in bush fields meant that men gained access to land that women had little chance to inherit or clear on their own (Cliggett 2005).

Changes in inheritance and ties between father and son

In addition to increased reliance on large, rain-fed fields and an increasing tendency to inherit from fathers, the growing reliance on cattle and plows for farming accentuated the ties children have to their father. A father depends on children's labor in his fields. In exchange he gives them land and lets them use his plow and oxen for their own farming (Cliggett 2005).

Changing importance of land and livestock

By the end of the 1970s and early 1980s, cattle ownership was the number one source of wealth and desire for land was not so frequently an area of conflict. Village fields have become less productive over time because of overuse and erosion. In this way, then, rights over land in the Gwembe these days do not guarantee a secure, reliable, and sufficient food base.

References

Adger, W.N. 2000, 'Social and Ecological Resilience: Are they related?' *Progress in Human Geography* vol. 24, no.3, 347-364.

Adger, W.N. 2006, 'Vulnerability' *Global Environmental Change*, vol. 16, 268-281

Bohle, H.G., Downing, T.E. & Watts, M.J. 1994 'Climate Change and Social Vulnerability: Toward a sociology and geography of food insecurity' *Global Environmental Change*, vol.4, no.1, 37-48

Cliggett, Lisa 2005 *Grains from Grass: Aging, Gender, and Famine in Rural Africa*. Cornell University Press, Ithaca and London.

Cutter, S.L. 1996 'Vulnerability to Environmental Hazards' *Progress in Human Geography* vol. 20, no.4, 529-539.

Devereux, S. & Naeraa, T. 1996 'Drought and Survival in Rural Namibia' *Journal of Southern African Studies*, vol. 22, no. 3

Eriksen, S., Brown, K. & Kelly, P.M. 2005 'The Dynamics of Vulnerability: Locating coping strategies in Kenya and Tanzania' *Geographical Journal* 171, 287-305.

Folke, C. 'Resilence: The emergence of a perspective for social-ecological systems analyses' *Global Environmental Change*, vol. 16, 253-267

Gallopin, G.C. 2006 'Linkages Between Vulnerability, Resilience, and Adaptive Capacity'

Global Environmental Change, vol. 16, 293-303.
Kinsey, B., Burger, K. & Gunning, W. 1998 ‘Coping with Drought in Zimbabwe: Survey evidence on responses of rural households to risk’ *World Development*, vol.26, no.1, 89-110
Little, P.D., Stone, M.P., Mogues, T., Castro, A.P. & Negatu, W. 2006 ‘”Moving in Place”: Drought and poverty dynamics in South Wollo, Ethiopia’, *Journal of Development Studies*, vol. 42, no.2, 200-225
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*, vol.10, 221-232
Sutherland, A.J., Irungu, J.W., Kang’ara, J. Muthamia, J. & Ouma, J. 1999 ‘Household Food Security in Semi-arid Africa: The contribution of participatory adaptive research and development to rural livelihoods in Eastern Kenya’ *Food Policy* 24, 363-390.
Watts, M.J. & Bohle, H.G. 1993 ‘The Space of Vulnerability: The causal structure of hunger and famine’ *Progress in Human Geography* vol. 17, no.1, 43-67.

Outline of Theme-IV:
Integrated Analysis of Social and Ecological Systems

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The most serious environmental problem in Africa is high population pressure and aggravation of ecosystem caused by the excessive land use. Most of cultivation crops in (SAT) semi arid tropics live under the severe environmental condition. Therefore, many of them cannot be alive when desiccation and a high temperature advance. After 1960's, a drought disaster as a result of desiccation occurred in many of African countries chronically. The cultivation crops seriously had decreased by this disaster. It caused serious lack of food and starvation and also serious social problem in Africa. The frequent drought disasters after 1960's were the same time as the first oil crisis. Mentioned two historical events brought bad influences for African countries' economical and political societies. Since these years, the total precipitation decreased year by year. In many countries, the famine became a chronic serious problem. Many countries became an aid recipient of food at the same time. Furthermore, the protracted famine caused social uneasiness and government overturns had been occurred in some of these countries.

From the mentioned background, theme IV decided some of sub-themes in order to understand an environmental (environment in a wide meaning to include ecological system as well as a social system) change to surround drought. Actually we challenge to know the environmental change with different spatial and time scales and to integrate various kinds of environmental information with different viewpoints. In theme IV, we focus on the time from 1960's to the present and on 1) Drought mechanism and its influences as social problems, 2) Food security and social system for poverty and the starvation, 3) Ecological system change, 4) Integration of social and ecological system with regional scale as our proposes.

Following are the sub-theme's descriptions and result of pre-research and analysis.

IV-1: Global Monitoring on Environmental Change

Tazu Saeki (Research Institute for Humanity and Nature)

1. Research objectives

Rainfall is an important factor to dominate environment in Zambia located in the semi-arid tropics. In this sub-theme we investigate climatorogical/meteorological changes, in and around Zambia from a view of two spatial scales, that is, a continental/country scale and a provincial/district scale.

2. Outline of this research

In order to achieve the objective, we focus on two approaches:

1) Analysis of archived global meteorological data to identify typical meteorological characteristics of Zambia and to investigate temporal and spatial rainfall variations in a continental/country scale.

2) Compiling and analysis of ground-based rainfall data to get better understanding of rainfall changes in a provincial/district scale and to identify "meteorological" drought period and region.

3. Results in the pre-research year

Based on our feasibility study in the last fiscal year, we considered appropriate and available global meteorological data for the analysis in terms of 1) a continental/country scale and 2) a provincial/district scale as mentioned above.

3-1. Continental/country-scale analysis

Rainfall and its seasonality is an important factor for climate of Africa. Since there is no large-scale mountain chain, topographic precipitation is not so effective. In a global view variations of rainfall over equatorial Africa are strongly influenced by the Inter-Tropical Convergence Zone (ITCZ) and Zaire Air Boundary (ZAB) (Scholes and Parsons, 1997). In addition to these two streams winds from the Indian Ocean flow is another important factor in the southern part of Africa including Zambia. These global-scale circulations determine African climate such as clear dry-rainy season.

Hence rainfall is influenced by large scale airstreams as mentioned above, analytical research using global meteolorogical data have been made. For example study on relationship between African rainfall and global atmospheric and oceanic variability such as ENSO, the Southern Oscillation Index (SOI), and sea surface temperature (e.g. Shinoda and Kawamura, 1994; Kadomura, 2005; Reason et al., 2005) and on high-resolution GCM over Africa (e.g. Hudson and Jones, 2002;).

Therefore global meteorological data sets are useful resources to investigate meteorological variations in a continental/country scale. At present major institutes which provide global gridded meteorological data sets are the US National Centers for Environmental Prediction (**NCEP**), The European Centre for Medium-Range Weather Forecasts (**ECMWF**), and the Japan Meteorological Agency (**JMA**). They have performed their own operational analysis data (products of their operational weather forecast system using data assimilation) and reanalysis project (which produced by consistent system over some decades producing global objective analysis dataset for over some decades in a consistent way using a weather prediction data assimilation system) such as NCEP reanalysis, NCEP reanalysis 2, ERA-15, ERA-40, and JRA-25. Spatial resolutions of these products are mostly 1.125 x 1.125 or 2.5 x 2.5 degree latitude-longitude grids. Time resolutions are twice or four times a day. Some data sets are charged and some freely and some are not.

Figure 1 shows monthly rainfall over the African continent in January and July 1992 and January1993 obtained from ERA-40 reanalysis (Uppla et al.; http://data.ecmwf.int/) at 2.5x2.5 grids. In January ITCZ located at the equator and brings rainfall over the Congo basin, Lower Guinea. Zambia is also in the middle of rainy season. On the other hand strong rain band spread over the Indian Ocean caused by southeast trade wind from the southern Indian Ocean and and northeast seasonal wind from the northern Indian Ocean, and Zambia is also affected by these circulations. ITCZ moves northward in April and the southern half of Africa go into the dray season. Zambia is also dry as shown in Fig. 1. It is well known that the 1991/92 cropping season in Zambia was hit by severe drought and the 1992/93 cropping season was not. Comparing rainfall in January 1992 with that in 1993 in Fig. 1, spatial change in rainfall is clearly seen in Zambia.

Addition to archived meteorological data sets, products from satellite remote sensing might be also useful. Global Precipitation Climatology Project (**GPCP**, http://www.gewex.org/gpcp.html) formed by the World Climate Research Programme (WCRP) provides monthly mean climatological precipitation data by a 2.5x2.5 degree latitude/longitude grid, averaged over the period from 1979 to 2000. CPC (Climate Prediction Center) Merged Analysis of Precipitation (**CMAP**; http://www.cpc.ncep.noaa.gov/products/global_precip/html/wpage.cmap.html ; Xie and Arkin, 1997) produces global precipitation on a 2.5 x 2.5 grid and extend back to 1979. In a process to make both GPCP and CMAP datasets observations from rain gauges are merged with precipitation estimates from several satellite-based algorithms. **TRMM** (The Tropical Rainfall Measuring Mission and also a name of the satellite; JAXA, http://www.eorc.jaxa.jp/TRMM/index_e.htm ; NASA, http://trmm.gsfc.nasa.gov/) is specially designed to monitor tropical rainfall and was launched in 1997. Based on TRMM data combined with other information observed by rain gauge data and other satellite sensors, various level product have been delivered. Spatial resolutions are 5 to 0.25 degree grid

according to the level. Figure 2 is a monthly rainfall in January 2005 obtained from TRMM 3B43 v.6 on 0.25 grid. During a preliminary field research in the last fiscal year we got an information that the 2004/05 cropping season in Zambia was severe drought which is comparable to that in 1991/92. Roughly to say rainfall patterns in Jan. 2005 seems to be similar that in Jan. 1992 (drought period) in Fig.1 rather to Jan. 1993 (normal year). It might be possible to identify characteristic precipitation and other meteorological patterns in drought year in a continental/country scale using these data sets.

Some international programmes have been carried out to investigate African climate and compile various kind of environmental information. Here we outline two programmes; VACS and AMMA.

- **VACS**: Variability of the African Climate System
  - ✓ http://www.clivar.org/organization/vacs/info.php

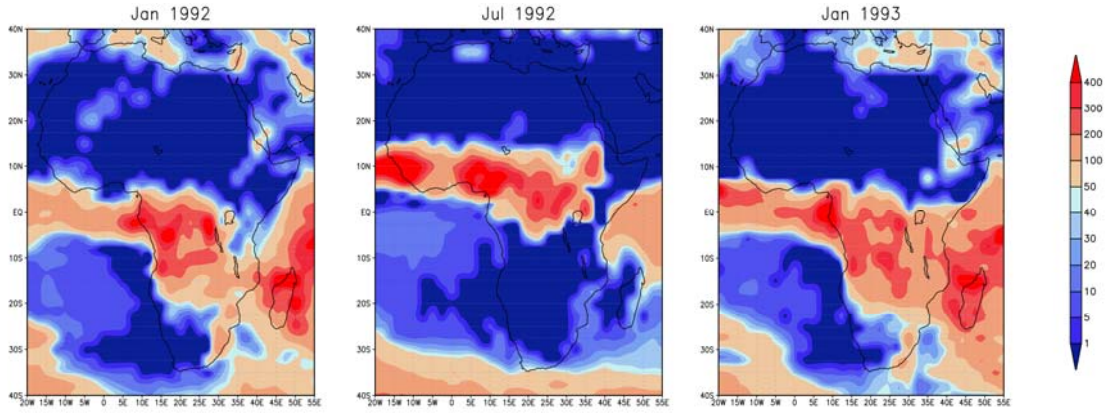

Figure 1 Reanalyzed monthly rainfall (ERA-40) [mm/month] over Africa in January 1992 (left), July 1991 (middle), and January 1993 (right).

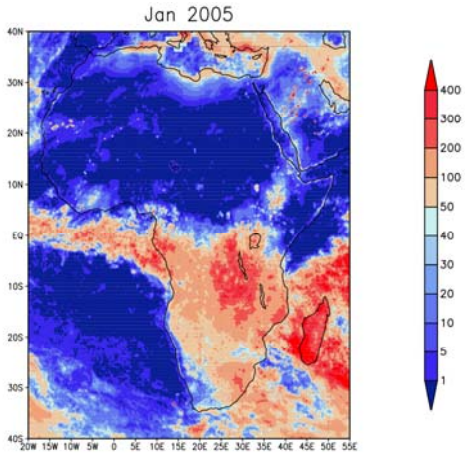

Figure 2 Satellite (TRMM) based monthly rainfall in [mm/month] January 2005.

- ✓ World Climate Research Programme (WCRP, http://wcrp.wmo.int/) carries CLIVAR (Climate Variability and Predictability) programme since 1995 to seek to develop predictions of climate variations on seasonal to centennial time scales, and refine the estimates of anthropogenic climate change. CLIVAR/VACS is one of regional panels which focuses on African climate.

- **AMMA**: African Monsoon Multidisciplinary Analysis
  - ✓ http://amma.mediasfrance.org/
  - ✓ AMMA is a French initiative to accomplish multidisciplinary research on the West African Monsoon (WAM) to improve prediction of WAM and estimate its impacts on West African nations. The main components are: atmospheric dynamics, continental water cycle, atmospheric chemistry, oceanic and continental surface conditions.

3-2. Provincial/district-scale analysis

Agriculture in Zambia heavily depends on rainfall amount in rainy season. To monitor rainfall change in a provincial/distinct scale, ground-based observations are essential. For this purpose, we obtained some of rainfall data observed using rain gauges by Meteorological Department of Zambia, Ministry of Communications and Transport. The department operate 36 meteorological monitoring sites for meteorological elements such as temperature, precipitation, evaporation, air pressure, sunshine, and cloud cover. Some sites have been operated since 1950's. Apart from decrepit measurement devices and question about data consistency, the raing gauge data is variable in consideration that compiled meteorological data are not so may in Zambia.

At present we have

- monthly rainfall at 36 sites from start year to 1991
- monthly rainfall at 23 sites from 1990 to 2001
- annual rainfall at 9 sites from 1993 to 2004.

Figure 3 shows annual rainfall at four sites in Central, Southern, and Eastern province i.e. target regions of our project. In this figure "annual" rainfall is defined as the sum of monthly rainfall from July in the year to June in the next year, according to rainy period in Zambia. Source of monthly rainfall data is observations by Meteorological Department of Zambia. Annual rainfall which has any missing value in monthly rainfall for the period was not plotted.

As seen in fig. 3 annual rainfall at each sites are highly variable and show drastic annual changes. Averaged annual rainfall are 994mm at Chipata, 972mm at Petauke, 827mm at Lusaka, and 806mm at Choma, similar to a definition in "Agro-Ecological Zones in Zambia"; are located in Region I (less than 800mm) and IIa (800-1000mm). It seems that annual rainfall is decreasing after 1980, which should be confirmed by analyses of global

meteorological data described in the previous sub-section.

Precedence research in Zambian rainfall (*e.g.* Iwasaki and Shinoda, 1989; Sakaida, 1995) identified that recent drought years were 1972/73, 1983/84, 1990/91, 1991/92. Though interviewees of the preliminary field research in the last FY mentioned that 2004/5 was big drought after 1991/92 drought, the 1994 rainfall show very low values at each site as seen in fig. 3.

Figure 4 is spatial distributions of inter-/extra-polated averaged annual rainfall based on observed sites during 1990's Right-side plate shows average of rainfall in 91 and 94 in which low rainfall were observed, while left-side plate is average of the other 1990 values (i. e. except 1991 and 1994 values). In normal years the rainfall is high in northwest area and decreases towards southeast. On the other hand, in 1991 and 1994 distribution show north-south gradient. Such a rainfall pettern in drought years may help what causes of drought. Some research investigated that drought in southern Africa including Zambia is wheather ENSO-depended or ENSO-independed (influence of variability in the neighbouring

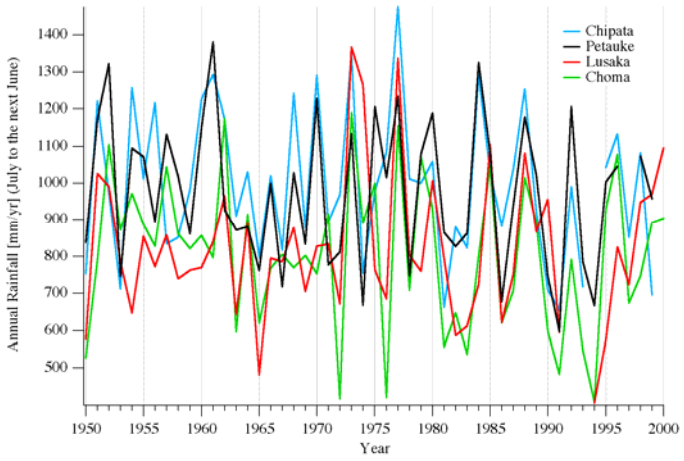

Figure 3 Annual rainfall at four sites in Zambia.

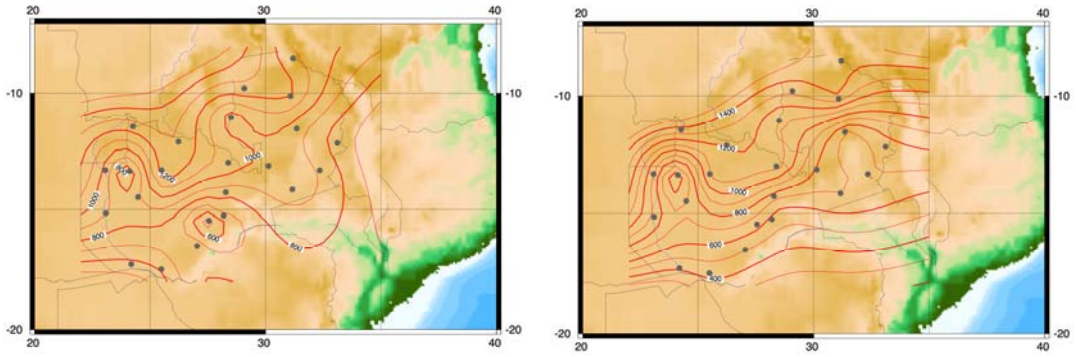

Figure 4 Spatial distributions of averaged annual rainfallin in 1990's normal year (left) and in 1991 and 1994 (right) . Gray dots show location of monitoring sites.

Indian and Atlantic Oceans or in the subtropical and midlatitude Atlantic, or in local land surface processes etc.) (Mason, 2001; Mulenga et al., 2003; Reason et al., 2004; Reason et al., 2006). Further analysis will be required for whole rain gauge data with use of global meteorological data.

4. Summary and future works

Preliminary survey on global meteorological data sets and satellite remote sensing products show that :

- The data capture qualitative characteristics of African climate
- They can be useful resources to investigate continental/country-scale meteorological variations in terms that these data sets cover the globe and keep scientific continuity though their special resolutions are not so fine.
- As for charged data sets we have some kind of global 2.5 grid meteorological data sets and 1.125 grids data in some limited region. To renewal of data sets up to the present and/or to get 1.125 grid data over Africa may be useful. Necessity of these data will be considered while analyzing exist data set in and after the next fiscal year.

Preliminaly provincial/district-scale analysis indicate that:

- To clarify drought area, period and types in a provincial/district scale, it is important to compile more rain gauge data in Zambia.
- The 1994/95 rainy season shows low rainfall while interviewees did not mention it during the preliminary field research in 2005.
- During 1990's the rainfall distribution in low-rainfall years (1991 and 1994) differ from that in normal-rainfall (1990's except 1991 and 1994).
- Statistical analysis will be made on compiled rainfall data to achieve this object.
- Continental/country-scale analysis may help for getting better understanding on provincial/district-scale rainfall changes.

Obtained outcome will be shared with other themes and sub-themes to evaluate resilience of social-ecological systems.

5. Research plan in the FY 2007 (FR1)

To get precise information about "meteorological" drought in Zambia we are planning to:

- Collect ground-based rainfall and related meteorological data in Zambia
- Analyze global meteorological data and ground-based data in focus on Zambia and identify drought area and period.
- Investigate a possibility of integration rainfall data with land cover data surveyed by the theme IV-2 as a first step to synthesize ecological data and social data.

Acknowledgement

We thank Professor Sakaida (Tohoku University, Japan) for providing us a part of the rain gauge data used in this report.

References

Hudson, D. A., and Jones, R. G., Simulations of present-day and future climate over southern Africa using HadAM3H, Hadley Centre technical note 38, pp. 36, 2002.

Iwasaki, K, and Shinoda, M., Climatic environments of Zambia, Kadomura, H. ed.: *Savannization processes in tropical Africa I*, 43-55.

Kadomura, H., Climate anomalies and extreme events in Africa In 2003, including heavy rains and floods that occurred during northern hemisphere summer, African Study Monographs, Suppl.30, 165-181, 2005.

Mason, S. J., El Niño, climate change, and Southern African climate, Environmetrics, Volume 12, Issue 4 , Pages 327 – 345, 2001.

Mulenga, H.M., M. Rouault and C.J.C. Reason, 2003: Dry summers over NE South Africa and associated circulation anomalies, Climate Research, 25, 29-41.

Reason, C. J. C., Hachigonta, S., and Phaladi, R. F., Interannual variability in rainy season characteristics over the Limpopo region of southern Africa, International Journal of Climatology, vol. 25, Issue 14, pp.1835-1853, 2005.

Reason, C. J. C., Landman, W. A., Tadross, M., Tennant, W. & Kgatuke, M. –J. 2004: Seasonal to decadal predictability and prediction of southern African climate. *CLIVAR Exchanges*, 9, 21-23.

Reason, C.J.C., Landman, W.A., and Tennant, W.J. 2006: Seasonal to decadal prediction of southern African climate and its links with variability of the Atlantic. *Bulletin of the American Meteorological Society,* DOI:10.1175/BAMS-87-7-941, 941-955.

Sakaida, K, Rainfall Changes and their Effects on Maize Production in Zambia, *The Science Reports of the Tohoku University, 7th Series (Geography), Vol. 43, No. 1*, 1993.

Scholes, R.J., and Parsons, D.A.B. (Eds.), IGBP Report 42 - The Kalahari Transect: Research on Global Change and Sustainable Development in Southern Africa -, pp. 62, 1997.

Shinoda, M., and Kawamura, R., Tropical rainbelt, circulation, and sea surface temperatures associated with the Sahelian rainfall trend. J.Meteor.Soc.Japan, 72, 613-624.

Uppala, S.M., Kållberg, P.W., Simmons, A.J., Andrae, U., da Costa Bechtold, V., Fiorino, M., Gibson, J.K., Haseler, J., Hernandez, A., Kelly, G.A., Li, X., Onogi, K., Saarinen, S., Sokka, N., Allan, R.P., Andersson, E., Arpe, K., Balmaseda, M.A., Beljaars, A.C.M., van de Berg, L., Bidlot, J., Bormann, N., Caires, S., Chevallier, F., Dethof, A., Dragosavac, M., Fisher, M., Fuentes, M., Hagemann, S., Hólm, E., Hoskins, B.J., Isaksen, L., Janssen, P.A.E.M., Jenne, R., McNally, A.P., Mahfouf, J.-F., Morcrette, J.-J., Rayner, N.A., Saunders, R.W., Simon, P., Sterl, A., Trenberth, K.E., Untch, A., Vasiljevic, D., Viterbo, P., and Woollen, J. 2005: The ERA-40 re-analysis. Quart. J. R. Meteorol. Soc., 131, 2961-3012.doi:10.1256/qj.04.176

Xie, P., and P.A. Arkin, 1997: Global precipitation: A 17-year monthly analysis based on gauge observations, satellite estimates, and numerical model outputs. Bull. Amer. Meteor. Soc., 78, 2539 – 2558

IV-2: Land Use Change and its Impact on Ecological System

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Mitsunori Yoshimura (Research Institute for Humanity and Nature)

1. Purpose

In order to know ecological system influences by environmental change (drought disaster), forest degradation and vegetation change will be investigated. For these investigations, land cover and use change analysis will be conducted using multi-temporal aerial photographs and satellite imageries. Human influences of environmental change will be considered and compared with its results and historical and social background.

The first subject of this theme is to understand the situation of land cover and use change caused by drought disaster and human activities after the independence.

2. Outline

For the achievement of above purpose, vegetation and land use/cover monitoring by multi-scale and multi-temporal approaches is the basic analysis. As for the multi-scale and multi-temporal spatial data infrastructure, remote sensing satellite imageries (Continental ~ Country ~ Regional ~ Provincial levels), the aerial photographs (local and plot levels), the various kinds of existing maps (Topography, Climate, Vegetation type, Soil etc.) and GIS data (Statistics, Elevation, Provincial boundaries etc.) will be obtained as required. The method of monitoring vegetation and land use / cover will be established to understand the typical seasonal change of vegetation distribution in country level and to identify the drastically changed area of land use / cover in regional and provincial levels. After identifying the specific area, the local level approaches will be started by using aerial photographs and the gathered field information such as human activities and historical and social background.

3. Preliminary analyses for Vegetation / Land use and cover monitoring in Multi-scale

Vegetation and land cover/use monitoring in continental, country and regional levels were carried out as preliminary analyses in order to confirm the possibility of the use of the existing satellite imageries. For this examination, Terra and Aqua/MODIS (Moderate Resolution Imaging Spectroradiometer) and Landsat/TM (Thematic Mapper) /ETM+ (Enhanced Thematic Mapper Plus) satellite imageries were used.

Terra and Aqua/MODIS have been observed the earth surface once or twice per day. As one of the products of MODIS imageries, there is 500m 32-day Composites which are generated to reduce the cloud areas with 500m grand resolution, so that these imageries are fit to use the multi-temporal vegetation monitoring. Landsat/TM and ETM+ imageries around Zambia are available in 3 or 4 times of 1970s, 1980s, 1990s and 2000s from the holdings of Earth Science Data Interface (ESDI). Therefore, it might be able to understand the land use

and cover change over the period of 30years. Furthermore, the province/district boundaries and 90m DEM (Digital Elevation Model) data are available as the geographical information. All of the imageries and data can be downloaded through internet as free.

The following describes the contents of preliminary analyses.

1) Seasonal change pattern of vegetation coverage in whole Africa continent

Used data were the browse images of MODIS 500m 32days composites observed from 2001 to 2005. The animation for one year (the start and end months are set as Sep.14-Oct.15 and Aug.13-Sep.13 of next year) was generated for 4 years of 2001Sep.-2002Aug., 2002Sep.-2003Aug., 2003Sep.-2004Aug., and 2004Sep.-2005Aug respectively. The greenness areas compared with four animations was moving from the central area to the southern area until Feb.-Mar., and back to the central in May.-Jun. and then moving to the northern area until Aug.-Sep. There is the time lag with about one or two months between Solar Calendar and vegetation growth. The seasonal change pattern of vegetation coverage can be visually understood in the continental level. Fig.1 shows the 2 times of MODIS images observed in 2003/Apr.7-May.8 (left) and 2003/Aug.13-Sep.13 (right) as examples. The greenness area extends over the central Africa on both images. The left image observed during the end of rainy season in Zambia shows much greenness in South hemisphere area compared with the right image observed during the middle of dry season in Zambia.

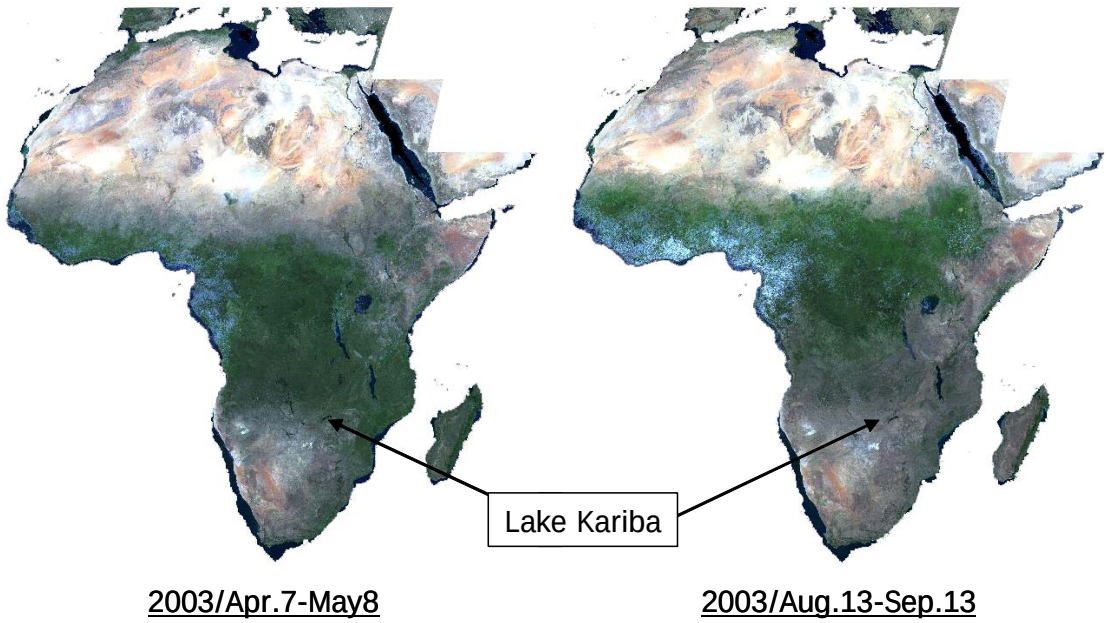

Fig.1 Terra/MODIS images

2) Influence on vegetation coverage caused by drought disaster in whole Zambia

The drought occurred during the rainy season in 2004/2005, and the harvest was decreased. Here, 3times MODIS imageries observed during the end of rainy season

(Apr.7-may8) in 2003, 2004 before drought and 2005 after drought disaster were used. Normalized Difference Vegetation Index (NDVI) was calculated to understand the vegetation coverage distribution. Generally, the higher value of NDVI shows the area covered with higher density of vegetation. NDVI distribution was compared to among the 3 times. Both NDVIs before drought in 2003 and 2004 were almost no changed. Fig.2 shows NDVI distributions in the end of rainy seasons of 2004 and 2005. Vegetation area which has higher values of NDVI extends through the almost whole Zambia before drought in 2004. On the other hand, lower values of NDVI shown by the warm colors are widely shown in Southern and Eastern Provinces after drought in 2005. MODIS 32days composites are very effective multi-temporal imageries in order to know the influence on vegetation coverage caused by drought disaster.

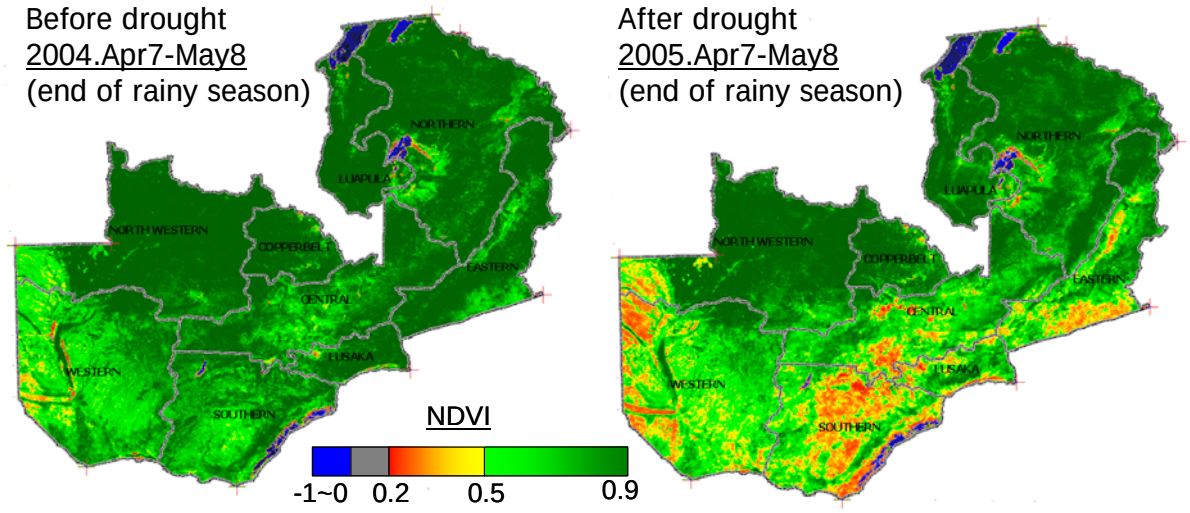

Fig.2 Comparison of NDVI distribution before and after drought

3) Data preparation for land use and cover change analysis in provincial and district levels

Landsat /MSS/TM/ETM+ series are one of the most popular satellite imageries for regional scale analysis and available through the internet recently. In this year, four scenes which cover around Southern province were obtained in 1970s, 1990s and 2000s respectively. Therefore, it might be able to grasp the situations of land use and cover by tracing back until 1970s by using these imageries. The geometric corrections are already done with the map projection of UTM (Universal Transverse Mercator) zone35 for all the downloaded imageries around Southern province. And also, the geometric location accuracy is very high, so that it is able to overlay with the other satellite imageries and GIS data easily.

Fig.3 shows Landsat/ETM+ four scenes observed in 2000s and overlaid with GPS tracks and interested points which were collected at field investigation. By using these Landsat imageries and portable GPS, it is useful to understand the location and gather the field information such as the types of land use/ cover, hearing investigation and photos etc.

Fig.4 shows the NDVI distribution calculated from Lnadsat/TM observed on

1990/3/1 of the rainy season and Landsat/ETM on 2001/12/20 of the beginning of rainy season in whole Sinazongwe district. The left image taken on 1990/3/1 extends the higher NDVI value area widely, on the other hand, the lower NDVI value areas are shown around the lake Kariba and the lowland area on the right image taken on 2001/12/20. It is difficult to compare both NDVI images directly because of the different season, however, possible to understand the situation of land use and cover at each season.

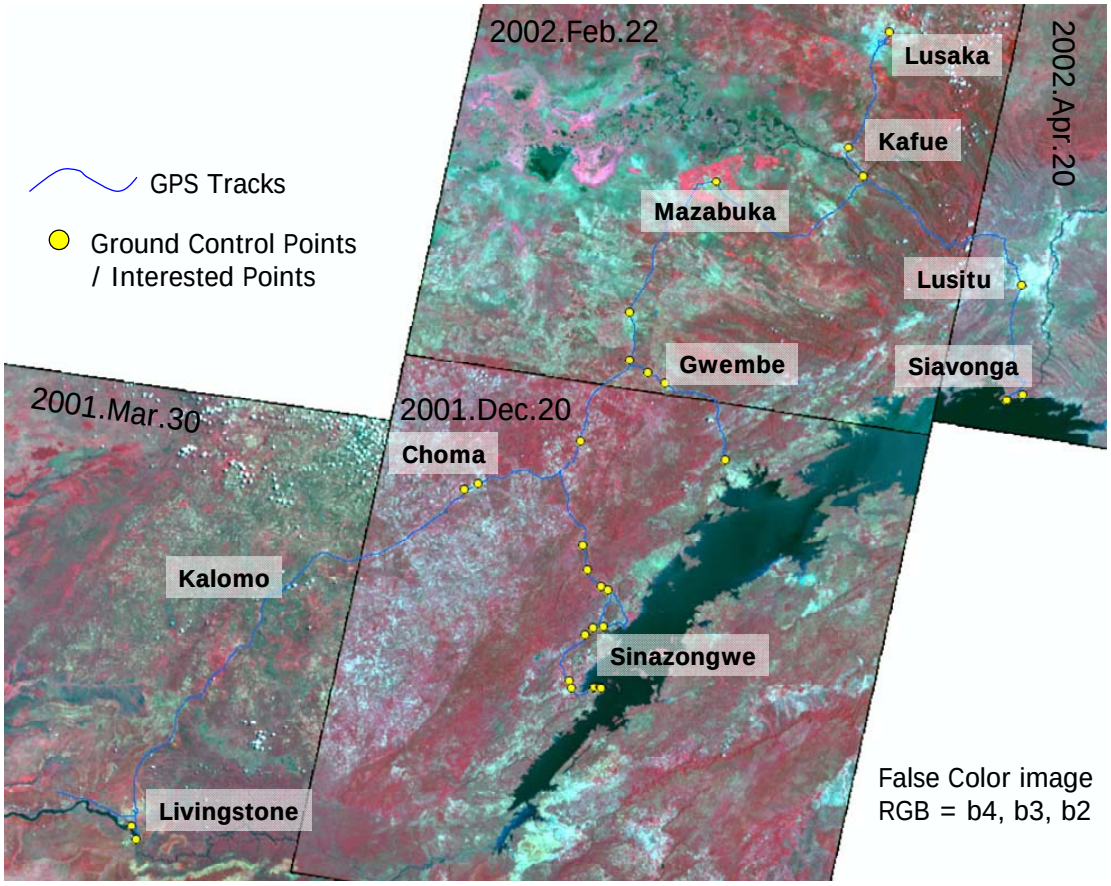

Fig.3 Landsat/ETM+ four scenes with GPS tracks around Lusaka and Southern province

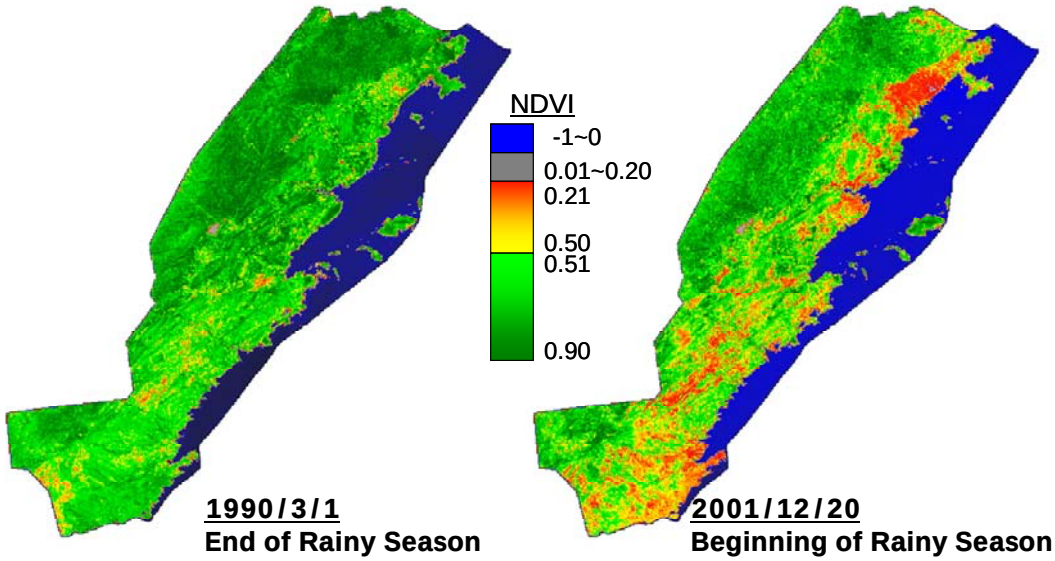

Fig.4 NDVI distributions in Sinazongwe district on 1990/3/1 and 2001/12/20

The existing maps are important information in order to understand the topographical and geographical background. The topographical map with 1:50,000 scale and regional map with 1:250,000 published by survey department are available in whole Zambia. And also there are various thematic maps of Zambia. The following shows the list of obtained maps (Feb. 2007 present). These maps have been scanned and added the map projection coordinate, will be provided with Geo Tiff format.

<< List of Regional, Topographic and the others Maps >>

Regional Map 1:250,000

1) ZS.31.Edition2 SE-35-4 KARIBA
2) ZS.31.Edition2 SE-35-6 LIVINGSTONE
3) ZS.31.Edition2 SE-35-7 SINAZONGWE
4) ZS.31.Edition1 SD-36-10 KATETE
5) ZS.31.Edition1 SD-36-6 CHIPATA
6) ZS.31.Edition1 SD-36-9 PETAUKE
7) ZS.31.Edition2 SD-35-15 LUSAKA (photocopy only, no scanning)
8) ZS.31.Edition1 SD-35-16 RUFUNSA (photocopy only, no scanning)
9) ZS.31.Edition1 SD-35-3 MONZE (photocopy only, no scanning)
10) ZS.31.Edition1 SD-35-2 CHOMA (photocopy only, no scanning)

Topographic Map 1:50,000

1) Series ZS.51, Sheet 1727A2, Edition 2-ZS 1994(Gwembe)
2) Series ZS.51, Sheet 1727A3, Edition 2-ZS 1994(Choma/Gwembe)
3) Series ZS.51, Sheet 1727B1, Edition 2-ZS 1996(Sinazongwe)
4) Series ZS.51, Sheet 1727B3, Edition 1-ZS 1993(Gwembe/Choma/Zimbabwe)

5) Series ZS.51, Sheet 1627C3, Edition 1-ZS 1973(Choma)
6) Series ZS.51, Sheet 1627C4, Edition 1-ZS 1984(Choma)
7) Series ZS.51, Sheet 1627D3, Edition 1-ZS 1985(Gwembe)

The others thematic map (1:500,000 to 1:3,000,000)

1) Vegetation Climate Map
2) Altitude 500,000 Map
3) Mtwara Development Corridor Map
4) Vegetation Soil Wegi District Map
5) Net Migration
6) Relief Drainage
7) Soil
8) Pre-Colonial Kingdom and Migration

4. Summery in FY2006

As the preliminary analysis for vegetation and land use/ cover change monitoring by multi-scale and multi-temporal approaches, the followings were confirmed;

1) It was possible to know the seasonal change of vegetation coverage pattern by MODIS 32days composites imageries in continental and country levels.
2) The influence on vegetation coverage caused by drought could be understood by NDVI distribution from MODIS data.
3) Landsat imageries downloaded from internet had the high location accuracy, so that it is useful for gathering the field information by using portable GPS.
4) It is necessary to obtain Landsat imageries observed during both seasons of dry and rainy seasons in the same year.

5. Plan in FY2007

Sub-theme II is planning about the followings for the next steps.

Continental and County Levels;

- Generation of NDVI data set by all MODIS 32days composites imageries in whole Africa in order to specify the seasonal changing pattern of vegetation coverage
- NDVI profiling around meteorological stations in Zambia and comparison with monthly precipitation data
- To obtain NOAA/AVHRR NDVI Monthly composites before 2000 in order to understand the influence on vegetation coverage by drought disaster in 1990's

Provincial and district levels;

- To obtain Landsat /TM and ETM+ images observed in Dry season of 1990 and Rainy season of 2002
- Searching the images observed in 1991/1992 and 1994/1995 when the precipitation

was decreased

- To identify the area drastically changed Land use and cover in Sinazongwe district

References

Satellite Imageries and GIS data download Web site

Global Land Cover Facility, Earth Science Data Interface (ESDI);
http://glcfapp.umiacs.umd.edu:8080/esdi/index.jsp

Southern Africa Humanitarian & Disaster;
http://www.sahims.net/gis/Gis%20Input/zambia_gis.asp

IV-3: The Early Warning System and Food Security

Yukiko IITSUKA (The International Peace Cooperation Headquarters, Cabinet Office)
Keiichiro MATSUMURA (Graduate School of Human and Environmental Studies, Kyoto University)

1. Main Aims of the research

In order to identify and clarify the crucial factors which are likely to lead the devastated situation of food insecurity in Africa, this research will focus on the "early warning system" of drought preparedness and food crisis. In particular, instead the early analysis based on the conventional data collection, the alternative analysis that attempts to examine the political and social causes of food insecurity seems to be one of the key factors to understand the resilience of the rural society to food crisis.

2. Abstracts of the research

The purpose of this research is to analyse political and social elements which lead to food crisis and social vulnerabilities in Africa, as well as to seek some potential correlation between those elements and the local resilience in the rural society. The preliminary research on current debates of food security in international societies reveals that it is essential to identify the early warning indicators implying political and social elements of food insecurity in addition to ecological indicators as initial causes of famine and food crisis in sub-Sahara Africa. Moreover, in Zambia, we will investigate how the mechanism and the indicators of the early warning system can be effective in scrutinizing resilience framework of rural society which is fragile to the food insecurity.

3. What We have done this year?

: Preliminary research on the Early Warning Systems provided by international organizations and African countries

As a preliminary research, we have focused on the early warning systems provided by international organizations (such as FAO and WFP) and African countries (see Figure1). Exploring causes of vulnerability to famine and food shortage in rural areas over Africa, the implementation of achieving food security generally imply the three types of frameworks; emergency relief aid, rural development assistance, and early warning system (FAO, 2005). In the research, it is largely notable to focus on the role of the early warning system which can provide its role of prevention, preparedness, response toward famine and food crisis. Thus, ensuring food security for rural people seems to be equivalent to pursuing their individual human security which consists of district and

national level of human security.

International society has established several early warning systems so far, including HEWS (Humanitarian Early Warning System) for food aid distributed by WFP, FEWS (famine Early Warning Systems Network) for development aid supported by U.S. government, and GIEWS (Global Information Early Warning System) for disaster aid by FAO. Particularly, FAO has a big effort in taking new approach called “Twin Track Approach (TTA)” which justifies the interaction of functions of food security. Furthermore, international donors support developing countries to correctly operate endemic early warning systems, including Ethiopia, applying their expertise at both institutional and individual level.

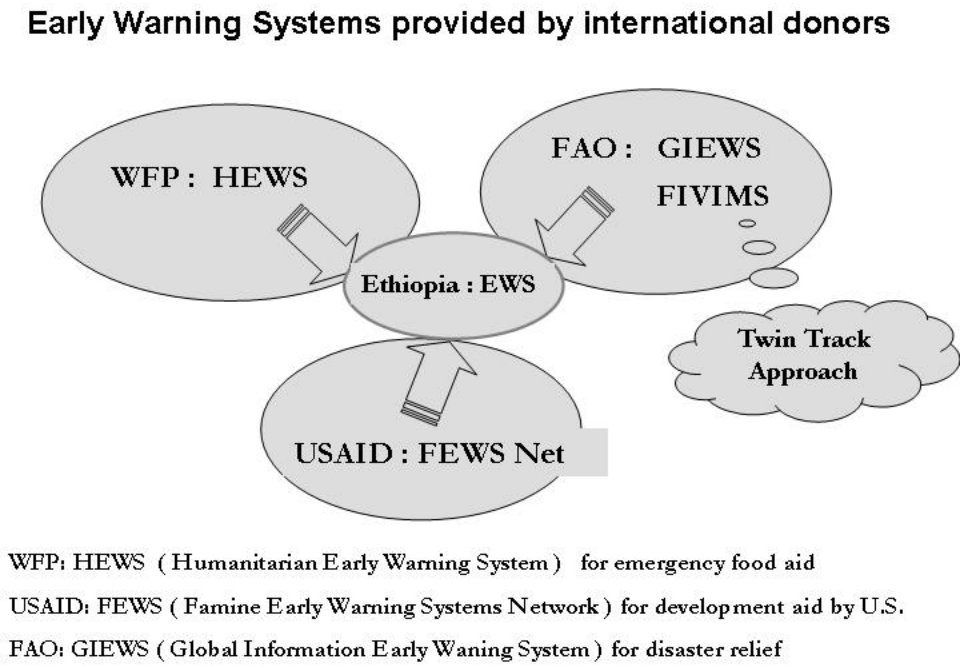

Figure1 Early Warning Systems provided by international donors

The Twin Track Approach has been recently provoked in the emergence of reviewing and re-addressing the perceived challenges of food crisis. It is also aims to achieve the sustainable growth of developmental interventions to poverty. Firstly, food crisis can be seen as political by nature, because it might be occurred by the lack of national policy and institutional capacity to implement the preventive programmes. Secondly, FAO is changing their principle from “Seeds and Tools Approach” to “Crisis Management Approach”, focusing concept, strategy and action of food crisis response. Lastly, enforcing food security is getting first priority among Millennium Development Goals (MDGs) agenda.

The TTA contributes to rebuilding the resilience framework in rural society, which results in making existing early warning system more effective (Pingali and et.al, 2005). In other

words, discussing the two focal points would be helpful to percept the rural vulnerability and to identify the elements of resilience framework (see Figure 2). On the one hand, strengthening both productivity and incomes would positively help recovering measures of rural livelihoods. On the other hand, granting direct access to food and social safety nets could provide immediate support to vulnerable people. That is, the process of reconsidering elements of the resilience framework would be one of the key factors to provide more sufficient and sophisticated early warning system available to affected people and international donors. In any protracted crisis, while these are new agendas for FAO, it is vital that they identify existing political and social factors and possible way to overcome the current limitations of response mechanism.

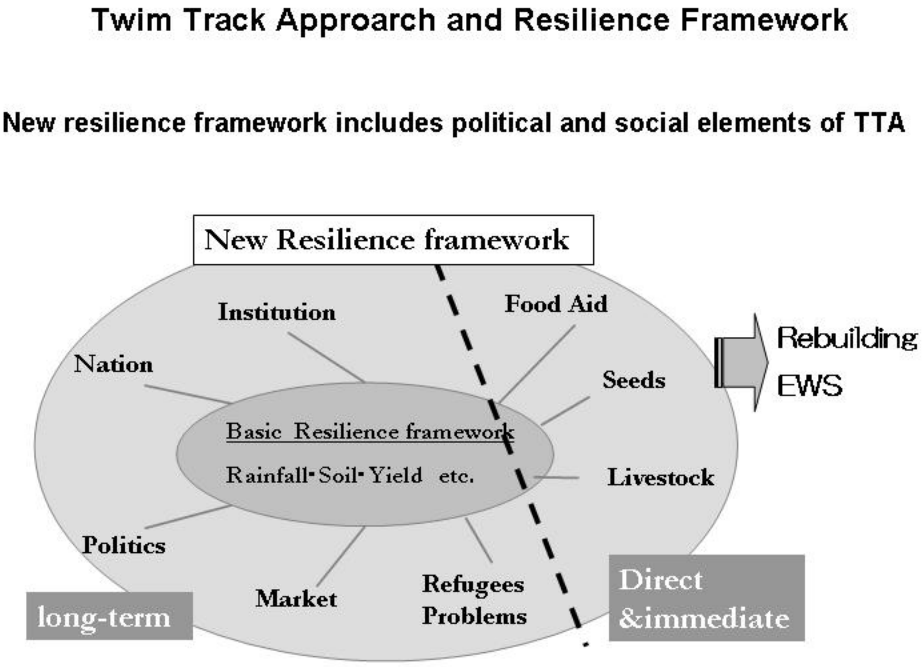

Figure 2 Twin Track Approach and Resilience Framework

As an initial case study of local early warning system in Africa, we have focused on the case of Ethiopia, which has a relatively sophisticated mechanism and a long history of early warning system among sub-Sahara Africa. It is obvious that Ethiopian government and international organizations cooperatively assigns the highest priority to prevent famine leading easily to food shortage in the drought-prone country (Disaster Prevention and Preparedness Agency, 2004). Therefore, the disaster prevention and its management have been facilitated in the two directions, relief aid and development assistance, when they face the forcible situation of serious food insecurity. Simultaneously, disaster reduction programmes are designed to address the causes of poverty, which in turn is the underlying causes of vulnerability to disasters (Getachew, 2005). Moreover, Ethiopia has tried to establish an effective early warning system to gather local information and to analyse it for famine preparedness, at the level of nation, region, zone and Woreda

(district). In fact, the data collected by the district officers would be more reliable to clarify the peculiar indicators of early warning analysing, being compared with the rough data collected by international organizations, including FAO or WFP. Their approach to analyse those indicators, however, is still mainly based on the conventional data collection without paying much attention to political and social factors.

To promote establishing better functional early warning system in Ethiopia, the perception of TTA would be an alternative strategies of addressing the causes of food insecurity. For example, the elements of new resilience framework imply lacks of capacity in the government and institutional faults could be political factors of food crisis, despite they have the healthy ecological conditions of food production. On the top of that, nowadays, the inflow of refugees into disaster-affected areas would be considered as a destructive trigger of facilitating food shortage in Africa.

4. Outcomes and Further Challenges

The preliminary research on international organizations related to agriculture and food aid reveals that they has a common understanding of the noticeable significance of the early warning system to perceive political and social causes of food crisis in famine-prone areas such as sub-Sahara Africa. In fact, those organisations have tried to provide their own efficient system and new concepts with international policy-makers and program-makers of food aid.

However, in the current context of the complex insecurity situation in which local people would be forced to be out of access to food, not only ecological conditions but also political and social conditions required as triggers provoking food crisis need to be closely considered. In fact, the actual early warning system in Ethiopia, which has a relatively good reputation among African countries, has not successfully adopted the political and social indicators as suggested by international organizations.

In other words, given that the rural societies in sub-Sahara Africa is likely to be affected by social system they have, it requires the further researches on the socio-political institutions at the local community level as well as the national policy level. In addition, new elements of food security in poverty-eradication efforts, including the African countries and international organizations, should be examined more in detail as potential indicators of early warning system and resilience framework of rural society to food crisis.

5. Research Proposal

Theme:

"Political and social factors of famine and food crisis in rural Africa
: a multi-level analysis on early warning indicators of food insecurity"

Aims:

The research will positively identify and estimate political and social causes of food insecurity, analysing indicators of early warning system in sub-Sahara Africa, especially in Zambia, in terms of the national policy level as well as local community level, which might imply essential influences to vulnerability and resilience in rural societies.

Contents:

Political and social elements consisting the resilience framework of rural society will be identified and examined by documentation research analysing the indicators of early warning systems of the several African countries vulnerable to food crisis. In particular, the field research in Zambia also contributes to discovering some social elements of resilience in rural communities, which would be unique and unexpected, referring to those indicators possibly related to national and international policy of food security. The research will have the following focal points.

A. <u>Categories of indicators of early warning system implemented in Africa</u>
   - What are considered as initial (early) indicators of early warning analyzing (eg. Ecological conditions) in African countries?
   - What kinds of risk factors are now adopted by African countries as important elements aggregating the food insecurity?
   - What difficulties are pointed out to expect the outcomes (late indicators) by analysing social and political indicators?
   - Which indicators would be much related to social factors of food insecurity?

B. <u>National and international policy of food security in Zambia</u>
   - What is the national principle and policy of food security in Zambia?
   - How international organizations, like WFP, FAO, USAID and WB, intervene the rural development? What is the mainstreaming agenda among them?
   - How the national and international agencies can be interacted?
   - How the above policy and implement can give any impact (food aid, development policy, early warning system) on rural society?

C. <u>Local practices and social elements of resilience in rural Zambia</u>
   - What kinds of social structure of local communities are established for food crisis?

- What is considered as indicators of food crisis by people?
- What kinds of endemic customs and skills to survive are practiced among the local people?
- How is the situation of rural development and food aid in rural Zambia?
- Which social elements of resilience framework in rural Zambia can be identified, focusing on the relationship with national and international policies of food security?

IV-4: District Level Analysis of Drought Responses and Resilience Index

Chieko Umetsu (Research Institute for Humanity and Nature)
Lekprichakul Thamana (Research Institute for Humanity and Nature)
Takeshi Sakurai (Policy Research Institute)

1. Purpose of Research

District level analysis is playing an important role in decision making by policy makers, international organizations and NGOs for identifying target areas and population for planning and implementing relief programs. However, the statistical information at the district level in Zambia is quite insufficient. The purpose of the research in this sub-theme is to analyze regional differences on drought shocks and responses by utilizing official statistical information of Zambia, information provided by other project themes together with our large-scale surveys. The final goal is to integrate the climatological, ecological, and socio-economic information with geographical information for identifying policies for enhancing resilience in the region.

2. Outline of Research

1) District level statistical data on socio-economic indicators, agricultural production and grain prices are collected from Central Statistical Office (CSO) and Department of Agriculture; 2) Crop Forecast Survey (CFS) and Post Harvest Survey (PHS) of CSO are combined with our own reanalysis planned in year 2006; 3) District level data will be analyzed with socio-economic and institutional factors as well as agro-ecological factors to provide mapping of resilience index; 4) The statistical information would be supplemented by the field interview survey of farm households. Socio-economics indicators are overlaid with agro-ecological information such as rainfall and soil conditions.

3. Research activities in FY2006

In this FY2006, we focused on the following issues. We identified statistical information available at CSO; conducted preliminary analysis for the impact of 2004/2005 Drought on Zambia's agricultural production; and planned for the large-scale household survey in Eastern and Southern Province.

3-1. Statistical information available in Zambia

CSO conducts various surveys in Zambia with different time intervals. CSO has provincial HQs and enumerators are trained and employed for various CSO surveys. The main work of District Agricultural Coordination Office (DACO) also includes implementation of CFS and PHS.

Crop Forecast Survey (CFS; annual):
Usually CSO conducts CFS in April-June for about 8000 households throughout Zambia. This annual survey is purposed to provide information of the level of domestic food crop production and used by the government to forecast the necessary amount of food crop import. Ministry of Agriculture and Cooperatives is the primary agent in this survey.

Post Harvest Survey (PHS; annual):
Usually CSO conducts PHS in October. The year 2000 PHS was conducted with new framework. Each district has 3-5 standard enumeration areas (SEAs) and 20 households per SEA are selected for the survey. Although SEA remains the same for some years, every year they select new households within SEA. The same households are selected for CFS and PHS.

Supplemental Survey by MSU/USAID:
Food Security Research Project (FSRP) of Michigan State University (MSU) and United States Agency for International Development (USAID) conducts supplemental survey (2001, 2004, 2007 planned) for the year 2000 PHS sample households. This survey is focused on post-harvest activities and other non-farm incomes.

Living Condition Monitoring Survey (LCMS; every 2 years):
Sample size: 10,000 households (1998), 15,000 households (2002-2003), 20,000 households (2004)
Households in LCMS are categorized into i) non-agriculture, ii) large (commercial) farm, iii) medium farm, iv) small farm, which categorization is different from agricultural census. The LCMS includes consumption data which has a potential for useful analysis for our project.
-Priority Survey (1991, 1993)
-Living Condition Monitoring Survey (1996, 1998)
-Census of Population and Housing (1969, 1980, 1990, 2000, 2010)
-Living Condition Monitoring Survey (November 2002-Oct 2003: 12 months longitudinal survey)
-Living Condition Monitoring Survey (December 2004: 1 month cross-section)
-Living Condition Monitoring Survey (November-December 2006)

National Census (every 10 years):
-1969 Population and Housing Census of Zambia
-1980 Population and Housing Census of Zambia
-Zambia Census of Population and Housing and Agriculture 1990
-Zambia 2000 Census of Population and Housing

3-2. Preliminary analysis for the impact of 2004/2005 Drought on Zambia's agricultural production

Based on 2003/2004 PHS and 2004/2005 PHS conducted by CSO, the Zambia's agricultural production during the 2004/2005 drought was analyzed (please see Thamana 2007 in this report). Chief purpose of this examination is to understand the picture of the drought episode of 2004/2005 from the statistical numbers.

Agriculture is an important sector in Zambia. Its contribution to GDP of 14.2 percent is only second to wholesale and retail trade of 18.3 percent (CSO, 2006). Among the real sector, however, agriculture is by far the biggest real sector in Zambia. It is estimated that livelihood of 75 percent of population directly or indirectly depends on the agricultural sector (FAO/WFP, 2006). According to PHS, production of staple crops which include maize, millet, sorghum and rice dropped by 22 percent. The decline was due mainly to drought effects on production of maize which is the main staple food and accounted for more than 90 percent of cereal production.

Zambian agriculture has two important characteristics. First, agricultural system has dualistic sub-sectors, a mixture of small land holders and large to very large scale corporate farmers. While 85 percent of the total farming households hold less than 5 hectares of land and use simple and somewhat primitive production technology, about 10 percent of them cultivate 20-150 hectares of land and use mechanized farming techniques. Secondly, the vast majority of farmers are heavily dependent on rain-fed farming. Their livelihoods are especially vulnerable to drought which unfortunately has become more frequent during the past two decades.

In the past 16 years from 1990 to 2005, Zambia experienced six droughts in 1991/1992, 1994/1995, 1997/1998, 2000/2001, 2001/2002 and 2004/2005. While the 1991/1992 drought is continental, the 2004/2005 drought is local. Maize production failures in 2005 were estimated at 740,000 metric tonnes (MT), the biggest production losses in recent history. Maize failures in the 1992 drought stood at 730,000 MT, only about 10,000 MT less crop losses than that in 2005. As far as assessment of severity of drought is concerned, magnitude of crop loss alone can be a misleading indicator especially when planted area significantly differs. Such is the case for the two drought episodes. In 1992, farmers planted maize on 660,000 hectares of land, whereas 875,000 hectares of maize crop was grown in 2005, a 30 percent more maize land exposed to climate variability over the 1992. Roughly, a 10 percent increase (decrease) in maize yield will result in approximately 7 percent decrease (increase) in maize price.

The southern and eastern provinces are key players in Zambia's agricultural sector. About 40-50 percent of planted land and 35-45 percent of all agricultural production are from these two provinces despite being drought prone areas. In 2003/2004 season, the pair contributed 50 percent of maize and cereal productions. About 90 percent of cereal land in the southern and eastern provinces was devoted to maize production and the remaining 10 percent for millet, sorghum and rice. The percentage yield losses of sorghum and millets were significantly higher than maize during drought in the southern region, according to the aggregation of PHS data. Whether this odd pattern of production failure among dried weather tolerant crops like

millet and sorghum and water-hungry crop like maize actually occurred is not verifiable from the data in the existing survey. More field research is needed to uncover possible explanations for this unusual occurrence. In Southern province, cereal crop share of land dropped from 80 percent in 2003/2004 to 70 percent in 2004/2005. Farmers in southern province reportedly are engaged in petty trade more intensely than those in the eastern.

There are two key research questions to assess household and community resilience to climatic shock: actual drought impacts on agricultural production and market and measurement of household resilience. Resilience can be redefined as household coping capability. Resilience can then be defined by degree of vulnerability. Many studies operationally define vulnerability based on consumption shortfall. There are two main methods of measuring resilience. The first is an *ad hoc* index method, and the second method is based on welfare or consumption theory. Although the latter approach is still evolving, assessing resilience of Zambian farming household by using consumption approach may be recommended.

3-3. Large-scale household survey in Eastern and Southern Province

In order to obtain information in wider geographical areas of Eastern and Southern Provinces, household survey is conducted during March-April 2007. The villages and households to be surveyed are those surveyed in 2004/5 PHS in selected districts in the Eastern and Southern Provinces of Zambia. The total size of the sample will be 1,180 households from 59 SEAs spread over 8 districts (Eastern Province: Nyimba (4 SEAs), Petauke (14 SEAs), Katete (11 SEAs), Mambwe (3 SEAs); Southern Province: Monze (7 SEAs), Gwembe (2 SEAs), Choma (8 SEAs), Sinazongwe (3 SEAs), Kalomo (7 SEAs)). This survey also collects anthropometric information such as height, weight, and Mid-Upper Arm Circumference (MUAC) for children under five.

4. Summary of Research and Forthcoming issues

We identified the characteristics of damages on agricultural production during 2004/2005 drought event using PHS. Maize production failures in 2005 were estimated at 740,000 MT, the biggest production losses in recent history. The comparison between 1991/1992 drought and 2004/2005 drought may be important by considering the socio-economic conditions in two major drought events.

5. Research Plan for FY2007

i) Analysis of CSO statistics (LCMS and other CSO data when available)
ii) Conduct household survey and preliminary analysis
iii) Compare 1991/1992 drought and 2004/2005 drought in agricultural production as well as socio-economic and political environments.

Impact of 2004/2005 Drought on Zambia's Agricultural Production: Preliminary Results

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This paper reports result of an examination of Zambia's agricultural production from the Post Harvest Survey of 2003/2004 and 2004/2005 agricultural seasons. The survey was conducted annually by the Central Statistical Office (CSO). Chief purpose of this examination is to understand the picture of the drought episode of 2004/2005 from the statistical numbers. As a by product of this exercise, we are hoping identify areas that require more research. This paper focused only on agricultural production as data on other aspects were still incomplete. The project is still in the process of securing the complete set of data from CSO.

The paper progresses in the following order. The next section will describe significance of agricultural sector to Zambian economy. It will then follow by looking at drought in the past 16 years since 1989/1990 to 2004/2005 planting seasons. Past drought episodes will be compared and contrasted with the most recent one by focusing on their impacts on crop failures. The third section will shift attention to drought situation at provincial level by focusing on what happened in our study areas in southern and eastern provinces. The fourth section will compare and contrast agricultural production in southern and eastern provinces versus that of the rest of the country. The fifth section documents farmers coping behavior. The paper concludes by identifying some key research questions for theme IV in understanding household, community and regional response to climatic variability.

The Agricultural Sector

Agriculture is an important sector in Zambia. Its contribution to GDP of 14.2 percent is only second to wholesale and retail trade of 18.3 percent (CSO, 2006). Among the real sector, however, agriculture is by far the biggest real sector in Zambia. It is estimated that livelihood of 75 percent of population directly or indirectly depends on the agricultural sector (FAO/WFP, 2006). According to Zambia's Central Statistical Office's (CSO) report on national income account, real production of agriculture, forestry and fisheries sector in 1994 constant price declined by 0.6 percent, a significant U-turn from the previous year in 2004 when Zambian agriculture, forestry, and fisheries sector registered a strong positive real growth of 4.3 percent. The decrease was attributable to lower output by 4.0 percent in the

agriculture sub-sector. The poor harvest was a result of drought in 2004/2005 agricultural season (CSO, 2006). That drought caused significant damages to major crops such as maize, millet and sorghum. According to the Post Harvest Survey conducted by CSO, production of staple crops which include maize, millet, sorghum and rice dropped by 22 percent from 1,134,319 tonnes in 2003/2004 to 884,575 tonnes in 2004/2005 planting season[1]. The decline was due mainly to drought effects on production of maize which is the main staple food and accounted for more than 90 percent of cereal production. Maize registered a drastic decrease of 233,234 tonnes or about 22 percent from a year before. The widespread production of maize even in the areas that are not appropriate for maize production was historically encouraged by past governments through price distortion program (Chizuni, 1994).

Zambian agriculture has two important characteristics. First, agricultural system has dualistic sub-sectors, a mixture of small land holders and large to very large scale corporate farmers. While 85 percent of farming households holding less than 5 hectares of land and use simple and somewhat primitive production technology, about 10 percent of large scale farmers cultivate 20-150 hectares of land and use mechanized farming techniques. A dozen of large corporate farms on more than 1,000 hectares of land using highly mechanized production technique with hired labors and advanced irrigation system to grow maize and cash crops. Maize productivity of the large scale and corporate farms is several times higher than that of the small sized farmers. Yields of large farms are around 5-6 metric tonnes per hectares (MT/Ha) while the national average yield during good harvest year during 1990-2005 period is 1.84 metric tones/hectare. Secondly, irrigation system is limited and irrigable crop land is largely occupied by large scale farmers and corporate farms. The vast majority of farmers are heavily dependent on rain-fed farming. Their livelihoods are especially vulnerable to drought which unfortunately has become more frequent occurrence during the past two decades.

Drought Situation

In the past 16 years from 1990 to 2005, Zambia experienced six droughts in 1991/1992, 1994/1995, 1997/1998, 2000/2001, 2001/2002 and 2004/2005 (see *Figure 1*). On average, droughts occur once every 2-3 years. There are some similarities and differences

[1] CSO published different agricultural production estimates for 2004/2005 planting season. The estimates are currently, at best, preliminary. The actual productions reported here are based on data from actual Post Harvest Survey. The magnitude of the changes in planted area and productions are *unusually* large. Verification of the validity of estimates is on going.

between the drought episode in 1991/1992 and that in 2004/2005. While the 1991/1992 drought is continental, the 2004/2005 drought is local. The 1991/1992 drought episode completely affected the entire country of Zambia as well as other countries in the southern Africa. Besides being a local drought, the 2004/2005 episode is partial. Many provinces were affected but the Northern, part of Northwestern, Luapula and Copperbelt provinces were spared .

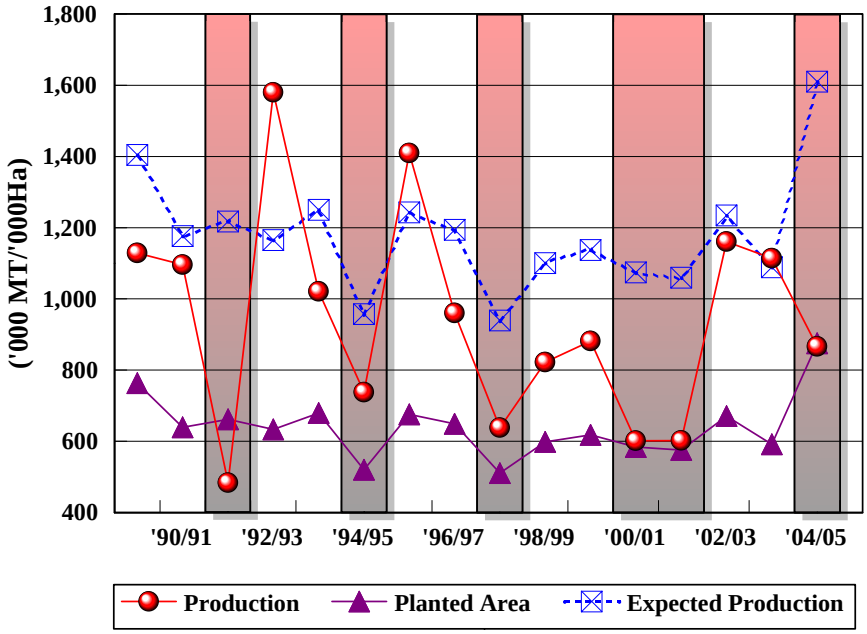

Figure 1: Maize Production, Expected Production and Planted Area, Zambia
Note: Highlights indicate drought year and distance between actual and expected production measures crop losses.

Although the scope of those two drought episodes is different, the scale of production losses is similar. Maize production failures in 2005 were estimated at 740,000 metric tonnes (MT), the biggest production losses in recent history. Maize failures in the 1992 drought stood at 730,000 MT, only about 10,000 MT less crop losses than that in 2005. As far as assessment of severity of drought is concerned, magnitude of crop loss alone can be misleading indicator especially when planted area significantly differs. Such is the case for the two drought episodes. In 1992, farmers planted maize on 660,000 hectares of land, whereas 875,000 hectares of maize crop was grown in 2005, a 30 percent more maize land exposed to climate variability over the 1992.

In term of year-to-year change, maize land planted increased considerably by 285,000 hectare from 590, 000 hectares in 2003/2004 to 875,000 hectares in 2004/2005, an increase of 48 percent! There is no evidence of shifts in crop patterns. In fact, there appeared to be rapid

increase in cultivated land for a majority of other crops as well. The overall increase of cultivated area in 2004/2005 was 46% over the 2003/2004 agricultural season. How and why such dramatic increase of planted land for maize and other crops occurred within such a short period of time are issues still under careful investigation.

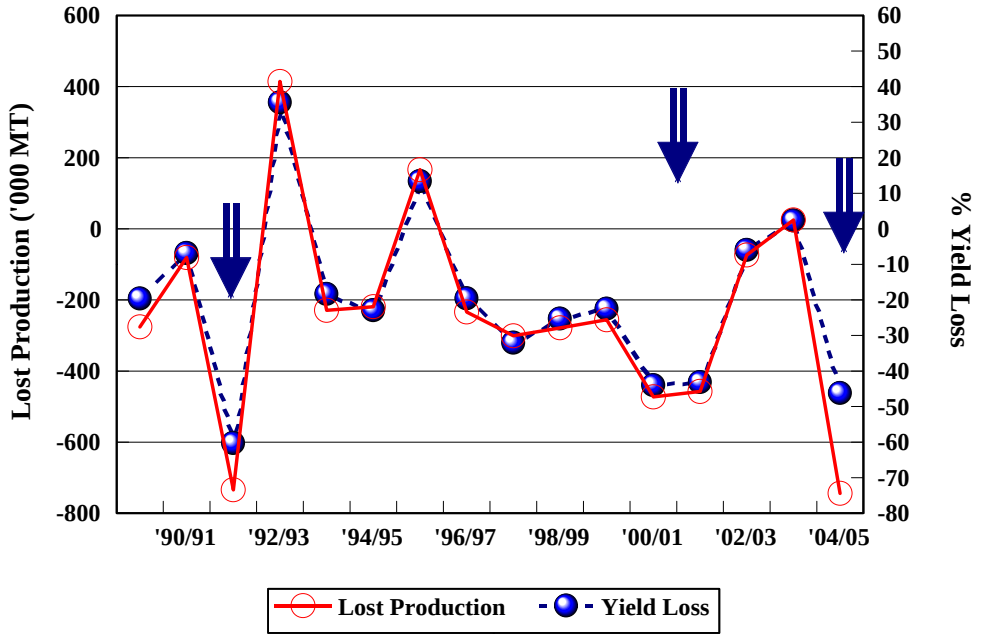

Figure 2: Maize Production Losses and Yield Losses, 1989/1990-2004/2005

Yield losses are better comparative measures of drought impact because the planted lands are normalized to one. When yield loss is considered, however, the 1992 episode remains the most severe drought in the past 16 years of Zambia agricultural history. In 1992, the yield loss was 60 percent vis-à-vis 46 percent in 2005. The rate of land productivity loss of the 2005 drought was comparable in magnitude to those in 2001 and 2002 with yield losses of 43 and 44 percent for 2001 and 2002 respectively (see *Figure 2*). Arrows in *Figure 2* point to the years in which severe droughts occurred.

In addition to examining the *rate* of crop losses, it is also crucial to investigate drought impact on *level* of remaining food supply or food security. The 1991/1992 episode of drought left the country with dangerously low maize supply. Production level of the 1991/1992 was about 40 percent of average production in good harvest years during the past 16 years. The maize production harvested in 2004/2005 was about 73 percent of the same good-years average. The food need gaps were filled by imported maize. In 1991/1992, Zambia imported maize for nearly 1 million tones whereas 270,000 tonnes of maize were imported in 2004/2005. In response to the moderate shortfall of domestic maize supply,

maize price increased by nearly 60 percent from $150/MT in 2003/2004 to $236/MT in 2004/2005. The increase was the second largest in the past decade following the 66% price rise in the 2000/2001 drought episode. Figure 4 shows inversed relationship between drought impact and maize prices. Roughly, a 10 percent increase (decrease) in maize yield will result in approximately 7 percent decrease (increase) in maize price.

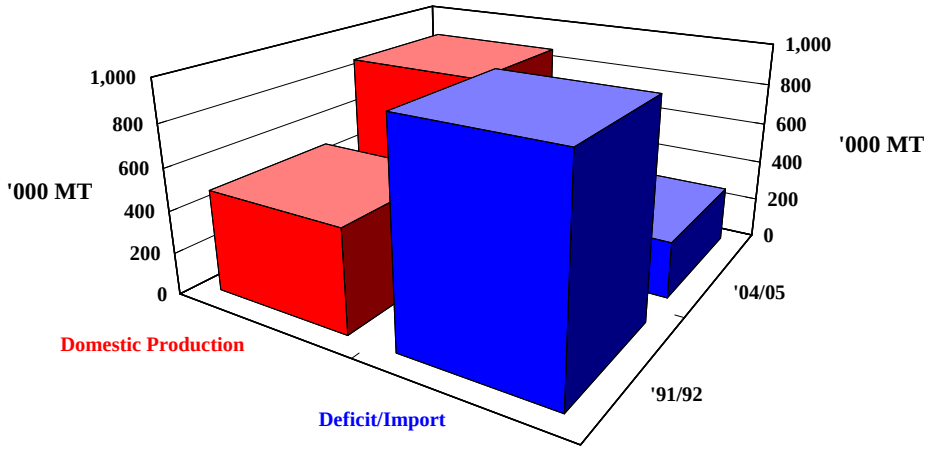

Figure 3: Maize Supply by Sources between 1991/1992 and 2004/2005 Droughts

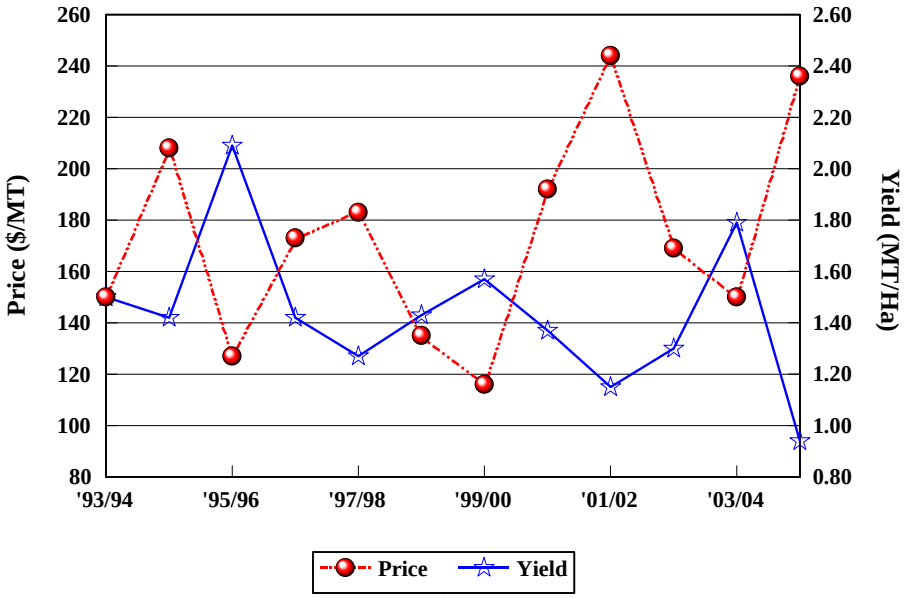

Figure 4: Drought Impact on Maize Price (Mill Price in Lusaka)
Source: Haggblade, (2006), for maize price data.

Table 1 shows production of cereal crops other than maize for each province. At first glance, it may seem that the drought of 2004/2005 had little impact on production of rice, sorghum and millets which are known to be more tolerant to dried weather condition than is maize. Production of rice and millets fell by only 2 and 4 percent respectively. Sorghum

production, however, suffered a huge drop of nearly 50 percent from a year before. When small drops in production of drought resistant crops were accompanied by a large increase in planted land ranging from 28-55 percent (see *Table 2*), yield losses became substantial. Rice, a relatively insignificant cereal crop in Zambia, experienced the smallest productivity loss of 28 percent. Yield loss of millet is slightly below that of maize at nearly 40 percent; sorghum was the cereal crop most affected by drought at 60 percent. The higher yield losses among drought resistant crops were unexpected and counter intuitive. More research is needed to understand reasons underlying this unexpected phenomena. Overall, the Zambia Vulnerability Assessment Committee estimated that 1.2 million people, approximately 10 percent of Zambia population, required food or cash assistance during the hunger period in January to March 2006.

Table 1: Production of Maize, Millets, Sorghum and Rice at Provincial Level, 2003-2005 ('000 MT)

Province	Maize		Millets		Sorghum		Rice	
	2004/05	2003/04	2004/05	2003/04	2004/05	2003/04	2004/05	2003/04
Central	122.1	207.1	1.2	1.8	1.4	3.4	0.0	0.2
Copperbelt	71.2	84.4	0.6	0.1	1.2	2.8	0.0	0.1
Eastern	196.6	296.7	0.7	0.7	1.1	1.8	3.7	5.2
Luapula	31.3	18.9	1.5	1.8	0.8	0.9	1.0	0.7
Lusaka	22.2	33.2	0.0	0.0	0.1	0.2	0.0	0.0
Northern	98.7	76.8	21.5	18.5	1.8	1.6	10.1	5.7
Northwestern	63.9	41.2	0.6	0.3	1.7	4.3	0.5	0.1
Southern	171.1	239.9	1.5	4.0	2.5	7.6	0.0	
Western	44.2	56.3	3.8	5.6	4.3	6.9	1.7	5.3
Zambia	**821.2**	**1,054.4**	**31.4**	**32.9**	**14.9**	**29.6**	**17.1**	**17.4**

Source: PHS 2003/2004 and 2004/2005

Table 2: Chang and Percentage Change of Planted Area, Production and Yield of Cereal Crop

Crop	Area Planted ('000 Ha)		Production ('000 MT)		Yield (MT/Ha)	
	Change	%	Change	%	Change	%
Maize	284.4	48.15	-233.2	-22.12	-0.85	-47.43
Millet	28.2	55.25	-1.5	-4.46	-0.25	-38.46
Sorghum	12.5	27.64	-14.7	-49.74	-0.40	-60.62
Rice	5.6	37.32	-0.3	-1.75	-0.33	-28.45

Source: PHS 2003/2004 and 2004/2005

Drought in the Southern and Eastern Provinces

The 2004/2005 season's rainfall in the southern provinces was characterized by late planting rains, below average quantities, and poor and erratic rainfall distribution. As for the eastern province, rainfall pattern was slightly different. Heavy rain came at the start of planting season and then followed by prolong dried spells in the latter part. Despite early

heavy rainfall, the amount of precipitation was below average level. As a result, water table was at usually low level. Many wells and some boreholes dried up threatening the survival of farmers and livestock.

Agricultural Production in Eastern and Southern Provinces

The southern and eastern provinces are key players in Zambia's agricultural sector. About 40-50 percent of planted land and 35-45 percent of all agricultural production are from these two provinces despite being drought prone areas. More importantly, the southern and eastern provinces are Zambia's main suppliers of maize and other cereal crops. In 2003/2004 season, the pair contributed 50 percent of maize and cereal productions. Last year, in relation to the rest of the country, the two were disproportionately affected by below normal level of rainfall and, yet, they still maintained 40 percent contributions to the national cereal production.

Table 3: Agricultural Production and Planted Area, Southern and Eastern Provinces vs. Other Provinces, 2003/2004-2004/2005

Crops	Planted Area		Production		Yield	
	S & E Provinces	Other Provinces	S & E Provinces	Other Provinces	S & E Provinces	Other Provinces
2003/04						
Cereal	328,467	373,375	555,842	578,477	1.69	1.55
Other crops	218,991	453,399	163,643	686,046	0.75	1.51
2004/05						
Cereal	447,683	584,832	377,137	507,438	0.84	0.87
Other crops	327,126	280,941	167,903	186,005	0.51	0.66

Source: CSO, Post Harvest Survey 2003/2004 and 2004/2005.

Agricultural production in the dyad provinces has two distinct characteristics. Firstly, flexibility of shifting crop pattern differs between the two regions. During the two periods under study, the crop pattern in the two provinces was stable over time. Farmers in the provincial pair allocated planted area in a 3:2 ratio between cereal and other crops, i.e. 60 percent of land for cereal production and 40 percent for production of cash and root crops. Crop distribution pattern in other provinces was more dynamic. In 2003/2004, farmers in provinces other than the southern and eastern allocated approximately equal ratio to cereal and other crops. In the next season, they oriented their production toward cereal crops with 70 percent cereal and 30 percent cash and other crops.

Why did farmers in the two regions behave the way they did? There may be many probable explanations. One of those may lie in the two regions' comparative advantages. While the southern and eastern provinces are significantly more productive in producing cereal (yield of 1.69 vs. 0.75 tonnes/hectare for cereal and other crops respectively), the rest of the country were equally productive in producing either (see *Table 3*). During good rainfall years, it is, therefore, reasonable for those other provinces to allocate roughly equal share of land to either crop. However, in drought year, the farmers in other provinces would be better off growing more cereal than growing other crops because those non-cereal crops were more susceptible to drought. Based on this limited evidence, farmers in other region could have suffered more cop losses if they did not shift their crop combinations. There is not enough information to determine how decision about crop combination was made and whether climatic expectations play any role in that decision. What we observed could have happened by chance. However, if it was not, this limited evidence might have suggested that Zambian farmers were rational and quite good at adjusting their crops to expected environmental risks, given their limited resources.

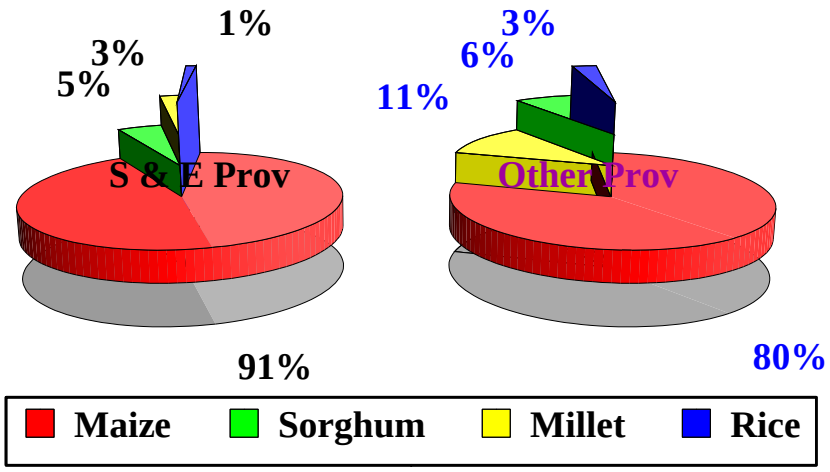

Figure 5: Distribution of Planted Land for Production of Cereal Crops, Southern-Eastern Provinces versus the Rest of the Country, 2004/2005

Secondly, degree of diversification differs between the two regions. About 90 percent of cereal land in the southern and eastern provinces was devoted to maize production and the remaining 10 percent for millet, sorghum and rice. Maize remained the most popular cereal crop in other provinces but farmers in those provinces allocated only 80 percent to maize and the remainders for dried weather tolerant crops (see *Figure 5*). It is interesting to note that other provinces appeared to have slight comparative advantage over the two provinces in

growing millet and sorghum. What roles productivity plays in crop diversifications are not immediately clear. Conventional wisdom has it that farmers' different attitudes toward risks are considered an important factor explaining different diversifying behaviors. It would be a challenge to quantify degree of risk aversion among different groups of farmers from the existing datasets.

The percentage yield losses of sorghum and millets were significantly higher than maize during drought in the southern and eastern region. While yield losses of sorghum and millet were at 70 percent, productivity losses of maize was at only 50 percent (see *Figure 6*). This peculiar phenomenon runs counter intuitive and appears to come mainly from the southern province (see subsequent section). In other provinces, yield losses of millet and rice were at 33 and 25 percent respectively, whereas failure rate of maize was at 45 percent which is comparable to that of sorghum. It is worth noting that the odd pattern of production failure among dried weather tolerant crops like millet and sorghum and water-hungry crop like maize does not exist in this region. More field research is needed to uncover possible explanations for this unusual occurrence.

Table 4: Production of Cereal Crops in Southern and Eastern Provinces vs. Others

Crops	Planted Area		Production		Yield	
	S & E Provinces	Other Provinces	S & E Provinces	Other Provinces	S & E Provinces	Other Provinces
2003/04						
Maize	300	291	537	518	1.79	1.78
Sorghum	16	29	9	20	0.58	0.69
Rice	4	10	5	12	1.16	1.17
Millet	8	43	5	28	0.57	0.66
2004/05						
Maize	409	466	368	454	0.90	0.97
Sorghum	21	37	4	11	0.18	0.30
Rice	5	15	4	13	0.70	0.88
Millet	13	66	2	29	0.17	0.44

Source: CSO, PHS 2003/2004 and 2004/2005.

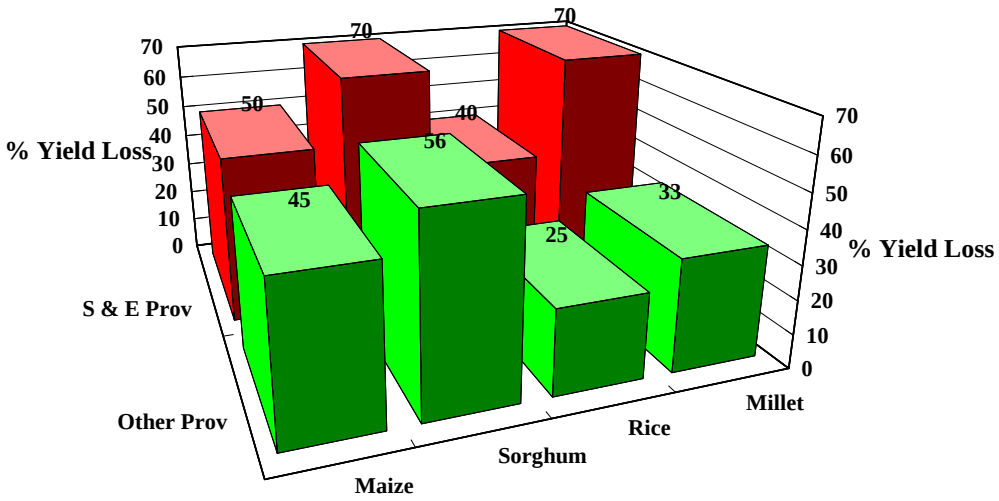

Figure 6: Percentage Yield Losses of Cereal Crops,
Southern and Eastern vs. Other Provinces, 2004/2005

Crop Production in Southern vs. Eastern Province

Crop patterns in 2004/2005 planting season in the southern and eastern province are slightly different. While farmers in the southern allocated about 70 percent of their crop land to cereal production and the remaining for cash and other crops, those in the eastern province equally distributed their land between cereal and other crops. As a result, this more diversified composition of crop portfolio enabled eastern province to be at a relatively better position to deal with agricultural and environmental risks (see *Figure 7*). However, from year to year change, crop portfolio composition of southern province appears to be changing. Cereal crop share dropped from 80 percent in 2003/2004 to 70 percent in 2004/2005 (see *Figure 8*). If his trend continues, more cash and other crops will be grown in the southern province and, hence, a more diversified crop portfolio.

Maize is the most important crops in the two provinces. Despite playing relatively less important role in the eastern province's crop portfolio, more maize was grown in the eastern than in the southern. About 60 percent of combined maize production in southern and eastern province was grown in the eastern, and the remaining 40 percent was from the southern province. However, the southern province was more productive than the eastern in the production of maize to a large extent, i.e. yield of 2.03 vs. 1.63 MT/Ha for southern vs. eastern province respectively. For other crops, there appeared to be no significant productivity differentials between the two provinces. Rice production in the southern province is an exemption. An increase in rice production was due to favorable rice price (FAO/WFP, 2006). Although rice productivity of southern farm was significantly higher

than the eastern, the southerners' rice production remained too small to be meaningfully compared with the easterners'. It is interesting to note that proportionately more of dried weather tolerant crops such as millet and sorghum were grown in southern than in the eastern province.

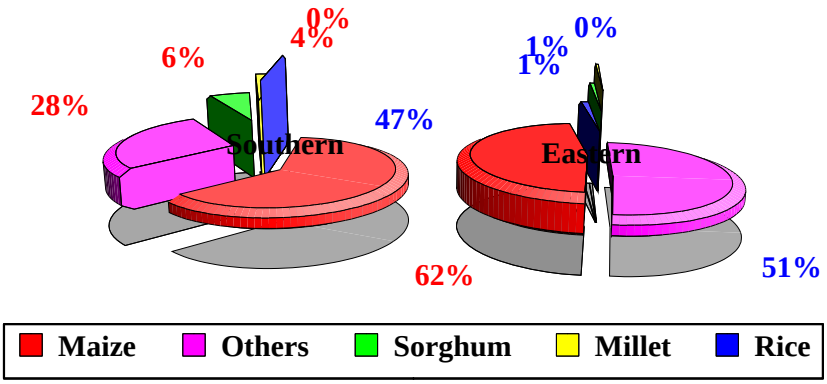

Figure 7: Distribution of Planted Area by Crops, Southern vs. Eastern Province, 2004/2005

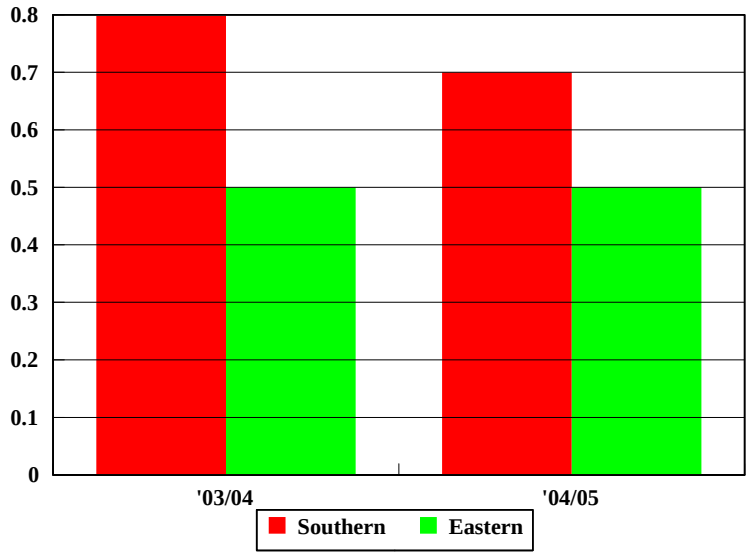

Figure 8: Share of Cereal Crop Land in Southern and Eastern Province

The southern province appeared to sustain marginally greater crop failures than did the eastern during the 2004/2005 drought. The yield losses of cereal and maize production were 54 and 47 percent for southern and eastern province respectively. However, the southern suffered much greater yield losses of millets and sorghum at 75 vs. 40 percent in the southern and eastern province respectively. A question remains as to what factors that might possibly explain the yield-loss rate differentials in the drought resistant crops between those two provinces.

Table 5: Area, Production and Yield by Crops, Southern vs. Eastern Province, 2003/04-2004/05

Crops	Planted Area ('000 Ha)		Production ('000 MT)		Yield (MT/Ha)		Yield Loss (%)	
	Southern	Eastern	Southern	Eastern	Southern	Eastern	Southern	Eastern
2003/04								
Maize	118.0	181.5	239.9	296.7	2.03	1.63		
Sorghum	13.1	3.1	7.6	1.8	0.58	0.59		
Rice	0.0	4.5	0.0	5.2		1.16		
Millet	6.9	1.5	4.0	0.7	0.58	0.50		
Cereal	137.9	190.6	251.5	304.4	1.82	1.60		
Others	43.5	175.5	26.8	136.8	0.62	0.78		
2004/05								
Maize	182.5	226.3	171.1	196.6	0.94	0.87	-0.54	-0.47
Sorghum	17.4	3.2	2.5	1.1	0.15	0.34	-0.75	-0.43
Rice	0.0	5.3	0.0	3.7	2.43	0.69		-0.40
Millet	11.1	1.8	1.5	0.7	0.14	0.36	-0.76	-0.28
Cereal	211.0	236.7	175.2	202.0	0.83	0.85	-0.54	-0.47
Others	82.8	244.3	35.9	132.0	0.43	0.54	-0.30	-0.31

Source: CSO, PHS 2003/2004 and 2004/2005.

Household Response to Drought in Southern and Eastern Provinces

While average crop failure for the region for cereal production was about 50 percent, many households experienced 100 percent crop losses. An early copying behavior of farmers in eastern and southern provinces was engagement in petty trade. Farmers in southern province reportedly engaged in petty trade more intensely than those in the eastern (FAO/WFP, 2006). Consumption of perceived inferior crop like cassava was common in the southern province. When household food supply dwindled, farmers attempted to extend their food stock by skipping meals from three to one or two a day. As household food stock ran out, people in many parts of both provinces were reportedly surviving by eating green mangos, and toxic root. Farmers who live near a forest made frequent visit to the forest to look for wild foods and, in the process, competed with wild animals for dwindling food sources. School children reportedly went to school in the morning without having breakfast and brought home their left over rations. Some distressed farmers resorted to desperate coping behavior such as stealing and prostitutions.

Further Research Questions

As a part of the Resilience Project, our focus is to assess household and community resilience to climatic shock. There are two key research questions: actual drought impacts on agricultural production and market and measurement of household resilience. These two issues are closely related. Resilience can be redefined as household coping capability. The stronger the ability of cope, the more resilience is the household. The household adaptability

to systemic risks is, in turn, a function of available assets, and the size of the shock. Our study of household resilience can be metaphorically compared to study of car safety through car crash test. The car safety features that protect drivers and passengers are to resilience and the speed of car crash is to the magnitude of climatic shocks. The United States, as one of the most affluent country in the world, was powerless to deal with climatic shock as big as the hurricane Katrina.

The assessment of drought damages in this report is based on simple *unconditional* estimates. Such estimates overstate the actual drought impact because other factors that potentially affect production and correlate with drought are not controlled. There are several economic approaches to obtain *conditional* estimates of drought impact. Given the nature of data available in the Post Harvest Survey, the list includes production function when there is single output, profit function for multiple outputs production function and distance function method.

To measure household resilience, one must first give resilience an operational definition. An opposite of resilience is vulnerability. They are not dichotomous but rather a continuum of the same substance (see *Figure 9*). Resilience can then be defined by degree of vulnerability. Economists view consumption as key element determining well being of an individual. When consumption of an individual falls short of a minimum requirement level, that individual is considered vulnerable. Many studies operationally define vulnerability based on consumption shortfall.

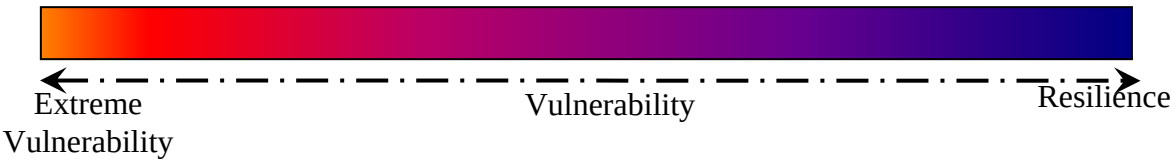

Figure 9: Conceptual Framework of Resilience as a Continuum of Degree of Vulnerability

There are two main methods of measuring resilience. The first is an *ad hoc* index method. This method is based on no economic theory and simply identifies factors affecting or correlating with vulnerability to generate a vulnerability index. Patnaik and Narayanan's (2005) study is one such example. The second method is based on welfare or consumption theory. This camp defines vulnerability as expected consumption shortfall. The work of this approach is still evolving. Some examples of this consumption approach to vulnerability are Christiaensen and Boiswert (2000) and Ligon and Schechter (2002). The project will assess resilience of Zambian farming household by using consumption approach.

Reference

Chizuni, J. (1994), Food Policies and Food Security in Zambia, *Nordic Journal of African Studies*, 3(1): 46-51.

Christiaensen, L. and Boisvert, R. (2000), *On Measuring Household Food Vulnerability: Case Evidence from Northern Mali*. Conference paper presented at IFPRI-World Bank Conference on Risk and Vulnerability: Estimation and Policy Implications, Washington, D.C., USA, September 23-24, 2002.

CSO, (2006), *National Account Statistical Bulletin No. 9, 1994-2005*, Lusaka: Central Statistical Office.

CSO, (2006), *Selected Social Economic Indicators, 2004-2005*, Lusaka: Central Statistical Office.

FAO/WFP. (2005), *Special Report: FAO/WFP Crop and Food Supply Assessment Mission to Zambia*, June 24, 2005, Rome: World Food Programme, Food and Agriculture Organization of the United Nations.

Haggblade, S. (2006), Maize Price Projections of Zambia's 2006/07 Marketing Season, *Policy Synthesis, Food Security Research Project – Zambia, No. 15*, June 2006.

Kalinda, T., Maimbo, F. and Mushimba, M. (2003), *Zambia Food Security Issues Paper*, Forum for Food Security in Southern Africa. www.odi.org.uk/food-security-forum/docs/zambiacipfinal.pdf, accessed on Jan 8, 2007.

Ligon, E. and Schechter, L. (2002), *Measuring Vulnerability*, Conference paper presented at IFPRI-World Bank Conference on Risk and Vulnerability: Estimation and Policy Implications, Washington, D.C., USA, September 23-24, 2002.

Patnaik, U. and Narayanan, K., (2005), *Vulnerability and Climate Change: An analysis of the Eastern coastal districts of India*, Conference Paper at an International Workshop on Human Security and Climate Change, Holmen Fjord Hotel, Asker, near Oslo, 21–23 June 2005.

WFP, (2005), *World Food Programme Emergency Report 2005*, Report No. 48/2005, Nov 25, 2005, United Nations World Food Programme.

Impact of ENSO and the Indian Ocean Dipole on the Northeast Monsoon Rainfall of Tamil Nadu state in India

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Abstract:

Tamil Nadu state, located in the southeastern part of Peninsular India receives most of its rainfall during October through December which is referred to as Northeast monsoon rainfall (NEMR). The onset and distribution of NEMR plays a crucial role on both agriculture and economy of the Tamil Nadu State of Indian subcontinent. It is interesting to note that Tamil Nadu Southwest monsoon rainfall (SWMR) received between June and September months has positive correlation with SOI, while NEMR shows negative correlation with SOI. A study was undertaken to investigate the relationship between global tele-connection signals viz. El-Nino- Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD), and precipitation over Tamil Nadu during the northeast monsoon season. The results indicated that NEMR of Tamil Nadu had the highest positive correlation with Nino-3 SST for the month of July indicating that whenever there is a rise in sea surface temperature in Nino-3 region, there is an increase in NEMR and vice-versa. The results also indicated that under extreme negative July SOI condition Tamil Nadu received 17.7 % more than the normal NEMR and that of the extreme positive condition 17.9 % less than the normal NEMR. To understand the relationship and/or local dynamic structure, composites of circulation field for the extreme El Nino/La Nina years are compared with the mean state. Composite circulation analysis clearly showed that in extreme El Nino years (SOI < -10) Bay of Bengal has a positive sea level pressure (SLP) anomaly and Arabian sea has a negative SLP anomaly, which resulted in strong northeasterly wind to the southern part of India. The strengthened Northeast monsoon brings more moisture and precipitation to the Tamil Nadu region in the El Nino years. The opposite case is also true. A strong negative anomaly is observed in the Bay of Bengal during the La Nina years (SOI > 10), which resulted in weak NE monsoon.

Keywords : Northeast monsoon rainfall; India; El-Nino- southern oscillation; Indian Ocean Dipole

INTRODUCTION

Rainfall during the 4 months period of June to September is termed as the Indian summer monsoon season in a general large-scale sense; however, the actual rainy period differs widely over different parts of the Indian subcontinent. Over Tamil Nadu region, located in the southeastern part of Peninsular India (Fig.1), the most important rainfall season is autumn and winter. Rainfall during October through December over India is referred to as Northeast monsoon rainfall (NEMR) when southwesterlies of summer monsoon are replaced by northeasterlies.

The increase in rainfall activity over Coastal areas of Tamil Nadu, which takes place in the middle of October, is generally considered as the 'setting in of the North-East Monsoon'. The normal date of the onset of the monsoon onset is around October 20th

with a deviation of about a week on either side. It plays a crucial role on both agriculture and economy of the Tamil Nadu State of Indian subcontinent (Srinivasan and Ramamurthy, 1973). As shown in Figure 2, major rains of Tamil nadu is received between September to December, hence, it is important to understand the NEMR activity and to investigate the relationship between global tele-connection signals and precipitation over Tamil Nadu during the northeast monsoon season.

Fig. 1 Geographic location of Tamil Nadus state of India.

There are large variations from place to place and year to year in NEMR. According to Bhatnagar (2003), the reason for the difference in rainfall from place to place has become inherent because when the monsoon system sets in, it brings in distributed rainfall at different places: Distribution and the amount of NEMR is influenced by various parameters including El-Nino- Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD). There are several studies, which have examined the relation between Southern Oscillation Index (SOI) and Indian summer monsoon rainfall that occur between June and September months (Sikka 1980; Rasmusson and Carpenter 1983; Shukla and Paolino 1983; Parthasarathy and Panth 1985; Ropelewski and Halpert 1989, Mooley 1997 and Krishna Kumar *et al* 1999). Studies of the influence of ENSO and IOD on NEMR are, however, meager (Pant and Rupa Kumar 1997, Kripalani and Kumar, 2004).

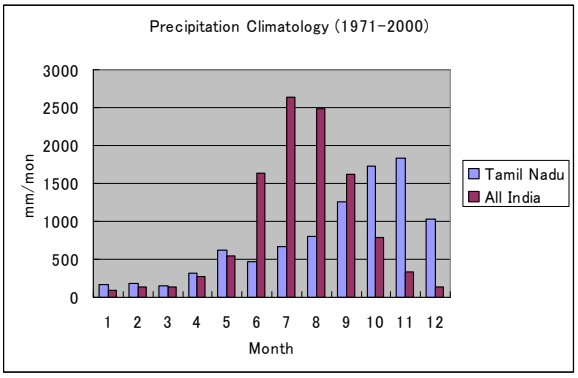

Fig. 2 Seasonal variation of precipitation climatology averaged for the 40 years (1961-2000) over Tamil Nadu state and All India. Data source is Indian Institute for Tropical Meteorology (IITM, http://www.tropmet.res.in/)

According to the previous studies which investigated the relationship between ENSO and global precipitation signals (Ropelewski and Halpert 1987, 1989; Curtis et al., 2001), most part of India has less (more) rainfall during ENSO (La Nina) years. In contrast to this, the southernmost part of India shows opposite signals which tends to have wet anomalies during the ENSO (SOI negative) years.

Recent investigations on the relationship with SOI and Nino-3 SST on NEMR of Tamil nadu concludes that the SOI is negatively correlated with NEMR in Tamil Nadu (Geethalakshmi et al, 2005) and Nino-3 SST is positively correlated (Geethalakshmi et.al, 2003) which imply that autumn-winter precipitation over Tamil Nadu is influenced by the global climatological signals. Recently, Zubair and Ropelewski (2006) pointed out the the relationship between ENSO and NEMR is strengthening. Since length of growing period and distribution of rainfall during Northeast monsoon season is important for agricultural production over Tamil Nadu (Geethalakshmi, 2003), detailed analysis between global signals to the local precipitaton is necessary for crop planning activities.

In the last decade of twentieth century, Indian summer Monsoon rainfall was normal or above normal during the two major ENSO events witnessed (Kumar et al., 1999), although it was widely recognized that less summer monsoon rainfall tended to be

observed during the ENSO years. Therefore, it is necessary to investigate the relationship between ENSO and precipitation over Tamil Nadu from a long-term point of view.

Recently, Indian Ocean Dipole (IOD) has been catalogued as one of the major ocean-atmosphere coupled phenomena in the tropical Indo Pacific sector (*Saji et al.*, 1999, *Webster et al.*, 1999). In this paper an attempt is made to evaluate the influence of ENSO and IOD on NEMR over Tamil Nadu region of India.

In terms of climate application study, localized or synoptic patterns those are more directly related to the precipitation of Tamil Nadu is necessary. Here we also show some composite charts of precipitation and water vapor flux those are compiled recently as given below.

DATA

The sources of India and Tamil Nadu precipitation data sets used in this study are RMC, Chennai for NEMR, (October - December) over Tamil Nadu and regional averaged monthly precipitation dataset created by Indian Institute of Tropical Meteorology (IITM, http://www.tropmet.res.in/). The Southern Oscillation Index (SOI) and Indian Ocean Dipole (IOD) indices were compiled by the Bureau of Meteorology, Australia. The period of the data sets of rainfall, IOD and SOI used for this study are 100 years (1901 - 2000). Sea Surface Temperature (SST) of five different regions viz., Nino3 (150W-90W, 5N-5S); Eastern box of Saji's dipole (50E-70E, 10S-10N); Western box of Saji's dipole (90E-110E, 10S-Eq); Eastern box of Webster's dipole (45E-55E, 5N-5S) and Western box of Webster's dipole (95E-105E,10S-Eq) were used in this study.

For composite analysis of precipitation anomalies, India Meteorological Department (IMD) daily gridded precipitation (Rajeevan et al. 2005) was used. The two meteorological reanalysis dataset compiled by the European Centre for Medium-range Weather Forecasts, namely so-called ERA15 (Gibson et al. 1997) and ERA40 (Uppala et al. 2005) were also used in this study. The computational procedure of vertically integrated precipitable water, moisture flux and its divergence of ERA15 (Figs. 3 and 4) is the same as that used in Yatagai (2003).

RESULTS

General Features

Figure 2 shows the seasonal change of monthly precipitation averaged for the year 1961-2000. Different from the most part of India, southern peninsular India get their maximum rainfall during the northeast monsoon season. Conventionally, October to December is treated as the northeast monsoon season over India, which is mainly affecting the states of Tamil Nadu and Kerala. The rainfall over the Indian state of Tamil Nadu during the months from October to December accounts for about 48% of the annual rainfall in the region.

Large-scale hydrological conditions over India are shown in Fig. 3 (for July) and in Fig. 4 (for November) to show both SW monsoon and NE monsoon characteristics. In July, cross-equatorial moisture flow over the Arabian Sea brings moisture to the Indian sub-continent. Moisture evaporated over the Arabian Sea brings moisture to the west coast of India due to the westerly (or southwesterly) in lower troposphere. Two centers of moisture flux convergence (negative divergence in Fig.3c) are observed, and these match the maxima of precipitation (Fig. 3d). Tamil Nadu is located under the lee ward side of the Western Ghats and hence, SWMR is not large. As a mean state, moisture from Bay of Bengal brings precipitation to the northeastern part of India and Bangladesh, during SW monsoon season.

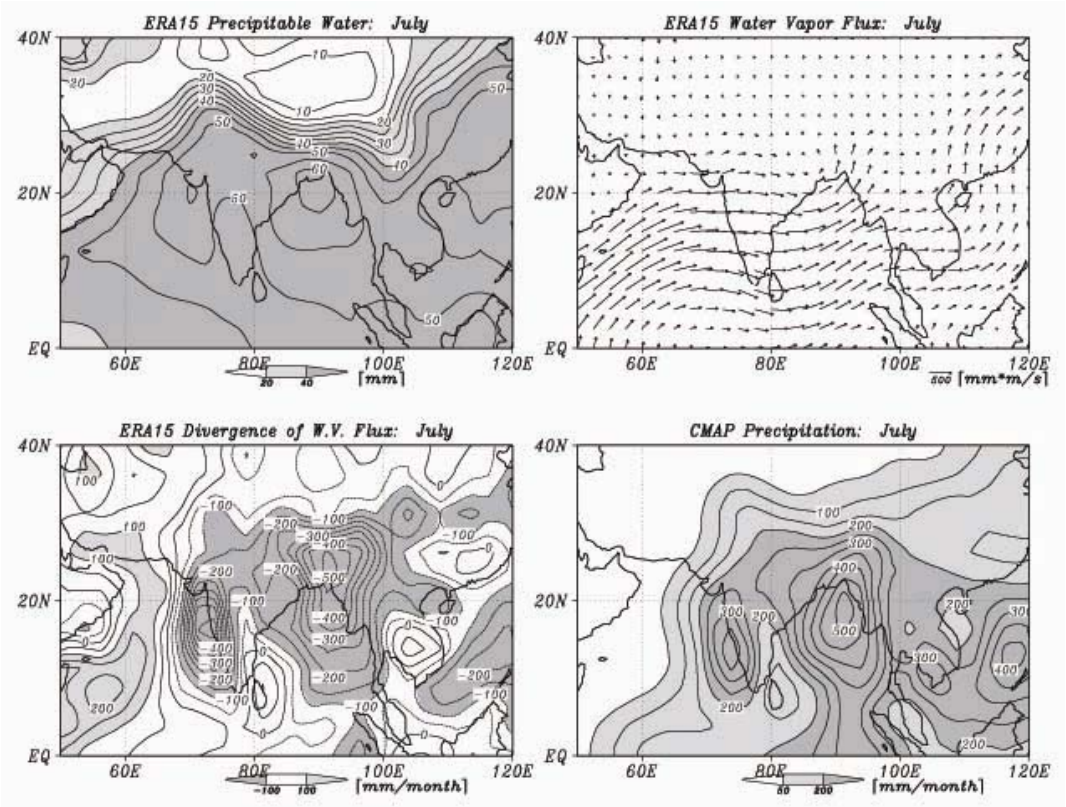

Fig. 3 Climatological mean (a) precipitable water (mm), (b) vertically integrated moisture flux (mm m s-1), and (c) its divergence (mm/month) estimated by ERA15 for July. Climatological precipitation (mm/month) given by CMAP is shown in (d).

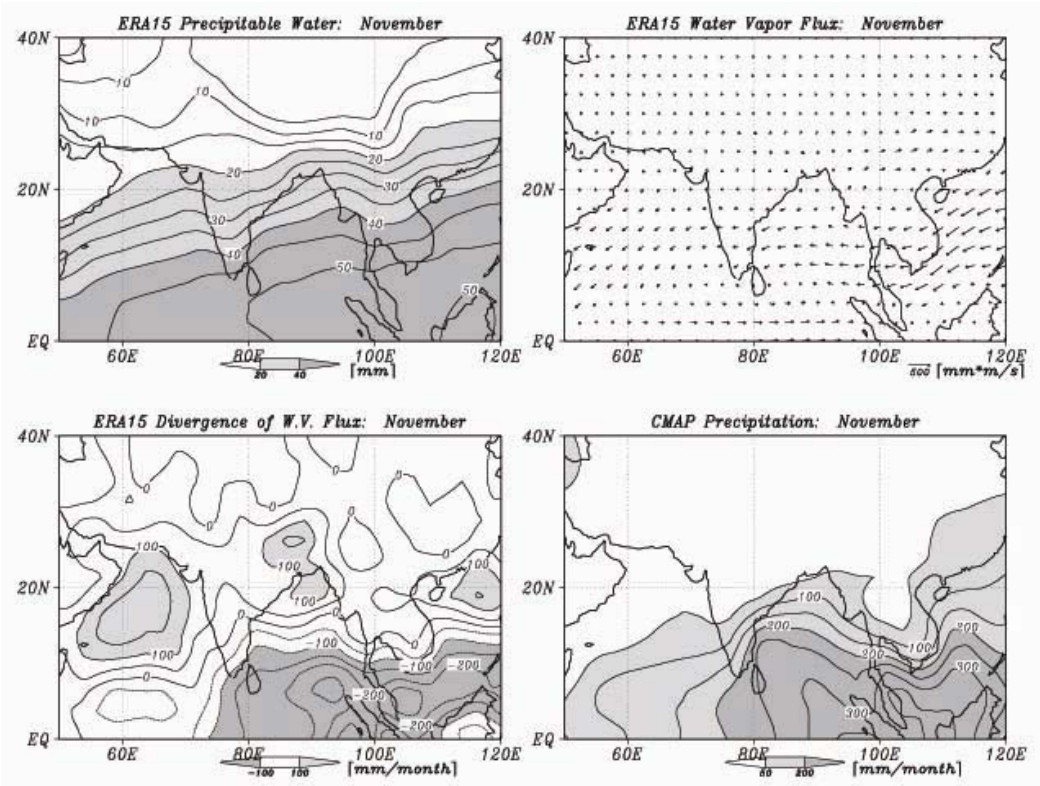

Figure 4. As for Figure 3, but for November.

By contrast, lower dominant wind is northeasterly (or easterly) to the India in November (Fig. 4), and total moisture around India and Bay of Bengal are much less than that in July. In this season, surface pressure over the ocean is lower than that over the land. Convection center locates not over land, but locates around the Maritime continent. Due to the low pressure over south of India (cf. Fig.13 top/center), northeasterly from Bay of Bengal brings moisture/precipitation to the Tamil Nadu state.

Probabilities of monthly rainfall of Tamil Nadu were worked out and presented in Fig.5. The variability of rainfall was also higher during this period which creates many problems in agricultural management. Therefore, it is important to know the pre-cursor signals those have significant relationship to the NEMR of Tamil Nadu.

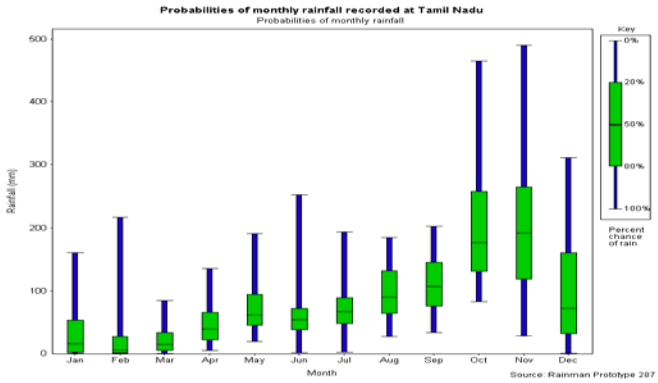

Figure 5. Probabilities of Monthly rainfall of Tamil Nadu, India. Individual bar indicates the variability of rainfall in term of rainfall quantity as well as probability of occurrence of rainfall which ranges from 0 to 100 per cent. The topmost value in the bar indicates the 0 % chance of occurrence and the bottom most value in the bar indicates 100% chance of occurrence of rainfall quantity in that particular month. With respect to the box within the bar, the topmost quantum of rainfall is expected with 20 % probability of occurrence and the bottom most value in the box indicates 80 % chance of occurrence. The horizontal line shown within the bar indicated the median rainfall i.e. 50% chance of occurrence of rainfall.

Relationship between NEMR and El Nino/Southern Oscillation (ENSO)

As the major rainfall of Tamil Nadu is received in Northeast monsoon season, the analysis was done for NEMR. Correlation coefficient between climate indices (SOI and SST at different regions) of different months (January to September) and NEMR are given in Table-1. The results exhibited that NEMR of Tamil Nadu had the highest positive correlation with Nino-3 SST for the month of July indicating that whenever there is raise in sea surface temperature in Nino-3 region, there is an increase in NEMR and vice-versa. There was also a significant negative correlation between SOI of summer monsoon season (June-September) and NEMR in the sense that NEMR is higher during negative SOI. These statistics show that in El Nino (La Nina) condition of boreal summer season is related to the wet (dry) NEMR over Tamil Nadu.

Table 1. correlations between NEMR over Tamil Nadu and SOI, SST in different months. A hundred year (1901-2000) data was used to compute the correlation coefficients.

Particulars	Region (SST)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
SOI		-0.064	-0.092	-0.111	-0.195*	-0.210*	-0.314**	-0.384**	-0.318**	-0.375**
Nino-3	150W-90W, 5N-5S	0.209*	0.191	0.301**	0.326**	0.314**	0.321**	0.388**	0.334**	0.344**
Saji-E	50E-70E, 10S-10N	0.124	0.033	-0.023	0.017	0.067	0.203*	0.111	0.139	0.115
Saji-W	90E-110E, 10S-Eq	0.080	0.151	0.113	0.198*	0.164	0.011	-0.126	-0.100	-0.112
Webster-E	45E-55E, 5N-5S	0.152	-0.105	-0.058	-0.008	0.014	0.075	0.029	0.098	0.034
Webster-W	95E-105E, 10S-Eq	0.105	0.142	0.123	0.193	0.151	-0.015	-0.117	-0.079	-0.104

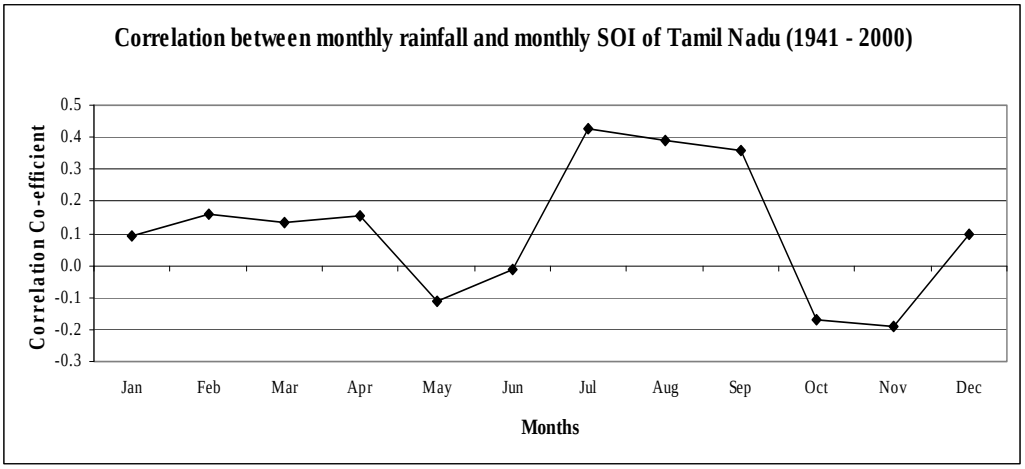

Figure 6. Simultaneous Correlation between monthly rainfall of Tamil Nadu and monthly SOI (1941-2000).

Figure 6 shows simultaneous correlation between monthly rainfall of Tamil Nadu and monthly SOI (1941-2000). A significant positive correlation was found during the Southwest monsoon season (July-September). On the contrary, a negative correlation coefficient was observed during the Northeast monsoon season (October-November). Historical analysis has shown clear evidence of an association between the weak SWMR , large negative southern oscillation index and El Nino events, and also between the strong monsoon, large positive southern oscillation index and absence of El Nino events (Sikka, 1980; Pant and Parthasarathy, 1981; Parthasarathy and Sontakke, 1988). The positive correlation during the Southwest monsoon season (i.e. less SWMR for the El Nino years) for Tamil Nadu has consistent signals with the most part of India.

Figure 7 shows precipitation anomaly over Tamil Nadu during SW monsoon season (June-September) for El Nino/La Nina period based on station data. For this composite, 12 El-Nino years (1963, 1965, 1969, 1972, 1982, 1987, 1991, 1992, 1993, 1994, 1995 and 1997) and 8 La-Nina years (1964, 1971, 1973, 1974, 1975, 1989, 1996 and 1998) were chosen. In most par of Tamil Nadu state, less (more) precipitation is observed during the Southwest monsoon on the El Nino (La Nina) years. On the contrary, during the Northeast monsoon season (Fig. 8), more precipitation to the normal is observed for the El Nino Years. For La Nina years, it tends to show negative biases, but results are not as clear as for El Nino Years.

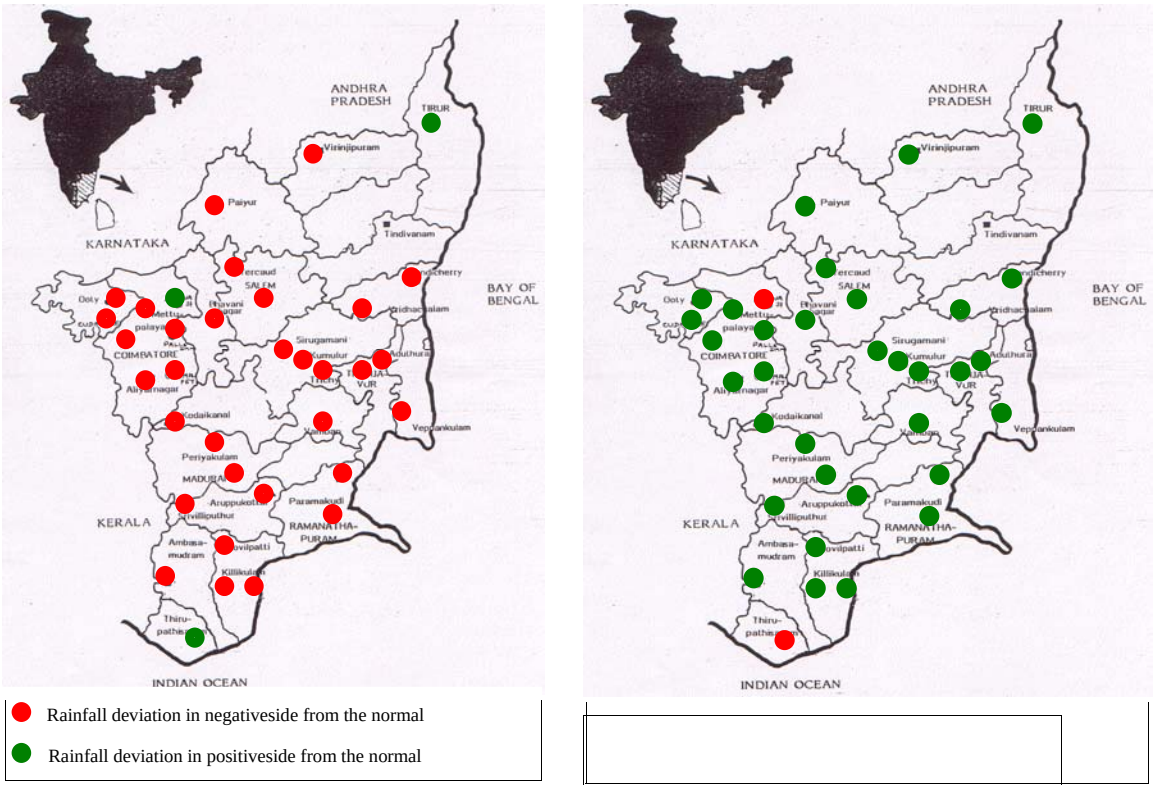

Figure 7. Precipitation anomaly during the SWMR (June-September) for El Nino (left) and La Nina (right) period.

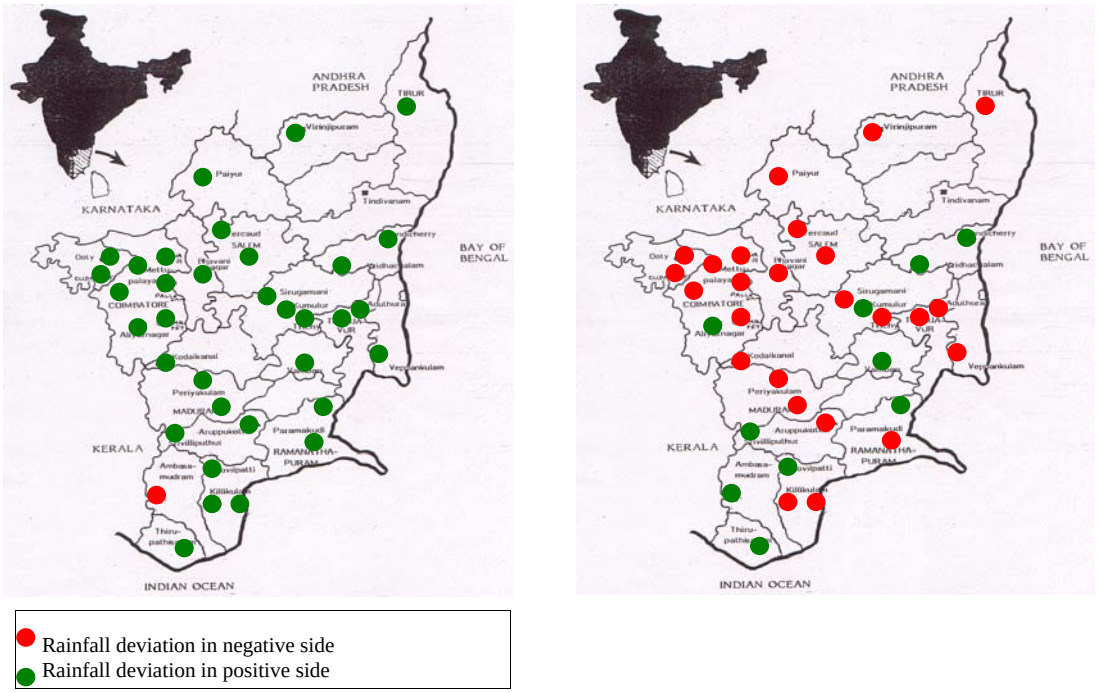

Figure 8. The same as Fig.5 but for NWMR (October-December).

Long-term Changes

The relationship between the NEMR and SOI is susceptible to decadal changes. *Krishna Kumar et al.*, 1999 has reported that the ENSO impact on SWMR is now weakening. Correlation between July month IOD of Nino-3 region and NEMR over a period of 100 years from 1901 to 2000 is only 0.338. To check the consistency of these relationship, decadal correlations between climate indices (SOI & IOD of Nino-3 region) of July month and NEMR of Tamil Nadu was done and presented in Fig. 9. The results clearly indicate that there is a consistent negative correlation between SOI of different months of SW monsoon season (June – Sep) and NEMR of Tamil Nadu except in the decade of 1901-1910 and 1951-60. Twenty year sliding correlations between NEMR over Tamil Nadu and SOI in different months was also done and the results are presented in Table -2. Among the different months, strong correlation could be seen from July month with NEMR which can serve as a viable predictor for the ensuing NEMR. It is interesting to note, in the last decade (1991-2000), correlation between July SOI and NEMR is not as high as that it was in the earlier decades indicating the weakening of the relationship between SOI and NEMR in the recent decade. However, the relationship between IOD of Nino-3 region and NEMR is not as strong as that of SOI with NEMR in different decades studied in general (Fig. 9). Hence further in depth analysis was done only to understand the influence of SOI on NEMR.

Extreme Conditions

July month SOI values above +10 and below -10 were assumed as extreme SOI conditions, and their impact on corresponding year NEMR was studied (Fig. 10). In the 100 year study period, there were 17 extreme negative and 14 extreme positive SOI conditions prevailed in the month of July. Normal NEMR averaged over the study period is 481 mm. Average rainfall received during the extreme negative July SOI condition is 566 mm which is 17.7 % more than the normal NEMR and that of the extreme positive condition is 395 mm which is 17.9 % less than the normal NEMR. Under negative extreme condition, only in 2 out of 17 events recorded lesser than average NEMR. This indicates a shift towards wetter (drought) conditions in relation to the extreme negative (positive) SOI in July over Tamil Nadu region.

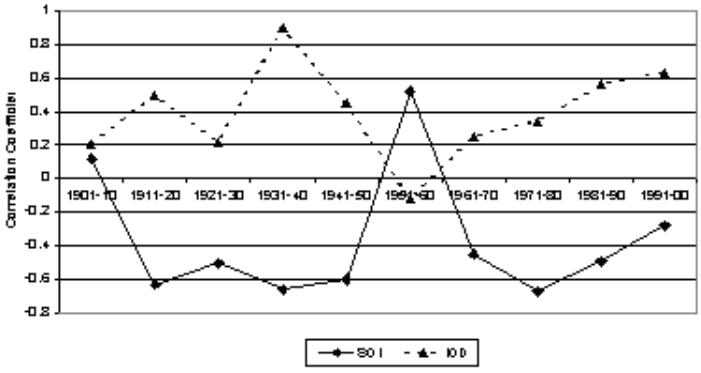

Figure 9. Decadal correlations between climate indices (SOI & SST of Nino3 region (150W-90W, 5N-5S)) of July month and NEMR of Tamil Nadu.

Table 2. Twenty year sliding correlations between NEMR over Tamil Nadu and SOI in different months. The left column (Year) indicates the first year of a 20 year time series subjected to take a correlation.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1951	-0.09	-0.03	0.20	-0.30	-0.11	-0.15	-0.16	-0.07	-0.19
1952	0.03	0.10	0.24	-0.19	-0.13	-0.12	-0.25	-0.04	-0.18
1953	0.02	0.11	0.23	-0.33	-0.23	-0.23	-0.39	-0.18	-0.33
1954	0.03	0.10	0.21	-0.34	-0.40	-0.25	-0.40	-0.28	-0.39
1955	-0.22	-0.11	-0.08	-0.40	-0.44*	-0.22	-0.47*	-0.28	-0.45*
1956	-0.19	-0.14	-0.11	-0.43*	-0.48*	-0.30	-0.55**	-0.35	-0.50*
1957	-0.22	-0.17	-0.13	-0.49*	-0.62**	-0.38	-0.62**	-0.39	-0.49*
1958	-0.25	-0.08	-0.24	-0.55**	-0.69**	-0.52*	-0.67**	-0.49*	-0.53*
1959	-0.38	-0.27	-0.31	-0.59**	-0.59**	-0.47*	-0.59**	-0.45*	-0.55**
1960	-0.42	-0.28	-0.32	-0.60**	-0.56**	-0.45*	-0.61**	-0.50*	-0.54**
1961	-0.44*	-0.30	-0.25	-0.49*	-0.51*	-0.44*	-0.59**	-0.48*	-0.49*
1962	-0.49*	-0.28	-0.40	-0.44*	-0.54**	-0.50*	-0.60**	-0.52*	-0.52*
1963	-0.50*	-0.26	-0.41	-0.41	-0.46*	-0.35	-0.49*	-0.34	-0.39
1964	-0.43*	-0.22	-0.37	-0.42	-0.46*	-0.34	-0.49*	-0.33	-0.37
1965	-0.44*	-0.25	-0.30	-0.41	-0.42	-0.23	-0.48*	-0.31	-0.34
1966	-0.44*	-0.24	-0.30	-0.38	-0.42	-0.22	-0.51*	-0.30	-0.34
1967	-0.42	-0.18	-0.25	-0.36	-0.32	-0.27	-0.53**	-0.27	-0.30
1968	-0.47*	-0.21	-0.27	-0.34	-0.29	-0.27	-0.52*	-0.29	-0.31
1969	-0.44*	-0.15	-0.29	-0.34	-0.29	-0.20	-0.54**	-0.35	-0.40
1970	-0.40	-0.14	-0.33	-0.34	-0.27	-0.22	-0.54**	-0.32	-0.36
1971	-0.41	-0.13	-0.32	-0.34	-0.28	-0.23	-0.54**	-0.32	-0.36
1972	-0.41	-0.16	-0.40	-0.43	-0.29	-0.24	-0.55**	-0.37	-0.40
1973	-0.41	-0.24	-0.43*	-0.41	-0.20	-0.18	-0.49*	-0.34	-0.34
1974	-0.43*	-0.26	-0.42	-0.49*	-0.26	-0.29	-0.53*	-0.42	-0.37
1975	-0.29	-0.12	-0.26	-0.41	-0.19	-0.26	-0.45*	-0.38	-0.29
1976	-0.27	-0.09	-0.27	-0.28	-0.09	-0.22	-0.45*	-0.35	-0.26
1977	-0.24	-0.09	-0.25	-0.23	-0.08	-0.14	-0.41	-0.31	-0.23
1978	-0.17	-0.05	-0.24	-0.28	-0.16	-0.18	-0.36	-0.37	-0.27
1979	-0.19	0.06	-0.27	-0.30	-0.31	-0.23	-0.39	-0.38	-0.27
1980	-0.18	-0.01	-0.30	-0.30	-0.37	-0.31	-0.36	-0.39	-0.31

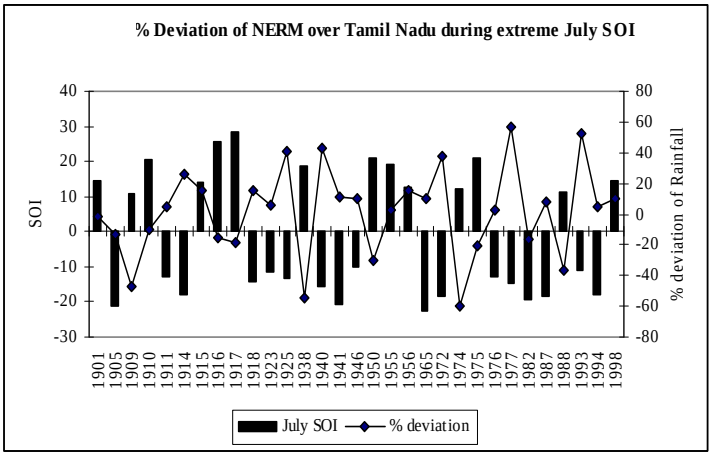

Figure 10. Comparison between July SOI and NEMR of Tamil Nadu. Only for the years of strong SOI > 10 (SOI <-10) are shown.

Circulation/Precipitation patterns

As Tamil Nadu SWMR has positive correlation with SOI and NEMR shows negative correlation with SOI, composites of circulation field for the extreme El Nino/La Nina years are compared with the mean state to understand the relationship and/or local dynamic structure. Since the ERA40 data is available after 1957, the 8 El Nino years (1965, 1972, 1976, 1977, 1982, 1987, 1993 and 1994) and 4 La Nina years (1974, 1975, 1988 and 1998) were chosen by the July SOI values as shown in the previous sub-section and Fig.10.

Figure 11 shows July mean circulation field and precipitation, anomalies of El Nino condition (difference between the average of the 8 years and climatology), and anomalies of La Nina condition (difference between the average of the 4 years and climatology). The climatology (top diagrams) were computed as an average of 40 years (1961-2000). During El Nino (La Nina) condition, there is less (more) precipitable water over Arabian Sea and northern part of India. Wind field of El Nino condition shows more divergent structure over the Tamil Nadu as well as whole of India.

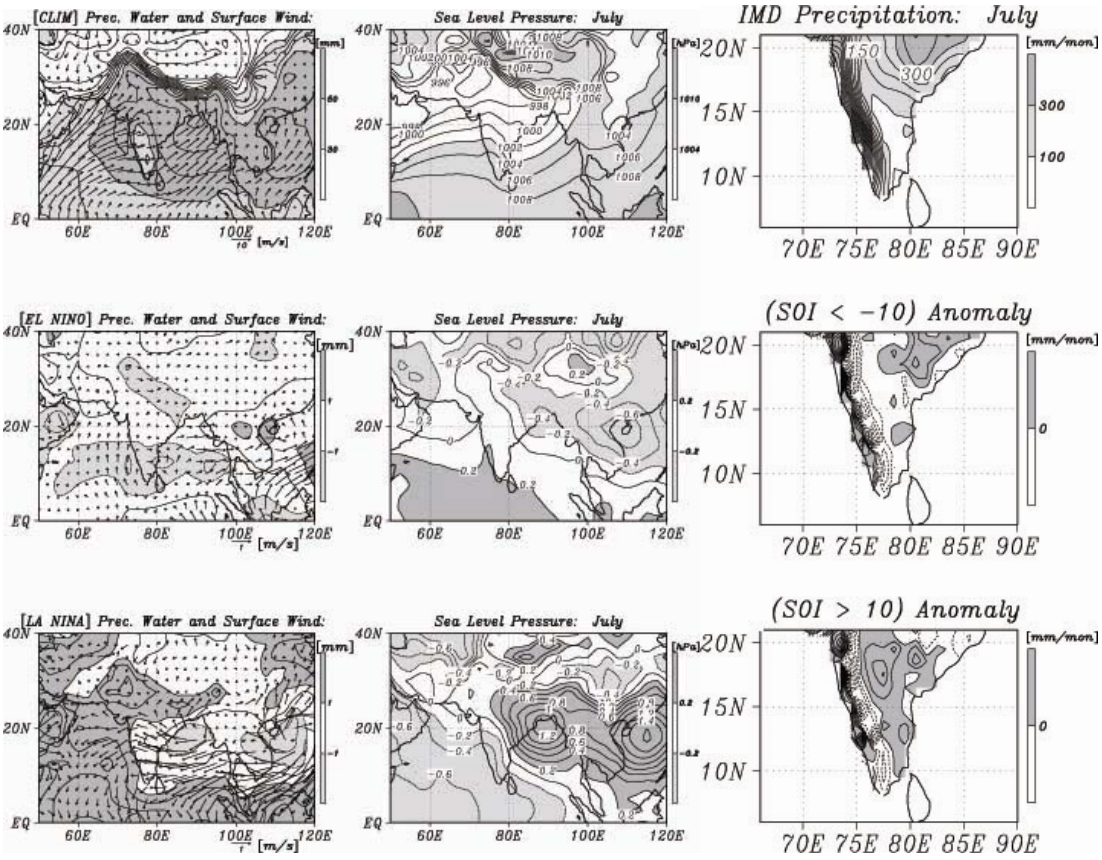

Figure 11. (Top left) Climatological mean precipitable water (mm) and surface wind (m/s) for July given by ERA40. Regions exceeding 30 mm month-1 (50 mm month-1) are lightly (darkly) shaded. Contours are spaced every 10 mm. (Top center) climatological mean sea level pressure. Regions exceeding 1002 hPa (1010 hPa) are lightly (darkly) shaded. Contours are spaced every 2 hPa. (Top right) Climatological mean precipitation (mm/month) given by IMD. Contours are spaced every 50 mm. (Middle diagrams) Anomaly composite for the year of extreme El Nino (SOI < -10). Positive (negative) strong anomaly are darkly (lightly) shaded as shown in the scales in the left and center diagrams. Positive precipitation anomaly areas are shaded, while negative precipitation anomaly areas are not shaded. (Lower diagrams) Anomaly composite for the year s of extreme La Nina (SOI > 10).

In order to see the continuation of the anomaly, the circulation field for September was checked before moving on to the November condition. Figure 12 shows, clearer difference of the circulation field than that of in Figure 11. In September (Fig. 12), less (more) precipitable water and higher (lower) sea level pressure are observed over India in El Nino (La Nina) condition. These resulted in drier (wetter) SWMR for El Nino (La Nina) years over Tamil Nadu as well as whole India in September.

In November (Fig. 13) anomaly of pressure gradient pattern is not identified with those in Fig. 11 and Fig. 12. In El Nino years, a positive sea level pressure (SLP) is observed in Bay of Bengal and a negative SLP anomaly is observed in Arabian Sea, which results in strong East-West pressure gradient over southern part of India. This gradient causes strong northeasterly (NEMR) in Tamil Nadu as well as southern part of India. During the La Nina phase, the opposite situation is observed.

From these composite analysis it is clarified that circulation anomalies over India, Bay of Bengal and Arabian Sea do not continue during the extreme SOI signal in July. This implies that the physical mechanisms of positive correlation with SOI in SWMR and negative correlation with SOI in NEMR are not the same each other. For the NEMR, the pressure gradient (or di-pole signals) between Bay of Bengal and Arabian Sea affects the precipitation anomaly over Tamil Nadu more directly to the SOI signals.

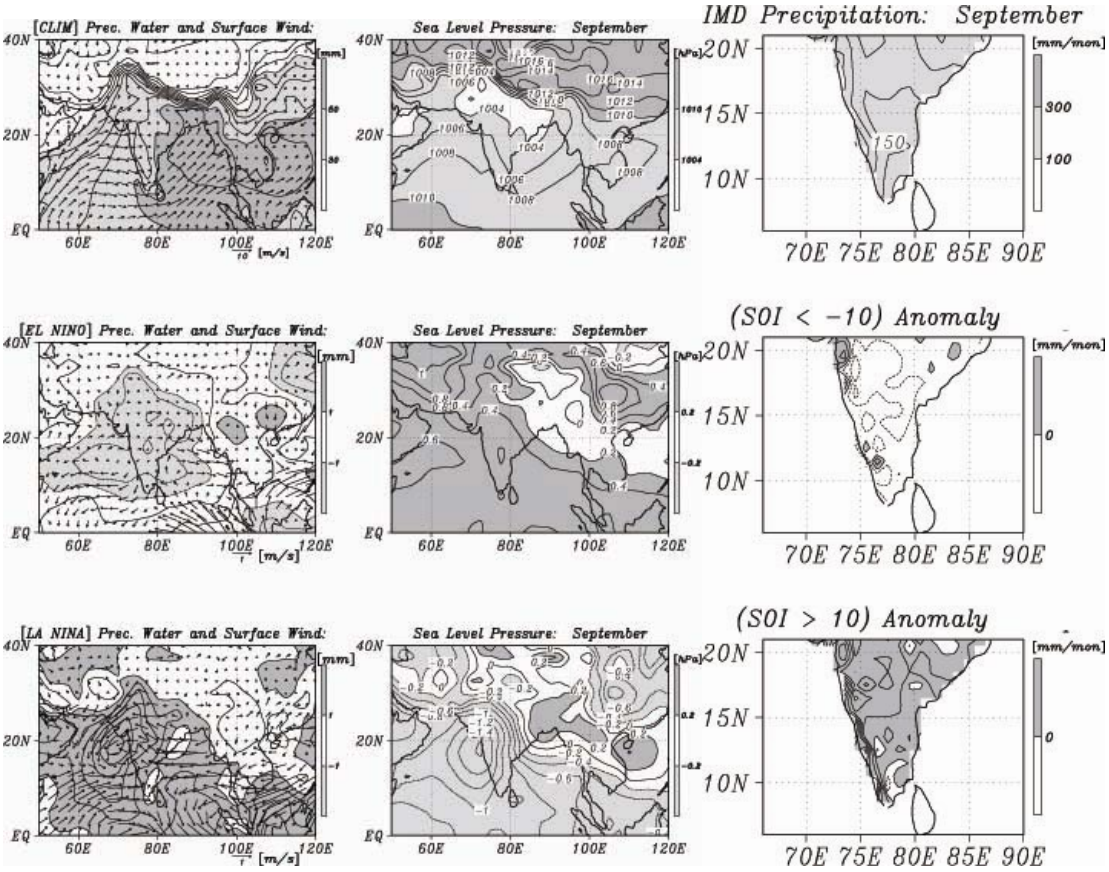

Figure12. As for Figure 11, but for September.

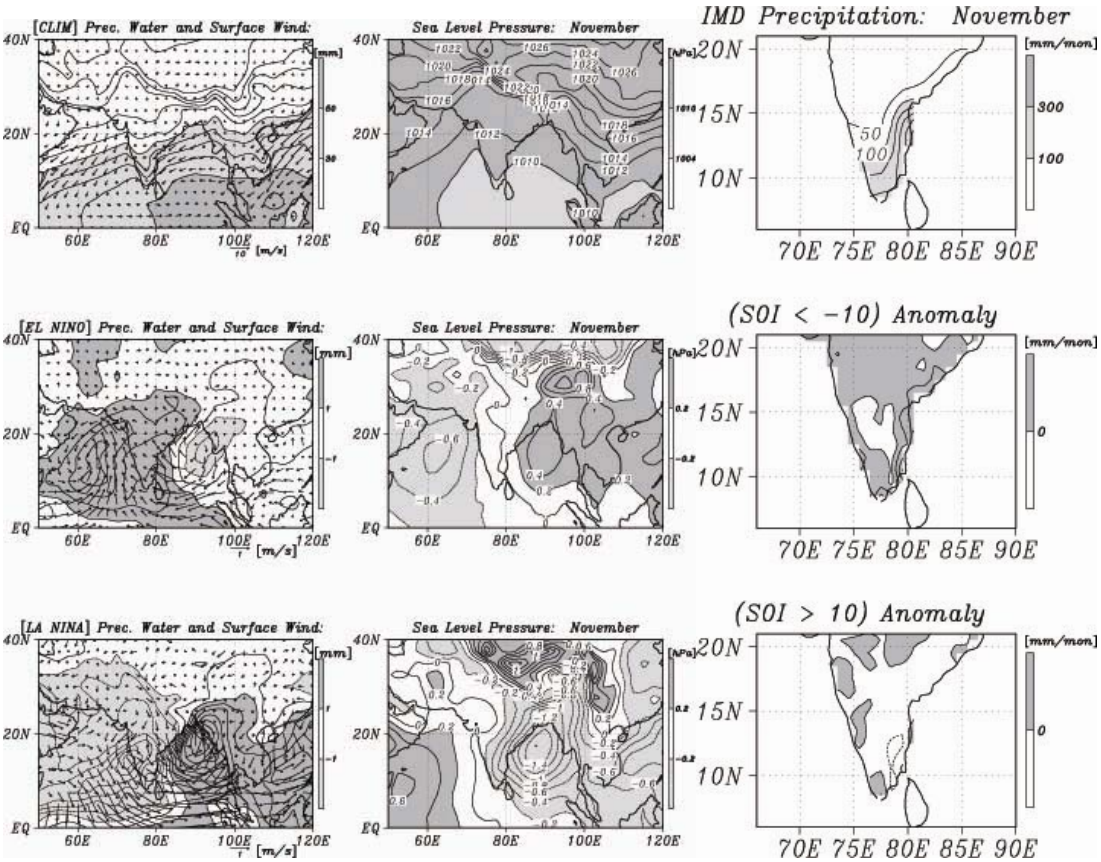

Figure 13. As for Figure 11, but for November.

CONCLUSIONS

From the above study it could be concluded that SOI and Nino-3 SST are having significant influence on NEMR. Among different months, July month SOI and Nino-3 SST has significant relationship with NEMR. July SOI is negatively correlated with the NEMR and the extreme negative SOI (El Nino years) resulted in wetter than average conditions during NEMR. SW monsoon rainfall over Tamil Nadu has significant positive correlation with simultaneous SOI, that is drier condition occurs in SW monsoon season in El Nino years.

Composite circulation analysis clearly showed that in extreme El Nino years (SOI < -10), Bay of Bengal has a positive sea level pressure (SLP) anomaly and Arabian sea has a negative SLP anomaly, which resulted in strong northeasterly wind to the southern part of India. The strengthened NE monsoon brings much moisture and precipitation to the Tamil Nadu region in the El Nino years. The opposite case is also true. A strong negative anomaly is observed in the Bay of Bengal during the La Nina years (SOI > 10), which resulted in weak NE monsoon.

ACKNOWLEDGEMENTS

This work was supported by the project Vulnerability and resilience of social-ecological systems that is on-going at Research Institute for Humanity and Nature, and Asian Precipitation – Highly Resolved Observational Data Integration Towards Evaluation (APHRODITE's) of the Water Resources funded by Ministry of Environment, Japan.

REFERENCES

Bhatnagar A K. 2003. Chennaionlineine aprèss release. Published on 29th Nov, 2003, http://www.chennaionline.com/cityfeature/Chennai/2004/11meterology.asp

Curtis S., R. Adler, G. Huffman, E. Nelkin and D. Bolvin. 2001. Evolution of tropical and extratropical precipitation anomalies during the 1997-1999 ENSO cycle. *Int. J. Climatol.* **21**: 961-971.

Geethalakshmi V. Bride J M, Huda A K S. 2005. Inpact of ENSO on Tamil Nadu rainfall. Vatavaran, 29 (2): 9 – 16.

Geethalakshmi V, Bride J M, Balasubramanian T N, Selvaraju R, Huda A K S, Vasanthi C, George D, Clewett J, Thiyagarajan T M. 2002. Effects of ENSO on Tamil Nadu rainfall and almanac studies. In: Seasonal climate forecasts in agricultural management. (ISBN No. 81-902081-3-6). P: 47-63.

Geethalakshmi V, Balasubramanian T N, Selvaraju R, Bride J M, Huda A K S, Vasanthi C, George D, Clewett J, Thiyagarajan T M. 2003. Length of growing Period as influenced by El-Nino and La-Nina over Coimbatore, Tamil Nadu, India. J. Agric. Res. Management. 2 (3&4): 31 – 38.

Gibson JK, Kallberg P, Uppala S, Nomura A, Hernandez A, Serrano E. 1997. ERA Discription. *ECMWF re-analysis project report series*, **1**, 72pp.

Kripalani RH, P. Kumar. 2004. Northeast monsoon rainfall variability over south peninsular India vis-a-vis Indian Ocean dipole mode, Int. J. Climate, 24, 1267-1282.

Krishna Kumar K, Rajagopalan B, Cane M A. 1999. On the weakening relationship between the Indian monsoon and ENSO. Science, 284: 2156-2159.

Mooley D A. 1997. Variation of summer monsoon rainfall over India in El Nino. Mausam, 48 : 413-420.

Pant GB, K. Rupa Kumar. 1997. Climates of South Asia. Wiley, 320pp.

Pant GB, B. Parthasarathy. 1981. Some aspects of an association between the southern oscillation and India summer monsoon. *Arch. Meteorol. Geophys. Biokl., Sr. B.*, **29**, 245-251.

Parthasarathy B, Panth G B. 1985. Seasonal relationships between Indian summer rainfall and the southern oscillation. J. Climate, 5 : 369-378.

Parthasarathy B., NA Sontakke. 1988. El-Nino/SST of Puerto Chicama and Indian summer monsoon rainfall –Statistical relationships. *Geofis. Int.*, **27**, 37-59.

Rajeevan, M., J. Bhate, J.D. Kale and B. Lal, 2005. Development of a high resolution daily gridded rainfall data for the Indian region, India Meteorological Department, Met.Monograph Climatology No. 22/2005, pp. 26.

Rasmusson E M, Carpenter T H. 1983. The relationship between eastern equatorial Pacific Sea surface temperatures and rainfall over India and Sri Lanka. Mon. Weather Rev., **111**: 517-528.

Ropelewski C F, Halpert M S. 1987. Global and regional scale precipitation patterns associated with the El Niño/Southern Oscillation. Mon. Wea. Rev. **115**: 1606-1626.

Ropelewski C F, Halpert M S. 1989. Precipitation Patterns associated with the high index phase of the Southern Oscillation. J. Climate, **2**: 268-284.

Saji N H, Goswami B N, Vinayachandran P N, Yamagata T. 1999. A dipole mode in the tropical Indian Ocean. *Nature,* 401:360-363.

Shukla J and Paolino D A. 1983. The southern oscillation and long range forecasting of the summer monsoon rainfall over India. Mon. Weather Rev., 111: 1830-1837.

Sikka D R. 1980. Some aspects of large scale actuations of summer monsoon rainfall over India in relation to actuations in the planetary and regional scale circulation parameters. Proc. Indian Acad. Sci. (Earth Planet Sci.), 89 :179-195.

Srinivasan V and Ramamurthy K. 1973. Comprehensive articles on selected topics, Northeast monsoon. FMU Rep. of India Meteorological Department, IV :18.

Uppala SM and co-authors. 2005. The ERA-40 Reanalysis. *Q. J. R.M.S. (in press)*.

Webster P J, Moore A, Loschnigg J, Leban M. 1999. Coupled ocean dynamics in the Indian Ocean during the 1997-1998. *Nature,* 401: 356-360.

Xie P, Arkin PA. 1997. Global precipitation: a 17-year monthly analysis based on gauge observations, satellite estimates, and numerical model outputs. *Bull. Amer. Met. Soc.* **78**: 2539-2558.

Yatagai A. 2003. Evaluation of hydrological balance and its variability in arid and semi-arid regions of Eurasia from ECMWF 15 year reanalysis. *Hydrol. Process.* **17**, 2871-2884.

Zubair L. and Ropelewski CF. 2006. The strengthening relationship between ENSO and northeast monsoon rainfall over Sri Lanka and southern India, J. Climate, 19, 1567-1575.

Abstract of Resilience Seminar in FY2006

The 12th Resilience Seminar

Date and Time: 10:00-11:30 Monday July 3rd 2006
Place: RIHN Lecture Hall
Co-organized by the Society of Commons Studies and Biwa-Yodo Watershed Project
Title: Developing Methods for Institutional Analysis: Institutional Diversity in Resource Management
Speaker: Elinor Ostrom, Co-Director, Workshop in Political Theory and Policy Analysis, Indiana University

[Abstract] Many policy texts stress the importance of institutions for political and economic development and for achieving sustainable resources. Yet, diverse scholars mean so many different things when they refer to institutions. And, there are many ways of conducting institutional analysis. I will present a brief overview of the Institutional Analysis and Development (IAD) framework that is laid out in my new book, *Understanding Institutional Diversity* (Princeton University Press, 2005). I will then dig into the framework to illustrate the diversity of rules we have discovered in doing field work related to common-pool resources (e.g. irrigation systems, forests, pastures, fisheries). In light of the diversity of rules in use, I will address the problem of recommending simple solutions to complex social and ecology problems and recommend considerable humility when we turn to policy recommendations. Building settings in which individual can adapt better rules in light of their experience in coping with problems over time is a better approach than presuming we know the right "blueprint" to build better institutions to cope with diverse problems we face. Resilience is enhanced by building institutions that can be adapted to local circumstances and change over time.

The 13th Resilience Seminar

Date and Time: Tuesday, 27 July 2006, 16:00-17:30
Place: RIHN Seminar Room 1&2
Title: Application of climate information for enhancing resilience to climate risk: Indian case study
Speaker: Prof. V. Geethalakshmi, Visiting Researcher at RIHN and Department of Meteorology, Tamilnadu Agricultural University, India

[Abstract] Planning for risk management should take into account of climate variability and expand the capacity to identify trends and adapt to hazards such as floods and droughts. Extreme weather and climatic events keep on cause much damage and loss to properties and lives in spite of considerable advance made in the forecasting and monitoring of climatic phenomena on varied time scale and space dimensions in the past. During 1990's, natural disasters hit the world to the tune of 500-800 times a year and resulted in loss of more than $600 billion and affected 2 billion people (Anthes, 2005). There are lots of uncertainties exists in natural variability of climate, extent and impact of global warming and climate change, population increase and related problems and societal and human response to these anticipated changes. However, let these uncertainties not be an excuse for taking any action against facing and managing the climatic risks. Regional understanding of the past trends and likely changes in the future will help in planning for the climate related risk management strategies. Early warning systems should become an integral part of risk management and planning. Anticipation and prevention are more effective and less expensive than having to react to emergencies. Few case studies of Indian subcontinent will be discussed as an example.

The 14th Resilience Seminar

Date and Time: Monday, October 2nd, 2006, 15:30-17:15
Place: RIHN Seminar Room 1&2

15:30-16:30
Title: Influence of gregarious flowering of *Melocanna baccifera* in Mizoram, North-East India
Speaker: Shozo SHIABTA, Graduate School of Global Environmental Studies, Kyoto University

[Abstract] Melocanna baccifera distributes in North-East India, Bangladesh and Myanmar largely in slash-and-burn agriculture area. Although flowering period of the most bamboo species is not clear, this species has been recorded its flowering every 48 years and the next flowering will come on the end of this year. To understand the ecological characteristics of bamboo flowering this chance is very great for bamboo researchers. It is said that previous flowerings brought the catastrophic damage to Mizoram people. In these several decades, after the last flowering of Melocanna in 1959, the social system of Mizoram changes by the promotion of domicile, deterioration of slash-and-burn rotation and so on. The influence of current bamboo flowering upon this changing social system is also interesting.

16:30-17:15
Title: Zambia Field Trip Report
Speaker: Mitsunori Yoshimura, RIHN

The 15th Resilience Seminar

Date & time: Thursday, November 9th, 2006, 15:30-17:00
Place: RIHN Seminar Room 1&2
Title: International approach to drought early warning system for human security ~ Current trends in international organisations and Ethiopia ~
Speaker: Yukiko IITSUKA, Secretariat of the international peace cooperation headquarters, Cabinet office

[Abstract] Among the countries in which a natural disaster and armed conflicts are occurring frequently, the "early warning system" for drought preparedness has been established by international organisations and other development assistance organizations as what contributes to people's "human security". However, in addition to the early analysis of the system based on the conventional data collection, the alternative analysis which takes political and social factor into consideration more attracts global attention in recent years. For example, in order to increase the efficacy of the system, a new approach called "Twin Track Approach (TTA)" has been recently discussed by the U.N. food and agriculture organisation (FAO). It incorporates the political and social factor as an element which constitutes a resilience framework in vulnerable society. In Ethiopia, on the other hand, the early warning system has been advanced over the basis of cooperation of international organisations, including USAID, in many years since it was introduced most early.

In the presentation, first of all, the new argument, such as the TTA which international society including FAO advances, will be introduced. Secondly, the history and information gathering system of early waning system operating in Ethiopia will be mainly reported. Furthermore, it would be discussed that what kind of problem could be identified in the early warning system currently carried out in Ethiopia, considering the lively argument of the TTA. Finally, the challenge of ensuring human security in drought correspondence of Africa, as well as the possibility of that, would be considered.

The 16th Resilience Seminar

Date & time: Thursday, February 22nd, 2007, 15:30-17:00
Place: RIHN Lecture Hall

15:30-16:15

Title: Creating social space for economic activities among rural women in Southern Zambia

Speaker: Tokuko Narisawa, Graduate School of Asian and African Area Studies, Kyoto University

[Abstract] In rural Tonga of Southern Zambia, women's source of cash income had been almost entirely limited to the sales of beer. Since the 1990s, economic hardships stemming from complex repercussions of the penetration of market economy, drought and cattle disease have deprived Tonga of cash income from agricultural and pastoral activities. For Tonga women, this has meant a loss of access to money which has been controlled by men. To counter this trend, development programs have been promoted for the empowerment of rural women. No studies, however, reveal the real feature of Tonga women's individual economic activities.

This presentation aims to discuss the rural Tonga women's way of accomplishing their own economic activities in the society, under recent socio-economic changes, based on field research conducted in a village located east of Monze, Southern Province of Zambia. I shall argue that it was the creative practice of women that played a central role in transforming local social space into their own "market"; a creativity which allowed women to pursue individual economic activities without contradicting social n

orms in a male-dominated economy.

16:15-17:00

Title: Sorghum cultivation in Gwembe valley, southern Zambia

Speaker: Kazue Awaji, Graduate School of Asian and African Area Studies, Kyoto University

[Abstract] Gwembe valley, located in the southern part of Zambia, has poor rainfall and is often hit by drought. The people who live in the Gwembe valley cultivate sorghum that has drought resistance. I try to discuss about their sorghum cultivation under hard climate condition, from views of the cropping system and varietal Characteristics.

FY2006 1-3PR Project Research Activity Overview												
2006	4	5	6	7	8	9	10	11	12	1	2	3
Resilience Seminar	13:00-17:00			10:00-12:00	16:00-17:30		13:00-17:00	11:00-17:00			15:00-17:00	
	12-Apr			3-Jul	25-Jul		4-Oct	9-Nov			22-Feb	
				12th Seminar	13th Seminar)		(14th Seminar	(15th Seminar)			(16th Seminar)	
Core-member Meeting	*							*			*	
Workshop			2-3, JuneWS					10-Nov				
			9:00-17:00					10:00-16:00				
								Theme IV/WS				
Field Research			Field Research						Field Research			
PR Proejct Report											PR Report Publication	
PR Related Meetings	FS Hearing	6-Mar				(FS Hearing)			RIHN Project			Evaluation
	IS application	14-Apr				22-Sep			Meeting			Committee
	IS Hearing	26-Apr							3-15 December			Hearing
									Kyoto Tersa			28 Feb-1 March
RIHN Events		Kamigamo						RIHN Internat				RIHN
	Opening Ceremony							Symposium				
		26-Mar						6-8 November				FS Hearing
Field Trip Schedule								KICH				9-Mar
Shinjo			10 June-5 July									3/15-4/18
Tanaka						Zambia						
Miyazaki			15 June-5July			Presidential						
Noro			15 June-5July			Election						
Miura						28-Sep						
Shibata												
Sakurai			10-17 June									
Kanno												
Shimada					(9-25 Augus							
Ito					9 August-			continues field research until Spring 2007				
Nakamura					9 August-			continues field research until Spring 2007				
Hanzawa												
Kodamaya												
Araki												
Yoshimura				22 August-5 September								7-24 March
Saeki												
Yamashita				22 August-5 September								7-17 March
Yamauchi								26 Nov - 6 D				
Umetsu			10-19 June					21 Nov - 6 D				7-17 March
Lekprichakul								21 Nov - 6 Dec				7-30 March
Yatagai												
Palanisami				1-9 July								
Geetha (Invited Researcher)			1 May-31 July									
Kume									India	11-23 January		

はじめに

地球研平成１８年度プレリサーチ (PR) 研究「社会・生態システムの脆弱性とレジリアンス」は本プロジェクトの準備段階としての一年を無事終了した。

平成１８年度は多くのプロジェクトメンバーがザンビアへ赴き、農民、大学関係者、政府機関スタッフ等との研究計画の打合せ及び予備調査を行った。現地の住民と政府機関の協力を得ながら、東部州ペタウケ郡の休閑地をプロジェクトの調査地としてお借りすることが出来、土壌分析も開始した。また２名の大学院生が雨期の開始前から南部州の村落に住み着いて、村落での農業生産、労働移動、旱魃対応の詳細な情報収集を開始した。現地踏査に基づく地理情報も整備しつつある。主な協力機関となるザンビア農業研究所 (Zambia Agricultural Research Institute) と地球研による研究協力覚書の締結も平成１９年３月に行なわれた。ザンビア中央統計局との家計調査の準備も進んでいる。

２００６年はグローバリゼーションを肌で感じた年でもあった。中国、韓国等アジア各国での銅需要増加の影響から、産出国ザンビアの銅景気により為替レートの上昇が続き、平成１７年８月に１ドル 4,630ZK であったクワチャが平成１８平成１８年６月には１ドル 3,500ZK まで高騰した。このような貿易・投資の拡大やショックがどの様に零細農民へ影響を及ぼしているのかも重要な問題である。アフリカにとって近年インド・中国は重要な貿易のパートナーとなりつつある。新しい「アフリカのシルクロード」との見方もある。

本プロジェクトは今年度の PR の段階を終え、平成１９年度から５年間の本研究 (FR) をスタートさせる。1-3PR メンバーの方々にはプロジェクトを軌道に乗せるためにご尽力をいただき感謝したい。また地球研の評価委員会、所長、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新しいプロジェクトを実現可能に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１９年３月

総合地球環境学研究所
1- 3PR プロジェクト・リーダー
梅津　千恵子

PR

P1－3PR

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： 梅津 千恵子　　**略称**： レジリアンス・プロジェクト

キーワード： レジリアンス，貧困， 社会・生態システム，資源管理，環境変動，脆弱性，人間の安全保障，半乾燥熱帯

１．研究目的と内容

（１）研究目的

・ 研究の背景と目的

貧困と環境破壊の悪循環は森林破壊，砂漠化などの「地球環境問題」の主要な原因である。そのもっとも顕著な例が，世界の貧困人口の大部分が集中するサブサハラ・アフリカや南アジアの半乾燥熱帯であろう。そこでは，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。この「地球環境問題」を解決するためには，人間社会および生態系が環境変動の影響から速やかに復元すること（レジリアンス）が鍵となる。そこで，本プロジェクトでは社会と生態を一つのシステムとしてとらえ，そのレジリアンスについて半乾燥熱帯を対象に実証的な研究を行う。

・ プロジェクトの最終成果として何を示そうとするのか

本プロジェクトは，社会・生態システムの脆弱性を規定する要因を解明し，システムのレジリアンスを高める方策を提案することで，貧困と環境破壊という悪循環の解決に資することを目的とする。そのために，現地調査に基づきレジリアンスを評価する指標を作成し，その指標を用いて望ましい社会制度や資源管理手法についてのオプションを提示する。

（２）研究体制と研究の内容・方法

・ グループに類の構成と役割

４つのテーマが互いにリンクしながら統合的なレジリアンス評価を行う。

テーマ I　環境変動下での人間活動と生態レジリアンス

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

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

テーマ IV　社会-生態システムに対する統合解析

・ 対象地域

本プロジェクトは多くの人口が天水農業地域に住み，環境資源に生活を大きく依存する半乾燥熱帯地域を対象とする。南アフリカ地域（ザンビア，ジンバブエ等），西アフリカ地域（ブルキナファソ，ニジェール等），及び南アジア（インド等）を調査対象地域とする。特にザンビアを主要調査地とし，旱魃常襲地帯の南部州，東部州をフィールドとする。

・ 研究内容・方法

テーマI　環境変動下での人間活動と生態レジリアンス(リーダー：真常仁志)

環境変動下における生態レジリアンスと人間活動の相互作用を明らかにする。生態レジリアンスの構成要件，許容量および遷移を評価するため，比較的安定な状態にある生態系が拓かれ農耕地へと転換される途上で起こりうる土壌の劣化，肥沃度メカニズムの質的変化などを時空間変動の観点から追跡する。立地条件，土地利用とその履歴，遷移段階などが異なる農

耕地生態系の比較から，生態レジリアンスが人間活動に与える影響を明らかにする。

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(リーダー：櫻井武司)

農村世帯が不規則な降雨に対して取る戦略を調査する。まず圃場レベルで降雨量の空間・時間分布を測定する。次に旱魃に対処するための世帯の資産状況を調査する。降雨量の変動に対してどの様に作物シーズンの前，途中，後に対処しているのかを分析し，最後に世帯のレジリアンスをリスク管理能力と対処行動の効果によって評価する。

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(リーダー：島田周平)

社会的レジリアンスの制度的側面に注目する。社会的レジリアンスは社会・政治・経済の変化のみならず，生態的変遷によって変化する。変化は空間・時間の複数スケールで同時に起こるので，社会的レジリアンスを理解するためにはまず脆弱性増大のプロセスと緩和プロセスを同時に理解することが必要である。

テーマIV　社会-生態システムに対する統合解析(リーダー：吉村充則)

生態システムの変遷とそれに影響を与える社会システムについて統合的かつ包括的な調査を行い、生態システムの脆弱性･レジリアンスと人間活動の相互作用について明らかにする。生態システムの脆弱性がもっとも顕著に現れる「旱魃」を取り上げ、気候･気象的要因と実際の旱魃被害状況について把握するとともに、旱魃によって起こる食料危機に対する早期警戒システムの果たす役割､さらにはこれが人間活動に与える影響について検討する。

（3）地球研のプロジェクトとして

・　何故，地球研のプロジェクトとして実施するのか

地球研のプロジェクトとして研究を実施した場合，今まで他の研究費で実現不可能であった研究内容に挑戦することが可能となる。レジリアンス・プロジェクトでは，森林伐採実験，広範囲での農家世帯調査と圃場レベルの土壌・降雨量データ収集をプロジェクト全期間に渡って実施する予定である。特に社会・生態システムのレジリアンス研究には多分野の研究者の参加が必要であり、地球研プロジェクトとして学際性を発揮したい。

・　「地球環境問題」の認識

環境資源に生産活動を依存する人々は環境変動に対して脆弱な生活を営んでおり，それが貧困と環境破壊の悪循環の原因となっている。この悪循環は重要な「地球環境問題」として認識され，2005 年 3 月に開催された環境開発大臣会議でも特にサブサハラ・アフリカ地域での人間環境に対する地球温暖化の影響調査の必要性が強調された。そこで，本プロジェクトでは国際社会で重要な「地球環境問題」と認識されている半乾燥熱帯地域での環境変動の影響と人間社会のレジリアンスについて考察する。

・　対象地域と「地球環境問題」の関係

本プロジェクトは南アフリカ地域（ザンビア），西アフリカ地域（ブルキナファソ），及び南アジア（インド等）の半乾燥熱帯地域を調査対象とする。この地域では，貧困な人々の人間活動に原因する森林破壊や砂漠化などの地球環境問題が顕著に現れており，その問題解決のため，「人間の安全保障」としての食糧安全保障やレジリアンスの向上、貧困削減が緊急の課題となっている。

・　プロジェクトの成果がどのように「地球環境問題」の解決に資するのか

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，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。現地での測定，観察，分析を通してレジリアンスの鍵となる指標を検討し，その指標を用いて生態系と資源管理へのオプションを提示する。

（4）「総合性」「学際性」の実現

・　方法・体制などの特徴と問題点

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。今後の活動への参画を望む研究分野は人類学，社会学，森林生態学，農業気象学，保健衛生学等。他のプロジェクトとの連携として，同様の関心・目的を持つプロジェクトと合同でワークショップを開催する。

（5）具体的提言に向けて

研究成果を本や論文として出版し，ワークショップや国際学会などで発表すると同時にホームページで発信する。IHDP 等の国際的研究コミュニティーに積極的に参加する。ザンビア国内での関係者とのワークショップにより研究交流・議論を深め成果を提言する。

２．進捗状況

（1）今年度までに明らかになったこと

・　研究体制の構築

－ザンビア農業研究所と MOU の締結交渉を行い合意に達した。今年度中に締結予定。

－研究協力機関（ザンビア大学社会経済研究所，金融国家計画省中央統計局，国土省測量局，Food Security Research Project, 通信交通省気象局）等の関係者と面談し，研究協力の同意を得た。ザンビア脆弱性評価委員会(Zambia Vulnerability Assessment Committee)と意見交換した。

・　方法論の検討成果

文献調査およびフィールドでの観察，予備的聞き取り調査によりレジリアンス研究のためにターゲットとするべき調査項目の特定を行った。

・　予備調査等の成果

－2006 年 6-7 月のザンビア調査では，テーマ I において実施する野外試験の適地をザンビア東部州ペタウケ郊外に選定し、現地住民・行政機関からの使用許可を得た。さらに、来年度から設定する各処理区を適切に配置できるよう、該当地域の土壌特性の空間分布を明らかにしつつある。テーマ I はテーマ II と密接な連携を取ることを確認した。

－2006 年 8 月からメンバー2 名が南部州の村落に居住し農村での労働移動、旱魃対応等の聞き取り調査を実施し、農作期が終了する 2007 年 6 月まで継続する予定　（テーマ III）。

－2006 年 8-9 月の調査（テーマ IV）では、南部州において衛星画像と実際の地上との対応による現地調査を実施するとともに、土地利用変化の顕著な地域において過去の土地利用状況などの聞き取り調査を実施した。大陸レベルにおける植生被覆の変化パタンを低分解能ではあるが時系列に観測された衛星画像データを用いて抽出した。また、国レベルでの植生被覆領域に対する旱魃の影響について中分解能衛星データを用いて行った。さらに、全国に散ら

ばる気象観測点で観測された降水量のデータ解析から、旱魃年に特異な降水パタンを見出した。

－2006 年 11-12 月のザンビア調査では, 医療関係機関を訪問し、旱魃時には出生体重が 2.5kg を下回る率が上昇すること、また農村地帯での HIV/AIDS 患者の現状を情報収集した。

－人間活動については、人間の安全保障といった観点から、特に食料安全保障に対する世界的取り組みや、比較的調査が容易なエチオピアの食料援助や早期警戒システムに関する調査を実施した。

－7 月 2 日に Prof. Elinor Ostrom によるセミナーを地球研で開催し内外から多くの参加者を得て資源管理制度について意見交換を行った。(Developing Methods for Institutional Analysis: Institutional Diversity in Resource Management)

－レジリアンス研究会を今年度５回 (7/2，7/25，10/2，11/9, 2 月末) 実施予定。

（２）当初計画から変更・追加された点

－旱魃の影響は乳幼児に顕著に現れるため、乳幼児の身体計測、保健衛生に関する情報収集にもターゲットを向けることが重要と思われる。

（３）評価委員会から受けた指摘に対する対応

－対象地域が大きすぎるとの指摘を受けたが大陸レベルなのは気候のみでその他の主要な調査はすべて地域・村落レベルで行う。

－ブルキナファソとインドの３ヶ所で研究を実施する理由を問われたが、ザンビア以外の SAT 地域の２国を加えることで人口や土地その他資源賦存量の違いによるレジリアンスの形成要因を考える。

－関連文献のレビューを示唆されたが、これは今年度の PR 報告書に取り込む予定。

３．今後の活動

（１）今後取り組むこと

・ プロジェクトとしての成果

－調査内容の重点項目を明確化し、今年度中に次年度からの調査計画を作成する。

－テーマごとの文献レビュー・調査計画を作成する。

（２）活動内容

－収穫予測調査のうち南部州と東部州のサンプル世帯へ 2007 年 1 月に追加調査を実施。

－2007 年 3 月までに東部州ペタウケ郡と南部州シナゾングェ郡の集中調査村の決定を行う。

－2007 年 3 月までに PR 報告書を作成する。

（３）研究遂行上の問題点と解決策

－足りない分野（救荒作物、農村地域のエネルギー等）での人材の確保（ザンビア、日本）

－観測・調査のためフィールドステーションの設置を今後検討する。

（４）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	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

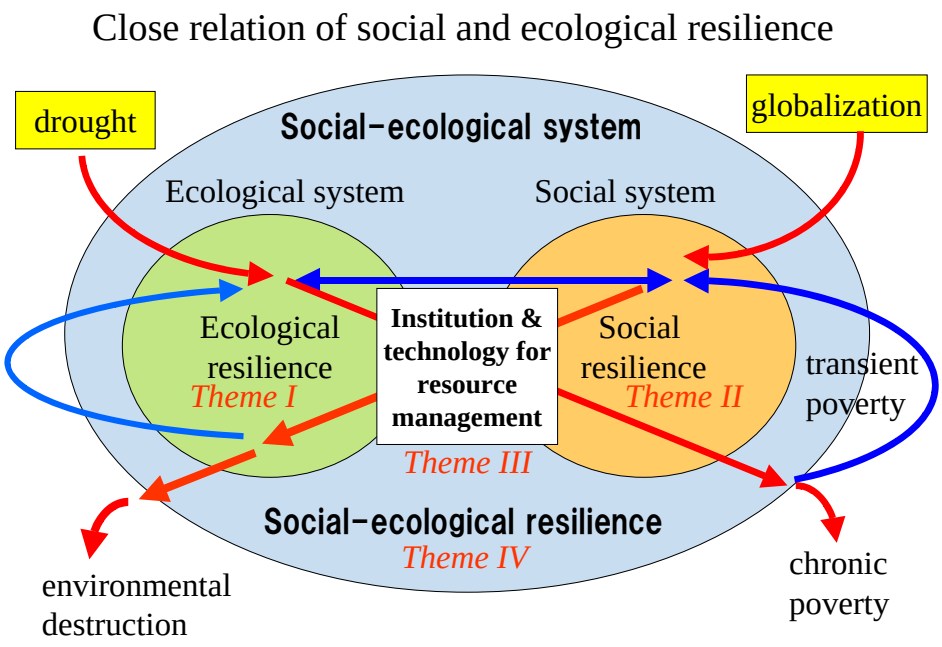

Figure 2. Regions of Semi-Arid Tropics

１－3PRプロジェクトメンバー表 （平成18年度）

	氏名	フリガナ	所属	サブ所属	職名	専門分野	役割分担
ﾘｰﾀﾞｰ	梅津　千恵子	ウメツ　チエコ	総合地球環境学研究所	研究部	助教授	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	総合地球環境学研究所	研究部	助教授	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	助手	土壌資源学	土壌有機物の分解・肥沃度測定
○	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	助教授	境界農学	土壌劣化の経時的計測
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	Theme II						
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	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
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	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
	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						
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	飯塚　裕貴子	イイツカ　ユキコ	内閣府国際平和協力本部事務局		研究員	開発学	早期警戒システム
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	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
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	C.R Ranganathan		Tamilnadu Agricultural University	Department of Mathematics	Professor	数理モデル	社会経済モデル分析
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	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

○＝コアメンバー; A = アドバイザー

テーマ I　報告概要

真常　仁（京都大学大学院農学研究科）

テーマ I-1 では来年度から実施する野外試験の適地をザンビア東部州ペタウケ郊外のミオンボ林に選定し、現地住民・行政機関からの使用許可を得た。さらに、試験において設定する各処理区を適切に配置できるよう、該当地域の土壌特性、大径木の空間分布について調べた。その結果、当地域の土壌は、ほぼ中性の pH を示す粗粒な土壌であり（Table 1, 2)、既往の研究が同一植生下の土壌について報告している値とほぼ一致していた。プリンサイトと呼ばれる未固化の鉄石が概ね30cm深から出現し、植物生育に有効な土層が薄いことから、野外試験において実施する毎年の耕作活動によって植物生育が急激に低下する可能性がある。

林内の土壌とその近隣の畑土壌の間には、全窒素や全炭素含量を除いては大きな違いが認められなかった（Table 1)。全窒素・全炭素含量は有機物含量を表し、畑地では耕起によって有機物の少ない下層の土壌が表層に混入したために、林内の土壌に比べ低い含量を示したと考えられる。

林内 100 地点の土壌について特性値間の相関分析をしたところ(Table 3)、土壌有機物含量の指標である全炭素・窒素含量が多いほど、仮比重が小さかった。試験地で得られた値の範囲で言えば、仮比重が小さいほど、土壌の保水性や透水性といった物理性が良好であるから、土壌有機物が良好な物理性の確保に重要であるというこれまでの多くの知見に沿うものであった。また、pH と全炭素・窒素含量の間に正の相関があったことは、植物によって深層から吸収された養分が落葉落枝の形で地表に還元されることで、表層土壌の養分と有機物含量が富化し、pH が上昇したためと考えられる。このように、土壌有機物が土壌の物理性、養分供給能に大きく影響していることが示唆され、土壌有機物の分解速度を評価するために土壌呼吸速度を測定する我々の研究計画の妥当性を支持するものと考えている。

ジオスタティスティクスを用いて、土壌特性値の空間分布を解析し図化した。EC（電気伝導度）と全窒素を除いては、試験地内におけるばらつきはいずれも小さく、ほぼ均一であった。全窒素では、4 地点が他の地点に比べ極めて大きな値を示した。それらの地点は炭焼きの跡やシロアリの巣が確認された場所であり、処理区から除く必要がある。以上の結果から、試験に用いる土地として、大径の Brachystegia 属が出現し、かつ EC と全窒素が均一な地域を抽出することができた（Fig. 4d)。

テーマ I-2 では、テーマ II と対象世帯を共有して来年度より調査を行うことを確認した。但し、作物の収量を規定する環境要因を特定するための栽培試験を対象世帯の畑で実施すると、家計調査への攪乱要因となる。そこで、本栽培試験には、対象世帯の畑に隣接する対象世帯以外の畑を借用することとした。また、栽培試験には、広範囲にわたる地域で生育可能なイネ科牧草の利用を予定している。栽培試験を実施する畑、テーマ II の対象世帯の畑の双方で、土壌特性値、雑草の種構成やバイオマス量を調べる。

サブサハラ・アフリカにおけるショックと貧困

―ブルキナ・ファソにおける実証―

櫻井　武司（農林水産政策研究所）

ブルキナ・ファソの南隣のコートジボワールでは，2002 年 9 月に政府軍兵士の反乱が勃発し，国土を南北に分断する内乱状態となった。その結果，コートジボワールに住むブルキナ・ファソ出身者の多くが帰国を余儀なくされた。ブルキナ・ファソはサハラ砂漠の南側の半乾燥地帯にあり，一般的に農業生産性は低く不安定である。そのため，同国の農村は伝統的にコートジボワールに移民や出稼ぎ民を送り出しており，移住した家族や親類からの送金および季節出稼ぎ収入が重要な現金収入源となっている。したがって，コートジボワールに発生した内乱はブルキナ・ファソの農村部に予期せぬ収入の減少をもたらした。また，帰村者を受け入れた村は，予期せぬ人口圧の増大も被ったことになる。こうしたショックが，そうでなくても貧困状態にあったブルキナ・ファソの農家家計の経済厚生にどのような影響を与えたかを解明することが本研究の課題である。

分析には，国際農林水産業研究センター（茨城県つくば市）とワガドク大学（ブルキナ・ファソ国ワガドク市）が共同で作成したパネルデータを利用した。このパネルデータは，ブルキナ・ファソのスーダン・サバナ地帯南部（700mm）の 2 つの村から選んだ 64 農家を対象に 1999 年から 2004 年までカバーしており，毎年，収穫後，乾期，農繁期の 3 回の調査を実施したものである。その間の 2002 年にコートジボワール内乱が発生した。

まず，コートジボワールの内乱に起因するショックが家計レベルで観察されることを確認した。内乱前後を比較すると，家計サイズが有意に増大し，送金受取額が有意に減少している。次に，このようなショックに対する家計の対処行動を明らかにした。まず，帰還者の増加は家計の耕作面積を有意に拡大し，ブルキナ・ファソ国内からの送金受け取りを有意に増大させていた。耕作面積の拡大は，大人 1 人当たり 0.7 ヘクタールである。一方，コートジボワールからの送金受け取りの減少は，非農業活動からの収入を有意に増やしている。以上から，送金受け取りの減少は農業生産や国内からの送金では代替できないことが示唆される。なお，家畜の売却に関しては，帰還者の増加，送金受け取りの減少，いずれにも反応していない。

農家家計によるこのような対処行動があるにもかかわらず，家計の消費水準はショックの影響を受けている。送金受け取りの減少は，有意に家計の 1 人当たりの消費支出を減少させていた。しかし，帰還者の受け入れについては，1 人当たりの消費支出に影響がない。後者は，耕作面積の拡大や帰還者自身の持ち帰った資金などにより対処できているものと思われる。農家家計を家畜資産の多寡により 2 グループに分けて分析したところ，送金受け取り減少のインパクトは，資産少ない農家家計でいっそう強かった。以上から，家畜資産の乏しい農家家計ほど，同時発生ショックに対して脆弱であることがわかった。

社会的脆弱性の分析試論

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はじめに

生態的・社会的レジリエンスを考える前に、社会的レジリエンスについて検討してみたい。その場合に、社会的レジリエンスを生態的レジリアンスとまったく切り離したところで検討することは、両者の関連性の中で考えるという本プロジェクトの新しい試みを最初から放棄することになりかねないので、そうならない保証として、自然的イベントと関係した社会的レジリアンスに焦点をあてて検討してみることにしたい。そのため、本稿で取り上げる事例は干魃による社会的インパクトとそれに対する社会的レジリエンスが中心となる。

しかも本稿では議論をさらにレジリエンスが働く前段とも言える社会の脆弱性といった点に焦点をあててみたい。それは、社会的レジリエンスという概念がそもそも、「ある異常で危機的状態からの回復能力および回復過程」を意味すると思うのであるが、そもそも「ある異常で危機的状態」とは何かを見定めておかなければ、そこからの回復能力も回復過程も分析できないと危惧されるからである。その「異常で危機的状況」を、ここでは自然的イベントに起因する社会的脆弱性増大という状態だと仮託して議論を進めようということ考えたわけである。

1．2 つのレシリアンス

社会のレジリエンス（回復能力）とはどのように考えるべきなのであろうか。我々はここ二年間そのことについて議論し、検討してきた。その中で明らかになってきたことは、社会のレジリエンスを考える時に、大きくわけて 2 種類のレジリエンスがあることを念頭にいれて考える必要があるという点である。

その 2 つとは、(1)ある社会の状態 A が、何らかの自然的、あるいは社会経済的変化の影響を受け状態 B になり、しばらく後に再び状態 A に復帰するという意味でのレジリエンス（A→B→A）と、もう 1 つは、(2)状態 A が、何らかの自然的、あるいは社会経済的変化の影響を受け状態 B になり、しばらく後に状態 C になる、という意味でのレジリエンス（A→B→C）である。この場合に、A と C はともに B よりも、「好ましい」状態であることを前提にしている。だから、B→A も B→C も「好ましい」状態への回復と考えられるわけである。そしてそれが可能なシステムのことをレジリエンスと呼ぶのである。

通常レジリエンスといえば、(1)の回復プロセスがイメージされやすい。特にアフリカの農村社会のレジリエンスといった場合に真っ先に浮かぶことは、豊かな自然に囲まれた農村社会の「回復」能力である。アフリカの農村社会研究で多くの成果を上げてきた生態人類学は、その様な社会がもつ回復能力の巧みさが、人間と自然との関係の中や人間社会の中に豊かに組み込まれていることを明らかにしてきた。

しかし他方、アフリカの歴史を少し遡ればすぐに分かることであるが、植民地時代から現代まで、アフリカの農村社会は常に(2)のレジリエンスを要求され続けてきた。輸出換金作物生

産の奨励、土地所有の近代化、改良品種の導入、さらに 1990 年代以降の女性のエンパワーメントもこの(2)のプロセスでのレジリエンスを想定した開発であったといえよう。近代化や開発は、状態 A をまず否定することから始まり、変革 B を経てよりよい状態 C に至るという発展史観に裏付けられている。

それでは開発援助の変換点ともいえる 1980 年代以降のプロジェクト・レベルでの「持続的発展」や「参加型開発」はどうなのであろう。持続的発展や参加型開発は、現状 A の肯定を出発点にしていない点をみれば、それらはやはり(2)型のプロセスを志向しているように見える。しかし上記の(2)のプロセスがそのまま当てはまるかというと、どうも違うようである。敢えて同じように模式的に表現するとすれば、A→A'→A"となるのではなかろうか。もちろんAとA"は同じではないので、(1)のプロセスとは違うが、(2)のようにまったく異なる C になる過程でのレジリエンスを想定していない。それは、持続的発展や参加型発展は、かつての(2)の発展プロセスにおいて「レジリエンスが崩壊」したことの反省があるからである。したがって、1980 年代以降のプロジェクト・レベルでの開発政策は、農村社会が持っているレジリエンス能力の活用、あるいはその能力の範囲内での開発や発展を考えるという考えが前面に打ち出されたものであった。これらの開発戦略は、かつての農地改革のように大規模な社会改革を手段として推進(A→B→C)しようとするもとのとは明らかに異なっていた。つまりこれらの開発は、(1)のプロセスを大事にする発想に基づいているといえる。このような点からみると、「持続的発展」や「参加型開発」は上記の(1)と(2)のプロセスの間で揺らいでいることになる。したがって、現在我々が社会的レジリエンスについて考える時に、上記の(1)と(2)の両方を、しかも地域によってはその間で揺らぐプロセスも視野に入れてレジリエンスを考えなくてはならないということになる。

2. レジリエンスの意味と脆弱性との関係

ここまで当然のこととしてレジリエンスとは「好ましくない」状態から「好ましい」状態への復帰または変化であることを前提に議論を進めてきた。しかし、その「好ましい」状態とはいったいどのような状態なのであろうか。

経済発展論の中では一人当たり所得の増大が目指すべき「好ましい」状態であり、人間開発の中では教育、保健衛生環境の改善などがそれであるとされてきた。しかしそのことが現在揺らいできている。それは、最近の開発援助のあり方がレジリエンスのプロセスの(1)と(2)の間で揺らいでいることと無関係ではない。「好ましい」状態をどのように考えるか、それを達成するためにどのような方法を用いるのかによって、そこにいたるプロセスも変わるからである。

この点について本稿で検討してみたいと思うのが脆弱性という概念である。1980 年代以降、脆弱性は貧困に代わる概念としてその重要性が指摘されてきている。すなわちアフリカの農村社会や農家世帯、そして農民にとって必要なこととして、貧困からの脱出よりは脆弱性の緩和や減少の方がより重要だという指摘である。脆弱性については後で詳しく述べるのでここでは触れないが、もし脆弱性の緩和や減少が「好ましい」目標だとすると、それは貧困削減や教育や保健衛生状況の改善といった「好ましさ」とは、明らかに質が異なるものであるこ

とだけはここで指摘しておきたい。なぜなら、脆弱性はレジリエンス能力と密接な関係があるからである。つまり、レジリエンスという概念そのものの中にすでに脆弱性の概念が組み込まれていると考えられるのである。

先に述べた（A→B→A）や（A→B→C）のプロセスの中における B の状態は、単に所得の減少や失業の増大といった状態を指すのであれば、必ずしも脆弱性概念の重要性を言上げする必要はない。しかし、上記プロセスのなかで想定されている B の状態は、貧困や教育・保健衛生などの指標で表されているものの背後に存在する、社会の全体的変化、とりわけ何らかの悪い方向への動態的変化を意識しているものであり、それはこれから述べる脆弱性概念と深い関わりがある。ある社会の脆弱性が社会のレジリエンス能力によって緩和され減少されたとすると、それはレジリエンスの結果「好ましい」状態になったことを意味する。と同時に脆弱性の減少は、その後の社会システムのレジリエンス能力を高める可能性が高いといった、相互依存関係にあるのである。

したがって、社会のレジリエンスのメカニズムを解明するということは、社会の脆弱性増大と減少のプロセスを明らかにすることでもあると言えるのである。本稿で、社会のレジリエンスを考えるための一手段として、社会の脆弱性について検討するのはこのような理由からである。もちろん、この一見迂遠にみえる方法をとることの最大の理由は、分析しやすさにあることは言うまでもない。脆弱性緩和のプロセス（B→A や B→C）は脆弱性増大（A→B）のプロセスよりも捉えにくい。干魃や政治的混乱で社会がどのような脆弱性増大に直面しているかは把握しやすいが、「脆弱性が大きい」状態からそれが緩和・減少される過程を捉えることは難しいのである。そもそも「脆弱性が大きい」状態をどのように定義するかという問題が先ずあり、しかもそれからの緩和・減少のプロセスは一般的に脆弱性増大プロセスより時間がかかるものであり、緩慢であるからである。

3. 脆弱性の主体を地域レベルで考える

脆弱性の方がレジリエンスよりも把握しやすいと言ったものの、その意味を正確に捉えてみようとするとそれが非常に複雑であることがわかる。複雑さをもたらしている一つの理由は、脆弱性増大の主体を何に想定するかによって、脆弱性の意味が異なってくるという点にある。つまり、個人にとっての脆弱性なのか、世帯にとっての脆弱性か、あるいはもっと大きな集団にとっての脆弱性なのかという主体の違いによって脆弱性の意味も異なってくるということである。これは次章で述べる脆弱性の定義とも密接に関係してくるので、それ自体でも議論をしても意味がないのであるが、論旨をわかりやすくするために、先ずは便宜的に、地域社会、世帯、個人の 3 つの主体に分けて、脆弱性といった問題がどのように議論されてきたのかみていきたい。それぞれの主体の脆弱性は相互に非常に複雑な関連性をもっており、単純な入れ子構造として理解できるものでもなさそうである。

ウォルデ・マリアム(Wolde Mariam 1986)はエチオピアの小農の脆弱性といった問題について考察を行った。そこで彼が対象としたものは、ある地域社会の中の小農であって、個別の小農世帯や農民にとっての脆弱性ではなかった。彼は、エチオピアの農村社会がどのようにして飢饉に陥るのかを研究して、その原因を社会経済的要因に求めた。彼は、豊かさ

のまっただ中にある一部の地域社会が慢性的な栄養失調状態にあることを飢饉とは言わないこと、さらに純粋に政治的軍事的大変動が原因で起きた食糧不足問題も飢饉とは呼ばないとした。また普通の食糧不足も栄養不足も飢饉とは呼ぶべきではないとした(Wolde Mariam 1986:4)。

彼は、デ・カストロ(De Castro 1969)の栄養不足をもとにした飢饉や、慢性的な食糧不足から飢饉を定義しようとしたルネ・デュモン(Rene Dumon)の両方[1]を否定し、次のように飢饉を定義した。すなわち、飢饉とは単なる食糧不足ではなく、絶対的な欠乏状態を意味し、食糧の質など問わなくなる状況であるという。飢饉になると人々は野生の根っこや木の樹皮、さらには食べられるものならば何でも食べるようになる。有毒植物や種子、さらには古い牛皮をも粉にして食べるようになるという(Wolde Mariam 1986:8)。

干魃は気候学的現象であって必ずしも飢饉に結びつくものとは限らないことを彼は強調する。飢饉は、人々が基礎代謝に必要なエネルギーを補充することができず、身体に蓄積されていたエネルギーを消費し、自分の身体を消耗することによって死に至るような、最も絶望的な食糧消費状態を意味する(Wolde Mariam 1986:9)という。それは、かなり広い地域で数ヶ月間続く耐えがたい飢えをもたらし、その地域の農村社会で大部分の人に影響を与える。このため飢饉は、大規模な社会的な無秩序状態を生み、大量の人を死にいたらしめるものであるという。

こうしてウォルデ・マリアムの飢饉に対する脆弱性は、社会システムの問題として議論されるようになるのである。彼の脆弱性の定義については後で述べるが、彼はこのような社会システムの問題と考えることによって、地域社会、彼の場合はエチオピアの小農社会における脆弱性を明らかにしようとしたのである。そしてエチオピアの小農たちは、不利な自然的要因による食糧不足で飢饉に陥る前に、まずもって社会経済的・政治的諸力によって飢饉に対して脆弱にさせられていると理解したのである[2]。

同様に、脆弱性を地域社会レベルで述べたものとして、ワッツ(1993)やスティーブン・デブロー (1999)の研究がある。ワッツは、北部ナイジェリアにおける干魃と食糧不足、飢饉との関係を、19 世紀から1980 年の長きにわたり分析し、資本主義の展開の中で小農が干魃などにたいする危機対応能力を喪失してきている過程を明らかにした。その過程はさまざまな出来事が積み重なって進行する。例えば商品作物生産の導入が協同労働組織ガンド(gandu)の弱体化をもたらし核家族の独立性を強め、それが危機における対応能力を低下させている。また、前貸し制度により下層農民がより一層貧困化し飢饉に対する対応力を低下させてきたという。さらに植民地支配がパトロン・クライアント関係を弱体化させ、地域社会の脆弱性を高

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1 デ・カストロは、世界で毎年死亡する 6000 万人のうち 3000 万人から 4000 万人が栄養失調による死だという。ここでいう栄養失調とは、カロリー不足とタンパク質不足を含めている(De Castro, Jose (1969) The black book of hunger, Beacon Press, Boston)。さらにルネ・デュモンは 6000 万人の死者のうち飢饉による死者は 1000 万人から 2000 万人だと推計した。ルネ・デュモンの飢饉の定義は、「人々の肉体的・精神的能力を衰退させ、最終的には早期の死を迎えるような慢性的な食糧不足」というものであった。

2 彼は、この本を書いた目的は、飢饉が社会経済的混乱と政治的無責任の結果であることを解明するためであると明言している。(Wolde Mariam 1986:14).

めてきたという。

さらにワッツは、北部ナイジェリアの小農地域では、世帯単位では常時飢饉の危険性に晒されているのにたいし、村単位の飢饉は 4、5 年に 1 回、地域的単位の飢饉は 7～10 年に 1 回の割合で起きているということを発見した(Watts, 1983)[3]。これには地域的範域の大きさによって脆弱性増大を引き起こす自然的リスクの大きさが異なっていることを意味している。このことは、地域社会といっても、脆弱性について議論するときには、どのような領域の社会を対象としているのか限定しておかないと、危険であることを示唆している。

4. 世帯レベルの脆弱性

世帯単位の脆弱性については、チェンバースとスウィフトが分析している。チェンバース(Robert Chambers 1989)は、個人や家族単位の脆弱性(Vulnerability)に焦点をあて、その定義を試みた。彼は、脆弱性は、欠乏(lack)や不足(want)を意味する貧困(poverty)と同じなのではなく危険性(risk)や衝撃(shock)、緊張(stress)に対して無防備(defenceless)で、安全性に欠け(insecurity)、それらに晒されている状態(exposure)を意味すると言った(Chambers 1989)。したがって、脆弱性の対極にある言葉は安全(security)である。

脆弱性について考える時はしたがって 2 方向からアプローチが可能であるという。まず 1 つは、個人や家族が晒されているところの外的要因からのアプローチ、すなわち危険性や衝撃、緊張などの検討であり、もう 1 つはそれらの外的要因に対処する能力、つまり損失(loss)なしには対処することができない無防備性(defencelessness)という内的要因の検討である。ここでいう損失とは、身体が弱くなったり、経済的貧困から社会的依存者になったり、屈辱や精神的損害を受けたりする、といったことを意味する。

脆弱性の定義を確立せず貧困との区別を曖昧にしておくと、結局は計測の簡便さから、所得や消費量によって定義される貧困とほぼ同義と捉えられ、結局は無視されることになる。そうなると貧困の指標の方が、喪失(deprivation)を示す諸指標として脆弱性を含むものとして利用されることになり、結局真の意味での脆弱性の追求がなされなくなることをチェンバースは恐れる。

ところで、上記のように定義される脆弱性は、貧困よりも純資産(net assets)との関連性が強い。たとえば、低所得という意味での貧困は、借金や投資によって減少させることができる。しかしそれによる借金はより一層家計の脆弱性を高める。貧しい人々は借金をすることを恐れており、専門家よりは貧困と脆弱性との間のトレード・オフの関係に敏感である[4]。脆弱性を減少させる、すなわち安全性を高める計画や政策は、貧困を減らす、すなわち所得を増やす計画や政策とは同じではないのである。

脆弱性が貧困よりも純資産（財産）との関連性が強いと言ったのはスウィフト(Jeremy Swift)

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[3]この書評は、拙著(1985)『アジア経済』26 巻 12 号 82-87 頁にある。

[4] チェンバースは、地方の計画や政策を改善するためには、地元の貧しい人々が、自分たちで決めたローカルな考え方や優先順位に基づいて行動することを勇気づけ、その実現を可能にすることが必要だと主張する。その様な認識からチェンバースらは 1988 年 9 月に IDS で脆弱性や対応(coping)に関する研究会を開催し、貧しい人々はどのようにして危険性や衝撃、緊張に対処しているか、政策や研究の優先順位はどこに置かれるべきかを議論した。

である。彼が言う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の時に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、飢饉の脆弱性と密接な関連のある世帯の財産を後で詳しく述べるように暫定的に、投資(investments)、貯蔵(stores)、請求(claims)の 3 つに分けて説明した。

スウィフトのいう広義の財産に対する請求権は、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。またセンのエンタイトルメントの主体となっているのは個人であるのに対し、スウィフトの請求権の主体は個人と家族となっていてこの点でも違う。

地域社会や特定の集団の脆弱性ではなく世帯の脆弱性を問題とすると、封建的支配構造やパトロン・クライアント関係といった社会的関係は、財産とそれに対する請求権に分解されて立ち現れる。それによって小農一般の脆弱性といった問題は視界から消え、世帯ごとの財産のあり方やそれに対する請求権のあり方が前面に立ち会われることになる。もちろん個人や世帯の財産のあり方は、社会構造を当然反映するものなので、地域社会の脆弱性や地域集団の脆弱性は世帯の脆弱性とも密接な関係を持つ。

しかし、地域社会や地域集団の脆弱性と世帯の脆弱性との関係が捻れてみえるケースも見られる。難民キャンプにおける難民世帯と、その受け入れ社会であるキャンプ周辺の農村部の農家世帯との関係である。集団としてみた場合、難民の脆弱性は援助の対象となる程厳しいものである。しかし難民キャンプにある難民世帯とキャンプ周辺にある受け入れ社会の農村世帯の財産への請求権を比較すると、前者の方が後者より確実で安全な権利を持っていることが多いのである。

また、西アフリカのサヘル地帯の農村はおしなべて南部の沿岸部森林地域の農村より脆弱性が高いといわれる。しかし、南部沿岸地域への出稼ぎが常態化しているこの地域の各農家世帯の脆弱性を考えると、サヘル地帯の変動幅の大きい自然条件のみを念頭に置いた脆弱性概念は見直しを迫られる。出稼ぎはサヘル地帯の農家世帯が変動幅の少ない他の気候帯の資源へのアクセスを獲得する行為といえ、この地域の農村世帯の脆弱性増大を緩和しているといえる(島田 2001)。農家世帯の脆弱性を、それを取り巻く地域的生態環境の中で閉鎖系として考えると、各世帯が外の環境との関連性のなかで持っている脆弱性緩和の能力を見失ってしまうということになる。つまり、ある地域社会の脆弱性は、その地域にある個別の世帯の脆弱性の単純な積算では見えてこないということである。

5. 個人レベルの脆弱性

アフリカにおける研究で、個人の脆弱性について一番研究が進んでいる分野はジェンダー研究である。多くのジェンダー研究が、アフリカにおける家族内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、もっと直裁に開発援助による換金作物生産導入の計画が、結局は男性の換金作物生産への特化、女性の食糧作物の負担の増大を引き起こし、現金所得の上昇分も男性が占有し女性には労働強化が実現しただけだという指摘もある。

また、個人を対象とした脆弱性に関しては最近問題になっているのは、HIV・エイズの感染拡大によって寡婦や孤児が増加し、彼女たちの社会的経済的環境が非常に悪くなっているという指摘である。寡婦や孤児たちがその脆弱性を増す理由は、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からである(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、このように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のである(FAO 2004)。

ところで、個人の脆弱性増大と家族の脆弱性増大との関係について、一つの議論がある。それは、家族の中で最も脆弱な対象であると思われる女性と子供のみを援助のターゲットにすることの効果をめぐって起きた議論である。女性と子供のみを主たるターゲットとした食料援助よりも世帯(全員)を対象とした食料援助のほうが結局は他の家族の健康状態も良いとする報告をめぐるものであった(Pryer 1981)。世帯を対象とした食料援助では当然のことながら世帯主(男性)がその援助の主たる受け手となる。つまり、世帯の主たる稼ぎ手(Bread Earner)の健康の方が、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家族全体の健康にとって有利であるという意見である。もちろんこれには反論もあり、世帯主への梃子入れは妻や子供の健康の保持にまったく効果がないという意見もある。

6. 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(または拡大家族)にするのかあるいは地域社会や地域集団にするかで脆弱性の内容は異なってくる。

しかし、脆弱性論の中でこの点に常に注意が払われてきたわけではない。たとえば、脆弱性の空間モデルで提示したワッツ&ボール(Watts & Bohle 1993)は、社会の権力構造、階級構造の中の社会集団に注目したため、この空間モデルでは「ある地域」の農村社会というよりは、「ある社会」の小農や小作、農業労働者といった社会集団に焦点があてられた。このため彼らの脆弱論においては、例えばある社会において小農が脆弱な集団だと思われる場合は、その社会では世帯単位でも小農は脆弱であると想定されている。つまり先に述べた集団のスケールの違いによる捻れ現象は見られないのである[5]。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を考えているのである。

このような捉え方だけでは、人間社会の脆弱性が、それを取り巻く生態環境の脆弱性と密接な関係のもとにあることを追究しようとする社会的・生態的レジリエンス研究には役立たない。なぜならそれは人間社会の脆弱性の問題を、既存の社会科学の枠組みの中で議論しているといえるからである。つまり、自然的要因たとえば干魃は、社会構造に働きかける外在

[5] この点についてはワッツ(1983)についても同様なことが言え、脆弱性の地域的差異や歴史性の重要性を述べているにもかかわらず彼の脆弱性理解が社会構造重視であることが、ベリーやリチャーズなどによって批判されている。この点については、拙著(1985)参照。

的存在として捉えられ、個人や集団の脆弱性はその社会構造を通して間接的に影響を受けるものと想定されている。

このことは、社会集団を、ある特定の生態環境の中の地理的集団として見るか、あるいは社会構造の中で定位しうる社会的集団としてみるか、という違いとも関連する。1 つの農村社会を生態環境の中の存在として見ると、その中には地主も小農も小作も、そして農業労働者もいる。地主、小農、小作などがそれぞれ直面している脆弱性は、もちろん同じではない。そのような農村社会内部での差異は、その農村社会が全体として他の農村社会より脆弱な社会であるかどうかにかかわらず存在する。地域間比較の中で相対的に脆弱な地域とされた農村社会の中に脆弱性とは関係のない世帯が存在する可能性が大いにある。その逆も可なりである。こうしてレベル間の脆弱性に捻れが生じるのである。

このような集団間でみられる捻れ現象を正確に理解するために、各レベルにおける脆弱性がどのような形で存在するのかをまず明らかにしておく必要がある。人間は、個人として、あるいは世帯や社会集団として、それぞれの仕方で自然に働きかけを行っている。もちろん個人は世帯の中で、世帯は社会集団の中で存在し、それらの間でも相互に働きかけが行われている。自然に対する関与は社会集団だけではなく、その構成要素である世帯単位でも、さらにその構成要素である個人単位でも行われている。したがって社会・生態的レジリエンスを検討するということは、個人から社会集団までの各レベルの社会的存在と生態環境との関わりを、まずは各レベルで個別に観察し、その後に個人、世帯、社会集団の間の相互関係、とりわけ捻れ関係を確認する必要がある。それによってあるレベルの脆弱化が他のレベルでの脆弱性緩和として作用している場合や、その逆の場合があることを理解することが必要である。個人と自然との関わりは社会的に規定されるが、しかしそれは、個人と自然との直接的関わりを否定するものではない。

7. 各レベルの脆弱性

最初に個人レベルの脆弱性について考えてみたい。個人レベルの脆弱性を規定する最も基本的なものは世帯内における権力関係である。これまでアフリカ研究の中で取り上げられてきた個人の脆弱性問題の中では、農家世帯の中の女性や子供の脆弱性増大が一番多く問題とされてきた[6]。その中で女性たちが、夫の死亡に際して土地へのアクセス権を失い、場合によっては家財の相続権も失うことがあることを指摘している。また、女性たちは換金作物生産から遠ざけられており、男性が現金収入源をより多く確保していることも指摘されている。このように、女性たちに脆弱性の増大をもたらしているのは、彼女たちの資源へのアクセスを規制している、婚姻制度、相続制度、土地制度といった制度や性別分業などにみられる慣行であるという。したがって、農村地域における個人レベルの脆弱性を見るためには、これらの社会的諸制度や慣行を丹念に観察することが必要となる。

次に、世帯あるいは拡大家族レベルの脆弱性についてであるが、これについてはスウィフ

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6 センのエンタイトルメントの概念においても、世帯レベルでのエンタイトルメントがいかにして世帯構成員のエンタイトルメントに移しかえられるかという問題が重要な問題として残っていることをスティーブン・デブロー（1999：101）も指摘している。

トが定義しているように広義の財産（投資、財産、請求）という概念が有効であろう(Swift, 1989)。スウィフトは財産を、有形無形の価値の貯蔵および危機の時に頼りにすることができる援助要求(claims to assistance)を意味するものとして広義に捉えた。そして彼は、飢饉の脆弱性と密接な関連のある、世帯の財産を暫定的に、投資(investments)、貯蔵(stores)、請求(claims)の 3 つに分けて説明した。

(1)投資には、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）などがあるという。

(2)貯蔵としては、食糧の保存や、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)請求としては、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まれるという。

ここで使われる請求という概念は集団内部での再分配プロセスと密接な関係がある。アフリカでは集団に帰属していることが即ち資源分配の権利や必要な時に支援を得る権利を含んでいることが多い。さらに請求には、より上部の社会的レベルにたいする請求も含まれている。例えば集団労働グループへの働きかけや食糧共同分配や共同倉庫の要求、さらには雨乞いセレモニーや共同物乞い（食糧不足時の金持ちへの支援働きかけ）などである。このようにみると世帯レベルの脆弱性を見る場合に最も重要な観点は、共同労働、共食関係（共同分配）、相互扶助・互助制度、貸借関係、そしてより上部組織に対する要求運動などであるといえよう。

そして最後に社会集団の脆弱性についてであるが、ウォルデ・マリアムが言うように、それは社会的システムと関係しているといえよう。彼は、エチオピアにおける小農の、飢饉に対する脆弱性は社会的システムによって生み出されたものであると主張する。その社会的システムとは、遊牧民(nomadic pastoralists)を含んだ小農(peasant)世界、自然の力(natural forces)、社会経済的・政治的力(socio-economic and political forces)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的・政治的な力に抑圧され搾取されているという(Wolde Mariam1986: 11)。したがって彼らが営んでいる自給的生産とは、単なる消費のための生産を意味するのではなく、リスクや抑圧、搾取などを含んだ生産であると理解すべきだと述べている。

自給的農民たちは、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おり、その後に残るのはせいぜい 6 ヶ月から 9 ヶ月の食糧でしかなく、穀物や現金を貯蔵することはできない。彼らはいかなる権利も与えられていないにもかかわらず、驚くべき数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というのである。農民たちは、不利な自然的要因による食糧不足で飢饉に陥る前に、まずもって社会経済的・政治的諸力によって飢饉に対して脆弱にさせられているというのである[7]。

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7 彼は、この本を書いた目的は、飢饉が社会経済的混乱と政治的無責任の結果であることを解明するためであると明言している(Wolde Mariam1986: 14)。

以上みてきたように各主体の脆弱性を増大させる要因は異なる。当然のことながら脆弱性の現れ方も異なり、それを分析するための対象も異なってくる。最後にそれらの要因と観点を要約して第１図に示しておきたい。

第１図　集団のレベルごとの脆弱性増大の要因、観点

集団のレベル	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	土地へのアクセス権の喪失、 生産手段・財産の喪失 換金作物栽培の可能性	婚姻制度、相続制度、 土地制度 性別分業
世帯レベル	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
社会集団 レベル	地域的飢饉、政治的混乱	社会構造、権力構造 政治制度、開発援助

アフリカにおける脆弱性と対応戦略に関する研究の若干のレビュー：ザンビアにおける調査への予備的考察として

児玉谷　史朗 (一橋大学)

近年、発展途上国の農民等における環境からの影響、それへの対応に大きな影響を与えている世界的な動向として、気候変動と経済のグローバル化の進展が挙げられる。アフリカにおいても干ばつや洪水が頻繁に起きるようになっている。またアフリカ諸国の経済自由化により、人々の生活がグローバル経済に密接に関連するようになり、対応戦略や脆弱性にも影響を与えている。

脆弱性の概念には統一的な定義はなく論者によって違いがある。脆弱性は最も単純には人間集団に対する環境からの影響やショックにさらされる(exposure)程度であるが、exposure だけでなく、より広くショックへの敏感度(sensitivity)や対応能力、回復力を含める概念化が主流である。環境変化への脆弱性は、集団の資源へのアクセスや政治的・社会的状況など、広い意味での政治経済学に関連しているととらえるのが一般的である。

アフリカにおける人々の脆弱性、対応戦略に関する研究は、干ばつなどのショックと食料安全保障（食料不足）に関するものが多い。ジンバブウェ、ケニア、タンザニア、エチオピア等の研究では、近年干ばつが頻発していることと、構造調整政策等による経済政策の変化が、世帯や集団の脆弱性や対応戦略に影響を与えていることが指摘されている。

これら諸国の農民世帯等の研究では、干ばつ時以外の平常時でも自給に十分な食料を生産できない農民が多いことや、対応戦略に重要な役割を果たす家畜の頭数が減少していることが示されている。

脆弱性の程度は集団や階層によって異なることが広く指摘されるが、脆弱な集団としては、高齢者世帯、土地の少ない世帯、女性戸主世帯等が挙げられる。

東南部アフリカの農民等における干ばつへの脆弱性や対応戦略に関する経験的研究では、さまざまな対応戦略が見いだされている。干ばつ時に家畜の売却等の対応戦略によって食料消費水準を維持しようとするのかどうかはセンの研究以来議論があるが、少なくとも一部の農民においては食料消費水準を下げることによって家畜等の資産を維持しようとすることが複数の研究で報告されている。世帯は干ばつ時に多様な対応戦略をとるが、ケニアとタンザニアの農村調査では、多くの活動に分散するよりも、比較的高い収入の見込める活動に特化した方が脆弱性が低いという結果が、報告されている。

エチオピアとジンバブウェでは干ばつ時における食料購入において家畜の売却がきわめて重要な位置を占めた。ナミビアの干ばつでは家畜以外に様々な家財が売却された。エチオピアの事例では家畜を多数持つ世帯は家畜の減少率も大きいが、干ばつ後家畜の価格が上昇したときに売却して収入を得ていることが報告されている。

エチオピアやナミビアの事例では親族集団等の社会関係が干ばつ時の食料等の援助に重要な働きをしている。干ばつによる食料不足時にこのような援助や都市部で働く親戚からの送金が増えることが観察されたが、同じ干ばつの影響を受けた住民の間では援助能力が低下することも報告されている。

最後に、ザンビアの Gwembe の人々の人類学的調査を行った Cliggett の研究を要約し、過去 40 年間における Gwembe の土地利用、家畜へのアクセス、社会制度の変化を跡づけた。

テーマ IV「社会･生態システムに対する統合解析」の概要

吉村充則 (総合地球環境学研究所)

現在、アフリカで起きているもっとも重大な環境問題は、高い人口圧力とそれに伴う過剰な土地利用、さらにこの過剰な土地利用による森林やサバンナなどの生態系の悪化である。元来、半乾燥地帯に適用する多くの栽培作物は、多くが生存条件ぎりぎりの環境に生活しており、これ以上の乾燥化や高温化には耐えられるものではない。一方、アフリカ諸国では、1960 年代以降、干ばつが慢性的に発生しており、これにより栽培作物が大幅に減少し、深刻な食糧不足を招くとともに飢餓が大きな社会問題になった。1960 年代以降に頻発した干ばつは、第一次石油ショックと重なり独立後 10 年余りしかたっていなかったアフリカの多くの諸国に対し経済的だけでなく政治社会にも大きな傷を残すこととなった。この頃からアフリカ各地の降水量は年々減っていき、多くの国々において食料不足は慢性的かつ深刻なものとなり、同時に多くの国々を食料の被援助国とすることとなった。さらに、長引く食料不足は、社会不安を引き起こし、一部の国ではクーデターによる政府転覆も見られる。

このような背景から、本テーマⅣでは、干ばつとそれを取り巻く環境(社会システムに限らず生態システムを含む広い意味での環境)の変化について、いくつかのサブテーマを設定し、異なる時間･空間スケールで異なる目線で追跡することとした。また、異なる視点からとらえられる環境に関して統合する試みも統合解析として実施することとした。

テーマⅣでは、ザンビアの独立後 1960 年代から現在に至る時間を対象として、1) 干ばつがどのようなメカニズムで発生し、どのように問題が顕在化していくのか、2) 干ばつが地域に与える貧困や飢餓といった問題に対して社会あるいは人々はどのようなシステムでこれに対抗するのか、3) 干ばつやそれに対抗する社会システムの変化が結果として人々の生活する場である生態システムに対してどのような影響を与えるのか、などを異なる空間スケールで追跡し、4) 地域レベルにおける干ばつに対する社会･生態システムの対応としてとりまとめることを目的とする。プロジェクトで収集されるさまざまな情報は、すべて空間的な位置を参照にして統合し、共通基盤情報として整備し、共通の議論の土台を作る。ここで扱われる情報は、単に地形や土地利用のような空間的広がりを持つ情報だけでなく、各戸別の聞き取り調査やいわゆる社会経済指標などといった統計資料的な情報も含む。

サブテーマ 1 は、「環境変動のグローバルモニタリング」として、干ばつの発生メカニズムについて明らかにするとともに、乾燥化という問題がどのように時間的空間的に顕在化するかを認識することを目的として、大陸･国と州･村落といった異なる空間スケールで気候･気象変動を把握する。

サブテーマ 2 は、「土地利用変化と生態システムへの影響モニタリング」として、干ばつやそれに対抗する社会システムの変化が生態システムにどのような変化を招いたかを把握することを目的として、テーマ 1 と同様異なる空間スケールで植生や土地被覆や土地利用の変化を把握する。

サブテーマ 3 は、「早期警戒システムと食料安全保障」として、干ばつが地域に与える貧

困や飢餓といった問題に対して、社会や政府あるいは国際機関がどのようなシステムで対応するのか把握することを目的とし、干ばつによって引き起こされる食料危機とその背後にある政治的・社会的要因について分析し、干ばつや食料危機に対する「早期警戒システム」が社会や人々に対してどのような影響を与えるかを明らかにする。

サブテーマ４は、「干ば対応と地域レベルでのレジリアンス」として、サブテーマ１から３および４で得られる成果を統合し、地域レベルにおける干ばつに対する社会・生態システムの対応としてとりまとめることを目指す。

今年度実施した予備解析ならびに予備調査の結果を、サブテーマ１から４についてこれ以下で順に記す。

IV-1：環境変動のグローバルモニタリング

佐伯田鶴(総合地球環境学研究所)

1. 研究の目的

半乾燥地帯に位置するザンビアにおいて、降水は環境を左右する重要な要素である。本サブテーマでは、大陸・国と州・村落の２つのスケールで気候・気象変動を把握することを目的とする。

2. 研究の概要

主として次の２点に焦点をしぼり課題を遂行する。

1）全球気象データを用いて、大陸・国スケールでの雨量変動の時間的空間的特徴を明らかにする。

2）ザンビア国内での雨量観測のデータを収集し解析することにより、州・村落スケールでの雨量変動を把握し、気象学的旱魃が起こった地域と期間を明らかにする。

3. 今年度実施した内容

1）大陸・国スケールでの解析

・全球規模で利用可能な気象データとして、NCEP、ECMWF、JMA の３機関による客観解析データ、再解析データ、及び衛星リモートセンシングによるプロダクト(GPCP、CMAP、TRMM) などが考えられる。

・予備解析として、ERA-40 再解析データ及び TRMM 衛星による観測データを用いて、アフリカ大陸の月積算雨量を求めた。ザンビアにおける旱魃による雨量の減少は定性的に再現できている。

2）州・村落スケールでの解析

・ザンビア気象局による雨量観測データを用いて、年降水量の予備解析を行った。

・南部、東部の４サイトでは、1991/92 の旱魃年に加え、1994/95 年にも雨量の減少が観測されている。

・1990 年代における少雨量の年（1991/92、1994/95）とそれ以外の年について、雨量の空間分布を比較した結果、少雨量年においては雨量の南北勾配が顕著となった。

4. 今年度のまとめと今後の課題

２つのスケールにおいて、気象データを収集し、予備解析を行った。今後はデータの問題点の検討も含めてデータ解析を続行し、得られた結果は随時プロジェクト内へ提供して行く。

5. 来年度の計画

・ザンビア国内での雨量データの収集を行う。

・大陸・国スケール、州・村落スケールでの解析を実施し、ザンビアにおける気象学的旱魃地域・期間を特定する。

・本サブテーマの雨量データとサブテーマ IV-2 で得られる土地利用・被覆データの統合化を推進する。

VI-2: 土地利用変化と生態システムへの影響モニタリング

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吉村充則（総合地球環境学研究所）

VI-2 では、独立後の政策による移住などの歴史・社会的背景や旱魃などの異常気象によって引き起こされる生態システムへの影響を、植生被覆と土地利用・土地被覆の変化モニタリングによって把握する。この目的遂行のために、大陸・国・地域レベルで、独立後間もない1970年代までさかのぼった時空間解析アプローチを考えている。今年度は、その予備解析として、既存の衛星画像および各種地図情報をできるかぎり収集し、大陸・国・地域の各レベルで衛星画像による植生被覆状況、土地利用・土地被覆状況を捉えることが可能であるかどうかを調べた。

Terra/Aqua 衛星搭載のセンサ MODIS が観測する画像は、1 日 2 回全球を広範囲で撮影しており、大陸・国レベルでの植生被覆モニタリングに適している。現在、雲領域を除去した月間データ MODIS500m32DaysComposite が、2001～2005 年の期間でインターネットからダウンロード可能である。この時系列月間データを用いて年間の動画像を作成し、大陸全域の植生被覆状況の季節変化を目視で判読した。結果、太陽高度と植生被覆領域の季節変化との間には、1、2 ヶ月のタイムラグがある傾向がうかがわれた。また、ザンビア国で 2004/2005 年に起こった旱魃の前年および翌年の雨季終り頃（4 月初旬～5 月初旬）に撮影された MODIS500m32DaysComposite を用いて、旱魃前後の正規化植生指数（NDVI）分布の比較を行った。旱魃後の NDVI 分布では、ザンビア南部および東部地域において、NDVI 値の低い（植生の被覆密度が低いと思われる）領域が、旱魃前のそれと比較すると広くみられた。従って、植生被覆モニタリングにおいて MODIS500m32DaysComposite データの利用は有効であると思われる。さらに、地域レベルでのアプローチとして、土地利用・土地被覆モニタリングに必要な衛星画像、各種 GIS データ、既存の地図を収集した。LANDSAT/MSS・TM・ETM の画像データは、高い空間解像度（30-80m）と長期データアーカイブによって、1970 年代までさかのぼった解析が可能である。ザンビア南部をカバーする LANDSAT 画像は、Earth Science Data Interface (ESDI)が所有するデータアーカイブから、1970 年代、1990 年代、2000 年代の 3 時期のデータを入手できた。その他、地形区分別・行政界別の解析のために、DEM（数値標高モデル）データと Province/District の境界線データも入手した。入手した LANDSAT 画像は、幾何学的補正処理がすでに施されており、現地で収集した GPS の位置情報と重ね合わせてみると、その位置精度は高いことが確認できた。しかしながら、3 時期それぞれの撮影季節が異なるため、今回は異なる年代の画像間の直接比較は困難であった。

今後の計画として、大陸・国レベルの植生被覆モニタリングにおいては、MODIS500m32DaysComposite を用いた植生被覆の季節変化を NDVI で示し、NDVI と

ザンビア国内の降雨量データとの比較による傾向と特徴を把握する。地域レベルの土地利用土地被覆モニタリングでは、画像の撮影季節を統一するために、雨季と乾季の2時期の画像を各年代で入手する。そして、現地にて収集した情報と統合し、土地利用が急激に変化したと推測される領域の特定を試みる。

引用文献

Chambers, Robert (1989) Editional Introduction: Vulnerability, coping and policy, in (Chambers, Robert ed. Vulnerability: How the poor cope, *I.D.S. Bulletin* 20(2)), pp. 1-7.

Food and Agriculture Organization (2004) *HIV/AIDS, gender inequality and rural livelihoods: The impact of HIV/AIDS on rural livelihoods in Northern Province, Zambia*, FAO, Rome,.

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,.

Pryer, Jane (1981) When breadwinners fall ill: Preliminary findings from a case study in Bangladeshi in (Chambers, Robert ed. Vulnerability: How the poor cope, *I.D.S. Bulletin* 20(2)), pp. 49-57.

Sen, A., (1981) Poverty and famines: an essay on entitlement and deprivation, Clarendon, Clarendon Press, Oxford)

Swift, Jeremy (1989) Why are rural people vulnerable to famine? in (Chambers, Robert ed. Vulnerability: How the poor cope, *I.D.S. Bulletin* 20(2)), pp. 8-15.

Watts, M. (1983) Silent violence: Food, famine and peasantry in Northern Nigeria, Berkley, Univ. of California Press.

Watts, Michael J. and Bohle, Hans G. (1993) The space of vulnerability,; the causal structure of hunger and famine, Progress in Human Geography, 17-1, pp. 43-67.

Wolde Mariam, Mesfin (1986) *Rural vulnerability to famine in Ethiopia 1958-1977*, London, Intermediate Technology Publications, p.191.

島田周平 (1985)「マイケル・ワッツ著: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, pp.82-87.

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, pp.21-36

島田周平(2005) 「[過剰な死]が農村社会に与える影響」(高梨和紘編『アフリカとアジアー開発と貧困削減の展望−』 慶應義塾大学出版会 pp. 89-114.

スティーブン・デブロー著、松井範惇訳(1999) 『飢饉の理論』 東洋経済新報社

IV-3: 早期警戒システムと食料安全保障

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１．　研究の目的

アフリカの旱魃など食料危機を引き起こす政治的・社会的要因を分析するとともに、旱魃・食料危機に関する「早期警戒システム」が、農村社会のレジリアンス・フレームワークに与える影響を明らかにする。

２．　研究の概要

本研究は、アフリカの旱魃に起因する食料危機の政治的・社会的要因を明らかにし、その要因と農村社会の脆弱性や社会的レジリアンスとの関連性を探る。とくに、たびたび食料危機に見舞われてきたサハラ以南のアフリカ諸国の早期警戒システムについて調査・分析し、生態的な条件以外に、どのような政治的・社会的要素が指標として考慮にいれられているかを明らかにする。また、ザンビアにおいて、早期警戒システムが、どのように農村社会のレジリアンス・フレームワークに影響を与えているか分析する。

３．　今年度実施した内容

国連食料農業機関（FAO）を含めた国際機関とアフリカ諸国の早期警戒システムの紹介と、早期警戒システムの指標と農村の新しいレジリアンスフレームワークとの関連を示すことによって、食料危機の発生が、従来の生態的条件だけでなく、政治的・社会的要因によるものである可能性を示唆した。具体的には、FAO による早期警戒システムの効果を高めるための最近のアプローチである「Twin Track Approach」について調査し、国際社会において、食料危機が農村社会のレジリアンスフレームを構成する政治的・社会的要素に起因する可能性が重視されつつあることを提示した。また、サハラ以南のアフリカ諸国の中では、もっとも早く旱魃の早期警戒システムが導入されたエチオピアにおいて､国際社会が進める TTA などの新しい取り組みからみたとき、現実にアフリカで実施されている早期警戒システムにどのような課題があるか、を分析した。

４．　今年度のまとめと今後の課題

今年度の調査から、国際社会において、早期警戒システムを効果的に作用させるために食糧危機の政治的・社会的要素を考慮する必要性が注目されていることがが明らかになった。しかし、国際機関の協力のもと、アフリカで高い評価をえているエチオピアの早期警戒システムにおいても、食糧危機の政治的・社会的指標をじっさいに採用

して、実施するにはいたっておらず、アフリカの農村社会においてどのような指標が、社会的レジリアンスを構成しているのかを明らかにすることは、きわめて重要な課題となっている。今後は、ザンビアの農村部を中心に、食糧危機に結びつく社会的・政治的指標について、国家の政策レベルだけでなく、コミュニティ・レベルにおいても調査を進めていく予定である。

５．　今後の計画

国際機関やアフリカ諸国の食料危機の早期警戒システムに注目し、食料危機が起こりやすい地域の早期警戒指標の抽出と分析を通して、農村社会のレジリアンスを構成する社会的要素を明らかにする。そして、これらの早期警戒指標や国際社会の食料安全保障政策をもとに、ザンビアにおける農村社会のレジリアンスを構成する社会的要素として、どのようなものが想定されるかを国家の政策レベルと農村レベルとの関係を視野に入れて検証していく。

（研究項目概要）

① アフリカ諸国における早期警戒システムの指標調査
② ザンビアの旱魃に関する国内政策や国際社会の方針・政策の影響調査
③ ザンビア農村部における社会的レジリアンス要素の抽出と分析

IV-4: 旱魃への対応とレジリアンス指標の郡レベル解析

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櫻井武司（農林水産政策研究所）

１．研究の目的

郡・地域レベルの分析はターゲットとなる地域の選定やその住民に対する政策決定に重要な役割を果たすにもかかわらず、このレベルでの統計情報はザンビアでは乏しい。このサブテーマの目的は旱魃のショックやそれへ対応を地域間で比較することである。最終的には気候、生態、社会・経済情報を地理情報と統合して地域のレジリアンスを高める要因の分析とそのための政策立案に寄与することを目指す。

２．研究の概要

１）社会・経済指標，農業生産，穀物価格に関する郡レベルでの統計データを中央統計局と農業省より入手する。２）中央統計局の収穫予測調査及び収穫後調査の対象となった世帯に対して再調査を実施し、統合したデータセットを作成する。３）郡レベルの統計情報は農家世帯の調査データに基づき補足し、さらに降雨量や土壌肥沃度等の農業生態の情報とを重ね合わせて分析する。４）郡レベルの社会・経済や制度的要因および農業生態的要因を用いてレジリアンス指標のマッピングを行う。

３．今年度実施した内容

平成１８年度は以下の３項目を実施した。１）ザンビアで入手可能な政府統計情報の調査および統計情報の取得、２）2004/2005 年の旱魃がザンビアの農業生産へ及ぼした影響の予備調査、３）東部、南部州での世帯調査の準備及び実施。

４．今年度のまとめと今後の課題

ザンビア中央統計局の収穫後調査から 2004/2005 年の旱魃による農業生産への被害の特徴を概観した。2005 年の農業生産の被害は 1991/1992 年の旱魃に匹敵するものであった。今後、近年で最悪の旱魃であった 1991/1992 年との比較も重要と思われる。

５．来年度の計画

１）ＣＳＯ等からの統計情報の入手と分析（ＬＣＭＳ及びその他のデータ）
２）世帯調査の実施（平成１９年３－４月実施予定）及び予備解析
３）1991/1992 年旱魃と 2004/2005 年旱魃の農業生産や社会・政治・経済環境の比較

2004/2005 年旱魃がザンビアの農業生産へ与えた影響―予備的考察

総合地球環境学研究所

Thamana Lekprichakul

本稿では、2003/2004 及び 2004/2005 年農作期の収穫量調査から、ザンビアの農業生産高を検討する。この調査はザンビア中央統計局(CSO)が毎年実施しているものである。この分析の目的は、2004/2005 年農作期の旱魃の概要を統計から理解することにある。また、今後の調査の方向も合わせて検討する。本稿では農業生産のみに焦点を当てているので、その他の視点についてはまだ不完全である。ＣＳＯからのデータ整備は今後も継続する。

次章では、ザンビア経済における農業分野の重要性について言及する。そして、1998/1990 から 2004/2005 年農作期の過去１６年間に発生した旱魃について検討する。過去の旱魃の経緯を最近の旱魃年と比較し、農作物の損失への影響について検討する。第３章では、州レベルに焦点を移し、特に我々の調査対象地域である南部州及び東部州で旱魃年に何が起ったのかを提示する。第４章では、南部州及び東部州の農業生産とザンビア全体との比較を行う。第５章では、農民の対処行動に焦点を当てる。まとめとして、気候変動に対する世帯、コミュニティそして地域の反応を理解するためのテーマ IV の鍵となる研究テーマについて言及する。

ザンビアの農業セクターは国内総生産の 14.2%を占め、18.3%である卸売業の次に位置する。約７５％の国民が、農業セクターに直接もしくは間接的に依存している。旱魃年であった 2004/2005 年農作期では、メイズ、ミレット、ソルガム、米の生産が 22%減少した。穀物生産減少の主要な原因は穀物生産の９０％を占めるメイズの減産にあった。ザンビア農業は高収量、灌漑・機械化農業の大規模農家と低収量・天水農業に依存する小農との２重構造になっている。特に小農は過去２０年間に起った旱魃の影響に対して脆弱である。過去１６年間にザンビアは６回の旱魃(1991/1992, 1994/1995, 1997/1998, 2000/2001, 2004/2005)を経験している。特に 1991/1992 年は大陸的な旱魃であり、2004/2005 年は地域的な旱魃であった。1991/1992 年と 2004/2005 年を比較すると穀物の損失はほぼ同じであったが、メイズの作付面積は 2004/2005 年に 30%ほど増加しているため、旱魃の影響を穀物の損失のみで見ることはできない。メイズ収量の 10%減少（増加）はメイズ価格を 7%上昇（低下）させる。南部州と東部州は、ザンビア全土の 40-50%の作付面積、35-45%の農業生産を持つザンビアの主要農業生産地である。2003/2004 年の農作期にはザンビアのメイズと穀物生産の 50%はこの両州から生産された。また両州の穀物作付面積の９割はメイズが占めていた。

またＣＳＯ統計では、旱魃耐性の強いとされるソルガムとミレットの南部州と東部州での収量損失は、他の州を上回っていた。この収量損失の両州の相違についてはさらにフィールド調査からの検討が必要である。特に南部州では近年メイズのみではなく、換金作物の作付面積が増加し農業が多様化している。南部州では旱魃時に多くの農家世帯が小売業に参入し生計を維持していたという報告もある。レジリアンス研究には１）実際の旱魃の農業生産と市場への影響、２）世帯のレジリアンスの測定、の２つの研究が重要となる。レジリアンスとは世帯の対処能力と定義することも出来る。レジリアンスは脆弱性の程度と考えることが可能である。多くの経済分析では、消費の一定レベルからの低下を脆弱性と定義している。レジリアンスの評価には２つの方法が考えられる。経済理論に基づかない指標分析、厚生もしくは消費理論に基づく方法である。後者の手法は進化途中であり、プロジェクトでは消費に基づくレジリアンスの評価が望まれる。

インドタミールナドゥ州の北東モンスーン降水にあたえるENSO（エルニーニョ南方振動）とインド洋ダイポールの影響

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K. Palanisamy (タミールナドゥ農業大学)
谷田貝亜紀代 (総合地球環境学研究所)
梅津千恵子 (総合地球環境学研究所)

インドタミールナドゥ州の雨季は10月から12月で、北東モンスーン降水（NEMR）といわれるものによっている。このNEMRの開始と総降水量は農業と経済に重要な影響を及ぼす。タミールナドゥの南西モンスーン（SWMR, 6-9月）は南方振動指数（SOI）と正の相関がありNEMRはSOIと負の相関があるのは興味深い。そこで、NEMRによるタミールナドゥの降水量とグローバルシグナルであるエルニーニョ南方振動（ENSO）とインド洋ダイポールとの関係を調べた。その結果タミールナドゥのNEMRは7月のNino-3 SSTと最も高い相関が見られた。ここで、Nino-3の海面温度 （SST）が高いときNEMRは多いことになる。一方、インド洋ダイポールを示す海面温度とは、有意な相関は見られなかった。また、SOIと地域的な降水とを関連させる大気循環構造を把握するため、SOIが高いとき、低いときについて対象地域周辺の水蒸気輸送構造についてあわせて示した。

レジリアンスプロジェクト第1回ワークショップ

日時：平成１８年6月２日（金）１３：００－１８：００
6月3日（土）　９：３０－１６：００
場所：地球研セミナー室３・４

プログラム（発表 15 分、質疑 5 分）

６月２日（金）

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

（司会　真常）

13:20-13:40　京都大学大学院農学研究科　三浦励一
「トウジンビエ栽培にみられるワケありの手抜き」

13:40-14:00　東京大学大学院医学系研究科　山内太郎
「脆弱な生活環境に対する小集団の栄養・行動適応－太平洋島嶼社会の事例」

14:00-14:20　京都大学大学院農学研究科　宮嵜英寿
「西アフリカ・サヘル地域における牧畜民と農耕民の関わりと生業活動の年次変動」

14:20-14:40　V. Geethalakshmi, RIHN and Tamilnadu Agricultural University
“Climate change and its impact on agriculture in Tamilnadu India”

14:40-15:00　地球研　谷田貝亜紀代
「アジアの日降水量の解析」

15:00-15:15　コーヒーブレイク

（司会　櫻井）

15:15-15:35　地球研　佐伯田鶴
「ザンビアにおける環境変動モニタリング～気象学の立場から～」

15:35-15:55　東北農業研究センター　菅野洋光
「西アフリカ、マリ共和国における現地気象観測の経験を今後にどう生かすか?」

15:55-16:15　京都大学大学院人間・環境学研究科　松村圭一郎
「生態・社会変動に対する農村社会のレジリアンス
―エチオピアにおける旱魃対応の事例から」

16:15-16:35　地球研　長野宇規
「レジリアンスを環境史とミネラルバランスで語れるか？」

16:35-17:45　テーマごとの打合せ

18:00　地球研のシャトルバスに乗車（地球研ハウス前）

19:00-21:00　懇親会　まんざら本店（二条河原町、地下鉄東西線市役所前下車北へ徒歩５分）
京都市中京区河原町通夷川上ル指物町３２１　TEL: 075-253-1558

６月３日（土）

9:30-10:45　地球研　梅津千恵子　レジリアンスプロジェクトの概要
「社会・生態システムの脆弱性とレジリアンス」
京都大学大学院農学研究科　真常仁志　テーマ I 概要説明
「環境変動下での生態レジリアンスと人間活動」
農林水産政策研究所　櫻井武司　テーマ II 概要説明
「変動する環境への家計とコミュニティの反応」
京都大学大学院アジアアフリカ地域研究研究科　島田周平　テーマ III 概要説明
「脆弱性とレジリアンスに関するポリティカルエコロジー：歴史的・制度的観点から」
地球研　吉村充則　テーマ IV 概要説明
「社会・生態システムに対する統合解析」

10:45-11:00　コーヒーブレイク

（司会　島田）

11:00-11:20　一橋大学大学院社会学研究科　児玉谷史朗
「環境対応としての人々の移動」

11:20-11:40　日本大学生物資源科学部　半澤和夫
「ザンビアにおける農業生産と農民の選択－C 村を中心に－」

11:40-12:00　近畿測量専門学校　山下 恵
「マルチスケール GIS データ整備のための空間情報収集・計測」

12:00-13:00　昼食

（司会　梅津）

13:00-14:00　総合討論

14:00-15:00　１．今年度の研究の重点
２．年間研究計画・旅行計画・機材輸送計画
３．予算計画
４．出版物に対する謝辞について
５．外部研究資金の獲得
６．ＨＰの作成について

15:00-16:00　プロジェクトに関する事務手続き説明
１．国内出張・海外出張手続き・精算方法（梅津）
２．地球研の団体保険について（梅津・吉村）
３．機材・機器の発注について（吉村）
４．調査許可について（島田）
５．その他連絡事項（梅津他）

16:00　閉会

平成１８年度レジリアンス研究会要旨

第１２回レジリアンス研究会（梅津ＰＲ）

日時：２００６年7月３日（月）　１０：００－１１：３０
場所：地球研講演室
共催：コモンズ研究会、琵琶湖－淀川プロジェクト
タイトル：「制度分析の研究方法を求めて：資源管理制度の多様性からの視点」
発表者：インディアナ大学・政治理論と政策分析ワークショップ代表
　　エリノア・オストロム

[要旨]　政策分析について書かれた多くの教科書では、政治・経済発展や持続的資源を達成するために制度の重要性が強調されている。しかし、研究者によって制度の意味も異なり、その分析方法もかなり様々である。昨年プリンストン大学から出版された拙稿 *Understanding Institutional Diversity* で提示した制度分析と開発 Institutional Analysis and Development (IAD)の枠組みを概説し、共有資源（灌漑、森林、牧草地、漁業資源）に関連したフィールド調査から発見したルールの多様性を示しながら、その枠組みを掘り下げる。多様なルールが存在することから、複雑な社会・生態学の課題に対して単純に解決策のみを提示する問題点を指摘し、政治的提案に際しては非常に謙虚であることを提案する。我々が直面する多様な問題に対処するには、解決に向けたよりよい制度の青写真を知っているかのようにふるまうよりも、人々が長年の経験に照らし合わせてよりよいルールをつむぎだせるような条件を整備することのほうが、より有効な方策となる。地域の状況と変化に適応できる制度を構築することによってレジリアンスを高めることが可能である。

第１３回レジリアンス研究会（梅津ＰＲ）

日時：２００６年7月２５日（火）１６：００－１７：３０
場所：地球研セミナー室１＆２
タイトル：「気候リスクへのレジリアンスを高めるための気候情報の適用―インドの事例」
発表者：地球研招へい外国人研究員、タミルナドゥ農業大学気象学部
　　Prof. V. Geethalakshmi

［要旨］　リスク管理の計画は気候の変動を考慮に入れ、洪水や旱魃などの災害の傾向を同定し、対応する能力を高めなければならない。過去における気候の時空間変動の

予測とモニターの分野での格段の進歩にもかかわらず、気候の極端な変動は人々の資産や生命の損失を招く原因となっている。1990 年代、世界中で自然災害は 500−600 回発生し、6000 臆ドルの損失と 20 臆人に被害を与えた(Anthes, 2005)。自然の気候変動、地球温暖化と気候変動の影響と程度、人口増加とそれに関連する問題、これらの変動に対する社会と人間の反応には多くの不確実性が存在する。しかし、これらの不確実性は気候リスクに対して対峙し、管理しない言い訳にはならない。過去のトレンドと将来に起り得る変化に対する地域の理解は、気候関連のリスク管理戦略を考える際に役立つ。早期警戒システムはリスク管理と計画の重要な部分である。予期すること防御は緊急時に対応するよりも効果的でコストも低い。インド亜大陸のケーススタディを例としていくつか紹介する。

第１４回レジリアンス研究会（梅津ＰＲ）

日時：２００６年１０月２日（月）１５：３０－１７：１５
場所：地球研セミナー室１＆２

１５：３０－１６：３０
タイトル：「インド・ミゾラム州のメロカンナ大開花が及ぼす影響」
発表者：京都大学大学院地球環境学堂・助教授　柴田昌三

[要旨] インド・ミゾラム州を中心とする数万 k ㎡にわたる地域には、Melocanna baccifera というタケ類が分布している。多くの竹種の開花周期が明らかでない中で、本種は数回にわたって 48 年に一度の開花が記録されている世界でも希有の種であり、その生態的な開花特性の解明が試みられている。2007 年は開花の年にあたっており、大きなチャンスである。一方、前回の開花時と比較してミゾラムの社会構造は大きく変化しており、定住化の促進と焼畑農地の管理方法の変化が、メロカンナの開花によってどのような影響を受けるのか、は従来、メロカンナの開花がミゾラム社会に壊滅的打撃を与えてきたとされることを考えた時、興味の尽きない点である。

１６：３０－１７：１５
タイトル：「ザンビアフィールド調査報告」
発表者：地球研・助教授　吉村充則

第１５回レジリアンス研究会（梅津ＰＲ）

日時：２００６年１１月９日（木）15:30-17:00

場所：地球研セミナー室１＆２
タイトル：「早期警戒システム(Early Warning System: EWS)への国際社会の取り組み～国際機関とエチオピアの動向を中心に～」
発表者：内閣府　国際平和協力本部事務局　飯塚　裕貴子

[要旨] 自然災害や紛争が多発している国々では、国際機関や援助組織が主導する「早期警戒システム」が人々の食料安全保障に寄与するものとして構築されてきた。しかし、近年は、従来のデータ収集にもとづいた早期警戒分析にくわえ、より政治・社会要因を考慮した分析が注目を集めている。たとえば、国連食料農業機関（FAO）では、早期警戒システムの効果をさらに高めるために、社会のレジリアンス・フレームワークを構成する要素として、政治社会的要因を盛り込んだアプローチ(Twin Track Approach: TTA)が議論されている。一方、サハラ以南のアフリカ諸国のなかでは、エチオピアにおいて、もっとも早く旱魃の早期警戒システムが導入され、国際機関の協力のもと、長年にわたって EWS の組織づくりが進められてきた。今回の発表では、国際機関における最新の議論をふまえたうえで、おもにエチオピアの EWS の歴史や情報収集体制について報告する。FAO を含めた国際社会が進める TTA などの新しい取り組みからみたとき、現実にアフリカで実施されている早期警戒システムにどのような問題点があるのか。アフリカの旱魃対応における“人間安全保障”の課題と可能性について考えてみたい。

第１６回レジリアンス研究会（梅津ＰＲ）

日時：２００６年２月２２日（木）15:30-17:00
場所：地球研講演室

15:30－16:15
タイトル：「ザンビア南部における農村女性の現金稼得戦略」
発表者：
京都大学大学院ｱｼﾞｱ･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 成澤 徳子
[要旨]ザンビア南部のトンガ農村社会において、従来、現金稼得は主に男性の役割で、女性の現金収入源は地酒の醸造・販売にほぼ限られていた。90 年代以降、市場経済化や旱魃・牛疫の発生等による一連の複合的影響により、トンガにとって、従来の生業である農業と牧畜からの現金収入が減少している。これは女性にとっては、男性が持つ現金にアクセスする機会が減少していることを意味する。そのなかで、女性のエンパワーメント向上を目的とする開発プログラムが近年活発に行われてきたが、女性たちがいかにして個人的な現金稼得を実現しているかについてはいまだ明らかにされていない。そのため本発表では、ザンビア南部州モンゼ県東部の農村

で行った現地調査の結果をもとに、近年の社会経済変容のなかで、トンガの女性たちが現在どのように生業を多様化し、現金稼得活動を展開しているのかを明らかにすることを目的とする。その結果、男性を含む当該社会に受容されやすい形で女性たちが個人的な現金へのアクセスを実現してきた過程には、ローカルな社会活動空間を自分たちの「いちば」に組み替える彼女たちの創造的実践があることを提示する。

16:15－17:00
タイトル：「ザンビア南部、グウェンベ渓谷におけるソルガム栽培」
発表者：
京都大学大学院ｱｼﾞｱ･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 淡路 和江
[要旨] ザンビアの南部に位置するグェンベ渓谷は、国内でも最も降水量の少ない地域のひとつであり、たびたび大規模な干ばつの被害を受ける地域として知られている。このように厳しい自然環境のなかで、地域住民は比較的耐乾性の高いソルガムを基幹作物として、その特徴を生かした農耕を営んでいる。今回の発表では、グェンベ渓谷で行われているソルガム栽培に注目し、不安定な気候条件下でのソルガムの栽培管理の特徴を作付体系と品種の特性から明らかにする。

ザンビア出張報告（梅津、櫻井、真常）６月１０日―１９日

プロジェクト全体的に関して

主に Theme I, II は Mt. Makulu C.R.S.の協力を得ることを話合った。Theme III, IV についてはすでに Institute of Economic and Social Research (INSESOR), Central Statistical Office (CSO), Survey Department なども協力機関に挙げられているので、Mt. Makulu を唯一の協力機関とするかは今後の課題となる。

Zambia Agricultural Research Institute (ZARI), Mt. Makulu Central Research Station

２日間に亘り、Acting Director である Mr. Moses Muwale とスタッフとのミーティングを行った。

６月１３日（火）14:00-15:50

―MOU に関する話合いでは農業省の研究部門である Mt. Makulu C.R.S.と地球研が MOU ならびに調査契約(Theme II)を必要に応じて結ぶのが適当との合意を得た。主に Theme I, II は Mt. Makulu C.R.S.の協力を得ることを話合った。

―観測機材のザンビアへの輸送については、Mt. Makulu C.R.S. はすでに海外の他機関と同様のことを行っており、空港到着後 Mt.Makulu C.R.S.が必要書類を本省へ送付後、本省から財務省を通じて税関へ書類が出され、約１週間で機材を空港の税関から受け取ることが可能との情報を得た。

―真常さんが Theme Ｉの研究計画を説明した。実験に使う土地の規模がかなり大きいため Petauke の DACO を通じて適当なフィールド候補地の情報を得、地元の村長と話し合い理解と協力を得る必要があるとのコメントを得た。Mt. Makulu C.R.S.の Mr.Sesele が真常チームと Petauke へ同行し、フィールドの選定にあたる予定。

―政府機関のスタッフを動員する場合、日当宿泊費 160,000ZK, 日当 50,000ZK が必要となる。これはどの政府機関でもほぼ同じレートの様である。

６月１４日（水）14:30-16:50

―Mr. Muwale (Vice Director; Acting Director), Mr. Sesele Sokotela (soil science), Ms. Milimo Chiboola (sociologist), Ms. Juliet Mataa (sociologist), Mt. Mathias Ndhlow (economist)とミーティング

―櫻井さんが Theme II の研究計画を説明した。Petauke と Sinazese の２サイトで 100 家計をサンプルし、一人の enumerator が２０家計を１週間でカバーし、毎週継続する。１サイトには５名の enumerator が必要となることを説明。

－Mt. Makulu C.R.S.のスタッフからはコミュニティの協力を得なければならないこと、大量の情報を３年間同じ家計から得るためなんらかの incentive の必要性が述べられた。農家の圃場が複数あり、それぞれ肥沃度が異なっているので一ヶ所の土壌の分析では不十分との意見も出された。

Central Statistical Office (CSO)

６月１３日（火）9:00-10:30

―南部州と東部州について Post Harvest Survey と同じ家計で家計調査を実施した場合、どの程度の予算が必要か見積もりを出してもらうが、予算が大きすぎるため、Standard Enumeration Area (SEA)の数を１１８から５９に減らして再度見積を作成してもらう。

―児玉谷先生から聞いた CSO の ZamSED (Zambia Socio-Economic Database)はすでに ZambiaInfo に継承されており、ＣＤも dissemination office で配布していた。これはユネスコの協力で作った DevInfo のザンビア版である。District, provincial level のデータが地図化できる。

６月１４日（水）10:00-11:30
―見積もりで削減できそうな項目、契約の必要な書類について話し合う。
―CSO に対しては調査委託なので契約だけで MOU はなくても（あるいは MOU の内容が契約書的であっても）よいことになった。
―CSO では Post Harvest Survey (PHS)のデータに 1990 年のセンサスの人口及び農業生産データから得られた weighting system を導入して district level data を作成している。これを加算して Provincial data が作成されているので最大の問題は weighting system にあるらしい。（農業に関する質問をしたのは 1990 年なので，当時のウェイトを使い続けている点が問題である（FSRP からの情報による)。
―CSO の cartographer から district 境界の入った digital map を２種類入手する。

Food Security Research Project (FSRP/USAID)
６月１５日（木）12:00-12:30
―supplementary survey data (2001, 2004, 2007)をもし利用する必要があれば FSRP と協力関係を作る必要がある。
―FSRP では次回の２０１０年のセンサスで、農業関係の質問項目を入れてもらい、この情報をもとに農業の地域的特性を加味して CSO の weighting system 及び群・州・国家統計を飛躍的に向上させる計画があり非常に興味深い。

Institute of Economic and Social Research (INESOR)
６月１５日（木）15:00-16:00
―Mr. Mulenga と Juls で会い、レジリアンスプロジェクトが今年度からスタートしたこと、今回の調査許可の収得状況を報告する。
―INSESOR とは協力するにしても MOU の必要は特にないことが Dr. Mulenga より話された。
―ペタウケでは小規模の農家が集中している。近年人口増加が激しい。ルサカやカッパーベルトからもともとペタウケ出身の者が退職や失業のため農村へ移住している。逆に農村地域から都市への移住は減少している。
―INESOR では African Social Research (June/December)、Zambian Papers (Research reports)を発行している。院生の論文も受け付ける。

Immigration HQ (Haile Selassie Ave. Intercontinental Hotelの隣)
６月１２日（月）9:15-
朝 9:30 前に行き、ファイルもすぐに見つかり、１時間ほどで調査許可（2007 年まで）とパスポートへのスタンプを終える（梅津、櫻井)。その後 Cairo Rd.の Pension House 2F の Immigration office で re-entry visa （３ヶ月間何度でも出入国が可能）を入手。(5,000ZK)
―真常さんと宮崎さんのファイルが見つからず、２F の Immigration Officer の部屋へ行くがファイルは見つかったものの、パスポートのコピーに High Court のスタンプを押したものを提出させられる。結局 Mr. Kapenpe に同行願い、2009 年までの調査許可を得る（４年分)。宮崎さんのファイルは紛失したままのため仮の調査許可を発行してもらう。佐伯、田中、吉村３名のファイルはあった。帰国時は通常どおり、出国税２０ドルを支払う。（International flight の resident 料金は 70,000ZK, domestic flight 20,000ZK）

その他

―ザンビアの銅景気のため換金レートは１ドル＝3,500ZK まで高騰している。（2006.6.15 現在）ルサカ市内でのガソリン価格は昨年並みで１リットル＝5,772ZK (2006.6.17)

ザンビア出張報告（梅津、タマナ、山内）１１月２１日―１２月６日

まとめ
―MOU のドラフトを Mt. Makulu Research Station と協議し合意に達した。その他の協力機関からも同意を得ることが出来た。
―南部州の伊藤千尋、中村哲也両氏の調査フィールドを見学した。
―Chikankata Hospital, Sinazese Health Centre, Department of Health, CSO Population and Demography の担当者から HIV/AIDS, 医療、人口統計関連の情報・データを入手した。（詳細はタマナ、山内報告を参照）
―CSO と今年度調査契約の内容、予算について合意を得た。Post-Harvest Survey04/05 を入手した。
―ZVAC の Comprehensive Vulnerability Assessment and Analysis 2006 について情報を得た。
―今年の降雨量は平年並みとの予測だが本格的な雨が降るのが遅れている。一部には旱魃の兆しもある。

１１月２２日（水）
Centre for Environmental Economics and Policy in Africa (CEEPA: The Centre for Environmental Economics and Policy in Africa), University of Pretoria, South Africa
Director の Prof. Rashid Hassan を訪問して CEEPA プロジェクトについて情報収集する。2003 年に GEF/WB の資金で温暖化が農業へ与える影響をアフリカ１１カ国で実施し、総計約 9,000 件の家計データを用い Ricardian approach により降雨量と気温の変化による純収益の変化を分析。

１１月２３日（木）
ルサカ空港の Immigration ではパスポートと調査許可証を見せ、USD25 を支払って無事終了。入国ビザには調査許可の滞在期限の日付が書かれる（入管の担当者がうっかり忘れて書いてもらえなかったので再確認して記入してもらう）。帰国前に Re-entry visa (ZK 5,000)を入手後、３ヶ月以内に入国した場合は USD25 を支払う必要はない。

１１月２４日（金）
Department of Mathematics and Statistics, UNZA
Prof. Suman Jain を訪ねる。CEEPA プロジェクトのザンビア担当者。Capetown Univ.で MM-5 の研修を受け、GCM と RCM を走らせている。気象データも持っている。ザンビアの CEEPA プロジェクトでは 2003 年に 1,170 件の家計データを CSO に委託し費用は USD17,000 であった。ご主人の Prof. Prem Jain は renewable energy の専門家で UNDP Namibian Solar Energy Project を担当していた。

Central Statistical Office (CSO)
Mr. Masiliso Sooka, Mr. Modesto Banda (Deputy Director)と会い、2004/5 年旱魃時の追加家計調査を依頼し、委託契約書のドラフトについて協議する。予算は前回交渉時は総額 USD69,000 であったが、CEEPA プロジェクトと同じサンプル数にもかかわらず４倍の予算なので見積額の削減を依頼。調査は南部州と

東部州について Post Harvest Survey と同じ家計を対象に 2007 年１月－２月の間に実施する予定。

Zambia Agricultural Research Institute (ZARI), Mt. Makulu Central Research Station

-Vice Director である Mr. Moses Muwale と MOU のドラフト案について協議し、スタッフとのミーティングを行った。協力機関として、Central Statistical Office, Ministry of Finance & National Planning, Government of Zambia; Food Security Research Project in Zambia (USAID/MSU); Institute of Economic and Social Research, University of Zambia (INESOR/UNZA); Meteorology Department, Ministry of Communication and Transport; Survey Department, Ministry of Land を MOU の最後に記入する。
-Mwale 氏に地球研の客員制度を説明し、来年度可能であれば来日したい希望を得た。
-Ms. Milimo Chiboola (sociologist), Ms. Juliet Mataa (sociologist), Mr. Sesele Sokotela (soil science)は JICA 研修で日本（京都大学）に滞在中、Mr. Mathias Ndhlow (economist)は JICA FoDis プロジェクトのアシストをしていた。
-JICA の Food Crop Diversification Project (FoDis)がスタートし、ZARI をベースに３年ほどプロジェクトを実施するということを ZARI に赴任した JICA 専門家 Suzuki Atsushi 氏から聞いた。Sinazongwe 地域もプロジェクトの対象地域となっており、cassava の普及活動をするとのこと。
Cell: 097-740692; e-mail: asuzuki@zamnet.zm

１１月２７日（月）

Institute of Economic and Social Research (INESOR)

Mr. Mulenga より HIV 関連の情報を得る。Department of Health の National Centennial Survey, Health Centre Survey（妊婦を対象）, Behavioural Surveillance Survey がある。District Hospital が HIV 患者に関する信頼できる情報を持っている。Mazabuaka Chikankata Hospital が良いデータを持っている。Health Centre では５歳まで検診のたびに体重をカードに記入し母親がそれを持っている。小学校等で定期的に身長、体重を計測することはない。

Survey Department, Ministry of Land

Mr. Ronald Moyo (Assistant Survey General), Mr. Danny Mubanga (Surveyor General)と面会し、MOU の件について了解を得る。IA(Implementation Agreement)で詳しい役割を知りたいとのこと。

Central Statistical Office (CSO)

Mr. Kalunbi (Deputy Director, IT), Mr. Goodson Sinyenga (CSO の Zambia Vulnerability Assessment Committee 担当者)から ZVAC について聞く。DMMU (Disaster Management and Mitigation Unit), The Office of the Vice President に本拠があり、UN, NGO, 各省庁が ZVAC に参加している。今年 CSO は ZVAC の Comprehensive Vulnerability Assessment and Analysis (CVAA) Survey 2006 のための大規模な全国世帯調査を担当しており、調査対象は約 30,000 世帯、400HH/district, 20SEA/district, 総額 1.2Million USD の予算で近々実施予定。国際機関や各国政府大使館へ資金援助を求めている。（中国大使館, WFP 等が資金協力するらしい）

１１月２８日（火）

ZVAC (Zambia Vulnerability Assessment Committee), The Office of the Vice-President, Disaster Management and Mitigation Unit (OVP-DMMU)

Mr. Mulenga, National Coordinator, DMMU を訪ね Mr. Goodson, Ms. Mwape も臨席し、情報収集する。
ZVAC の全国調査 Comprehensive Vulnerability Assessment and Analysis (CVAA) Survey 2006 はベースラインとして今後も５年に１回程度実施する予定。ZVAC 調査は food security issues, broader sectoral approach

を中心にしている。National inventory も将来作成予定。
―伊藤千尋さんの Simwele village を訪問。この村はカリバダムの建設によって移住した農民の村。雨季が始まったので朝から村人は畑に出ており、日中はあまり人が残っていない。sourghum、finger millet が主体で maize はあまり作っていない。調査は２７世帯をカバーしている。近々道路を隔てた所にあるカリバダムの建設以前からあった村を調査し、比較する予定。

１１月２９日（水）

Chikankata Hospital, Chikankata Mission (Salvation Army)

Dr. Mlenga (UNZA)から紹介していただいた、Mr. Gift Mumkombwa から情報収集。CHAZ(Churches Health Association of Zambia), EU から資金援助を受け Local Community Confidence and HIV Prevention Program を実施している。カリバダムによって移住してきた Tonga 農民が居住する地域で、病院看護よりコミュニティボランティアによる在宅ケアーを約 76,000 世帯を対象に推進している。この地域の死亡原因は：１．マラリア、２．下痢、３．HIV 関連の疾病。この地域では 01/02 の旱魃は 04/05 より被害が大きかった。旱魃時には出生体重(birth weight)が 2.5kg を下回る率が高まる。

１１月３０日（木）

―中村哲也さんが滞在している Malabai village を訪ねる。村には４０世帯があり、農民はカリバダムの建設と Zambeef の農場のために２度の移住を余儀なくされた。斜面を利用して農業をしているため土壌侵食が起こっている。メイズ作が主体。家長の Mr. Robert Siambiko は３人の妻を持つ。５歳児までの体重を記録する Children Clinic Card (Ministry of Health)を母親（２番目の妻）から見せてもらう。カードには Health Centre で検診を受けるたびに月ごとの体重と注射歴が記録される。父親はあまり子供の発育・健康状態については知らない。
―Sinazeze の Health Centre を訪ねる。医者は駐在していないが看護師が駐在し簡単な処置を行っている。栄養不良等の場合にのみ身長と上腕周囲が計測されヘルスセンターに記録として残される。Sinazongwe の District Hospital は Maamba にある。この他、村には health worker がおり、500ZK で薬を住民へ供与している。
―Sinazongwe, DACO (District Agricultural Coordinator), Mr. Steven Chitila を訪問し、プロジェクトについて説明する。前任者の Mr. Samiaamba は DACO/Choma へ移動した。

１２月１日（金）

―CSO, Mr. Sooka を訪ね、調査委託契約書の最終ドラフトを作成する。Mr. Goodson にも来てもらい、計画していた委託調査の見積を４割削減してもらい、RIHN からの資金を今年度（南部州と東部州の家計調査）、と来年度（ZVAC への調査委託）として２分割することを了承してもらう。
―Ms Nchimunya Nkombo, Population and Demography に会い CSO が持っている人口統計、栄養状態等の資料について情報収集。
―Dr. Gear Kajoba を Department of Geography/UNZA に訪ねるがあいにく不在。
―Dr. Mulenga, UNZA と Mrs. Blenda Mulenga と Juls で情報交換する。以下は Dr. Mulenga の見解。
＊食料不足時には５歳以下の乳幼児の受診回数が増える。乳幼児の健康は世帯の vulnerability を測る示標となっている。WHO スタンダードは実際の生活状況に対応していないのであまり有効ではない。
＊食料不足時には、近隣の森林での密猟、野生植物の採集が増える。2004/5 年の旱魃時にペタウケで摂取されていた根菜は野生タイプの cassava でニャンザ語で mupama と呼ぶ。
＊　多妻世帯は南部州に多い（約１０％以下）。家計を維持するために収入が必要なので、広い農地、

多くの家畜等、何らかの収入基盤がある場合が多い。経済的理由とキリスト教では多妻は望まれないことから多妻世帯は減少している。

＊女性家長の家計(Female headed household)は他の家計と比較して貧困、子供の栄養不良、労働力不足、資源へのアクセスが不利などの問題がある。耕作時に男性労働者を雇う経済力があるかが鍵となり、結果的に耕作される農地面積が小さくなる。夫の死亡時に土地を夫の兄弟に取られるケースが多い。

＊Department of Health の所属機関が所有する疾病等のデータを利用して研究を行う場合は研究計画を提出しザンビア大学医学部の倫理委員会(Ethics Committee)から許可を得る必要がある。

＊旱魃の記憶：何を植えるかは過去の凶作に対する対処行動から来る。伝統的な作付形態は混作(cassava+groundnuts, maize+beans)。

＊食料援助は地域限定型で通常非常に遅れて到着するので、農民が援助を期待して農業活動に対する意思決定が影響を受けることはそれほどない。

＊食物禁忌（タブー）：主に豚や一部の魚など。Adventist 派は食物タブーがある。多いキリスト教の宗派は（南部州）Roman Catholic, United Church of Zambia (Protestant), Pentecostal, Salvation Army;（東部州）Anglican (Katete).

１２月４日（月）

CSO: データをリクエストするが、担当者不在で Living Condition Monitoring Survey data, Health Survey data を入手できなかった。

Ministry of Health: Dr. Reuben Kamoto Mbewe (Reproductive Health Specialist)から情報収集。

Ministry of Agriculture: Dr. Gregory M. Mululuma (Department of Veterinary and Livestock)から東部州と南部州に多い家畜の疾病について情報収集。家計調査に加える場合は District にある veterinary camp/veterinary officer から家畜疾病の local names について聞く必要あり。

Food Security Research Program (FSRP) : MOU の協力機関に FSRP を入れることを了承してもらう。

その他

―ザンビアの換金レートは１ドル＝3,500ZK(2006.6.15)から１ドル＝4,040ZK(2006.11.23)まで戻っている。ルサカ市内でのガソリン価格は 5,134ZK/litre(2006.11.27)、ディーゼル価格は 4,805ZK/litre.

―帰国時の出国税は 25 ドルに値上がりしている(ZK は不可)。

―Juls との交渉価格（2006 年 12 月現在）

Guesthouse	$65/day (including breakfast and dinner)
Saloon car	$50/day (excluding driver charges and fuel)
4x4	$100/day (excluding driver charges and fuel)
overnight charge	$25/day (including meals and hotel)
overtime charge	$2/hour
lunch allowance(Lusaka)	$5/day

収集資料（２００６年６月・１１月出張収集資料）

[CEEPA]

Kurukulasuriya, Pradeep and Robert Mendelsohn, “A Ricardian Analysis of the Impact of Climate Change on African Cropland”, CEEPA Discussion Paper No. 8, July 2006.

Seo, Sungno Niggol and Robert Mehdelsohn, “Climate Change Impacts on Animal Husbandry in Africa; A

Ricardian Analysis", CEEPA Discussion Paper No. 9, July 2006.
Maddison, David, "The Perception of and Adaptation to Climate Change in Africa", CEEPA Discussion Paper No. 10, July 2006.
Jain, Suman. "Economic Impact of Climate Change on Zambian Agriculture: a Ricardian Analysis", CEEPA Discussion Paper No. 27, July 2006.
Kambikambi, Tamala Tonga, "Cropwat Exercise Report for Zambia", CEEPA Discussion Paper No. 39, July 2006.
Household survey questionnaire, CEEPA project in Zambia, 2003 (from S. Jain, UNZA)
Langmead, Peter et al. eds. Tax Policy Issues in Zambia: Selected Papers. Langmead & Baker Ltd. Zambia, 2006.

[CSO]

Central Statistical Office (CSO) (2006) Agriculture Production: Post Harvest Data 2003/2004 for Small and Medium Scale Farmers.
CSO(2004) Agricultural and Pastoral Production: Structural Type and Post Harvest Data 2002/2003 for Small and Medium Scale Farmers.
CSO (2005) Living Conditions Monitoring Survey Report 2004.
CSO (2004) The Country and its People: A Summarized version of the 2000 Census of Population and Housing in Zambia.
CSO (2005) ZambiaInfo Version 2.0. (Data for Provincial and District Level Data in CD).
CSO, National Accounts Statistical Bulletin No. 9: 1994-2005. CSO, October 2006.
CSO, Selected Socail Economi Indicators; 2004-2005. CSO, November 2006.
CSO, Selected Social Economic Indicators; 2003-2004. CSO, January 2006.
CSO, Post-Harvest Survey 2004/05 data set. [SPSS file]
CSO, Living Condition Monitoring Survey data set 1996-1998. [CD]
CSO, Zambia HIV/AIDS Service Provision Assessment Survey 2005. Ministry of Health, Central Statistical Office, ORC Macro, July 2006.
CSO, Zambia Sexual Behaviour Survey 2005, Central Statistical Office, Ministry of Health, MEASURE Evaluation, March 2006.
CSO, The Non-Farm Informal Sector in Zambia 2002-2003, Central Statistical Office, February 2006.
CSO, The Evolution of Poverty in Zambia 1991-1996. Central Statistical Office, December 1997.

[HIV/AIDS]

FASAZ, Baseline report on the interlinkages between HIV/AIDS, agricultural production and food security, Southern Province, Zambia. Integrated Support to Sustainable Development and Food Security Programme, FAO. June 2003.
Chilshe L. Mulenga, Social Norms, Human Rights and HIV/AIDA in LCCB Project Areas in Zambia: Research Report. Local Community Competence Building and HIV/AIDS Prevention Project. CHAZ/DCA/INESOR, October 2005.
[Chikankata Hospital]
Chikankata Church Health Institution, Local Community Confidence Building Project [PPT file]
Chikankata Church Health Institution, Local Community Competence Building in HIV/AIDS/STIs Prevention

[PPT file]

Community Mobilization [PPT file]

Local Community Confidence Building Project: Character of the project in the next phase [PPT file]

Chikankata Health Services, Community members input in programme extension [PPT file]

Community Support Groups [PPT file]

[ZVAC]

Rapid Floods Assessment Report-Bangweulu Swamps and Islands: Final Report. February 2005, Vulnerability Assessment Committee. [Word File]

Final Analysis Report on the Phase Out/Scaling Down of Emergency Relief Programme. March 2006, Zambia Vulnerability Assessment Committee. [Word File]

2005 Vulnerability and Needs Assessment. June 2005, Zambia Vulnerability Assessment Committee (ZVAC). [Word File]

Zambia Vulnerability Assessment Committee, Comprehensive Vulnerability Assessment and Analysis (CVAA) Survey 2006, Household survey questionnaire (district, community, household levels) and concept papers. ZVAC/OVP-DMMU, Office of the Vice President, 2006 [unpublished material].

[ZARI: includes files obtained in June 2006]

Domestication and Commercialization of indigenous fruits [PPT file]

AfricaNUANCES Detailed Farm Characterisation Questionnaire [Word file]

AfricaNUANCES Project Questionnaire [Word file]

Setting Indicators for Definition of Farm Typologies-Rapid Rural Appraisal for Kalomo and Sinazongwe Districts, Zambia Agricultural Research Institute, August 2005 [Word file]

Suggested Outline for IP Impact Study Report-Baseline Final Report Sinazongwe Draft 1 [Word file]

Moses Mwale et al. Participatory Diagnosis of Constraints and Opportunities at Community and Plot Level: Agro-economic Assessment of Agricultural Production and Soil and Nuturient Management in Zambia, December, 1999. [Word file]

Sinazongwe Summary Report [Word file]

[Others]

Arnold, Guy. Africa: A Modern History. London: Atlantic 2005.

Chipungu, Samuel N. ed. Guardians in their Time: Experiences of Zambians under Colonial Rule, 1980-1964. London: Macmillan, 1992.

Colson, Elizabeth (1971) The Social Consequences of Resettlement: The Impact of the Kariba Resettlement upon the Gwembe Tonga. Manchester: Manchester University Press.

Eberiei, Walter et al. eds. Poverty Reduction in a Political Trap?: The PRS Process and Neopatrimonialism in Zambia. Lusaka: UNZA Press, 2005.

C.R. Hopegood (1940) A Practical Introduction to Chitonga. Lusaka: Zambia Educational Publishing House.

Kay, George (1967) Changing Pattern of Settlement and Land Use in the Eastern Province of Northern Rhodesia. Occasional Papers in Geography No. 2. University of Hull Publications.

Macintosh, Donald. Forest of Memories: Tales From the Heart of Africa. London: Little Brown and Company, 2001.

Moonga R.N., F.W. Wafer (1997) Mweenzu Wafwulwe Ulalila Bowa (An advanced Chitonga Langueage Course)

2006 年 7 月 21 日

ザンビア出張報告

京都大学大学院農学研究科土壌学分野
真常仁志・宮嵜英寿・野呂葉子

1. 目的

・　テーマ1の調査地の決定、土壌試料採取
・　Study Permit の取得

2. ザンビアでの旅程

6 月 11 日　真常　ザンビア到着。6 月 15 日まで、梅津さん・櫻井さんに同行
6 月 16 日　宮嵜・野呂　ザンビア到着。Immigration Office
6 月 18 日　Lusaka-Petauke 移動
6 月 19～28 日　現地調査
6 月 29 日　Petauke－Lusaka 移動
6 月 30 日　Immigration Office、Mt. Makulu Research Station
7 月 1～2 日　Sinazongwe 訪問
7 月 4 日　ザンビア出国

3. 現地調査

現地調査の内容は、大きく二つに分けられる。一つは、調査地の使用許可を関係者・関係機関から得ること、もう一つは、調査地の概要を知るための調査である。現地調査には、ZARI(Zambian Agricultural Research Institute)から Mr. Sesele Sokotela に同行してもらった。

3－1. 使用許可の取得

6月19日（月） DACO での説明

6月13日の Mt.Makulu での話し合いより Theme I で研究に使う土地の規模がかなり大きいため Petauke の DACO（District Agricultural Coordination Officer）を通じて適当なフィールド候補地の情報を得、地元の村長と話し合い理解と協力を得る必要があるとのコメントを得ていた。そこで、Petauke の DACO に寄るが不在であったため Mr. Sikombe （SAO：Senior Agriculture Officer、DACO の下で実務を取り仕切る立場にあるようだ）に研究計画を説明。更に、Mr. Sikombe に候補地の BEO（Block extension officer）である Mr. Davis Siwo を紹介してもらい、研究計画を説明。また、研究をはじめるにあたっての話し合いをどのように進めればよいかたずねた。

土地を用いての研究をするには、まず、Chief （Mr. Sandwe）にあって了承を得る。その後、候

補地である Mwelwa 村の Headman（Mr. Dickson Banda）に許可をもらうのが一番よいと教えてもらう。Chief に会うために BEO に翌日同行してもらうことになる。

ここで、行政区分として District は Block、Camp、Zone の順に細分化される。Petauke District の場合は5つの Block に分けられ、候補地の Mwelwa 村は Chinika Block（Msanzara 川と Mawanda 川の間）、Mawanda Camp、Zone 1 に属する。一方、行政上の組織とは別に、Chief を長とする（民族的？）ヒエラルキーも存在するので、両系統に話を通しておくことが重要なようだ。

6月20日（火） Headman・Chief への説明

Chief の所在が不明確で、更に、Mawanda camp の CEO（Camp Extension Officer）である Mr.Johnson Banda が不在だったため、Mwelwa village の Headman をたずねた。

Headman と Camp Secretary の Mr.Dauglaus Chupa Banda と数人の村人の前で研究計画を説明した。その際、Headman から村人全員を集める機会を改めて設け、研究の説明するよう求められた。また、村人（Headman の兄弟）の葬儀のために Headman が同行できなかったので、替わりに Camp Secretary に候補地を見てもらった。

Chief が帰宅したとの情報を入手し、Chief の住居（Palace と呼ばれていた）を CEO とともに訪問した。Mr.Sokotela が研究計画を説明し了承を得た。

6月28日（水） 村民への説明

Mwelwa 村の住人と Chinika Block 内の他村の Headmen に集まってもらい研究計画を説明するための meeting を開いてもらった。子供以外の男女ほとんどの村人が参加していた。また、CEO、Camp Secretary にも出席してもらい CEO には Mr. Sokotela が英語で説明する我々の研究計画を現地語で通訳してもらった。研究計画については Theme I でおこなう内容を説明し、今後調査地内での木の伐採などしないでほしいとお願いした。

研究計画を説明した後の質疑応答では以下のようなやり取りがあった。

・Chipela 村の Headman から「調査地はどのようにして決めたのか」と質問された。

⇒まず初めに、道路事情が良好で Petauke 近辺の森林を地図上で目星を付け、その後、現地に赴き我々が求めていた条件を満たすかどうかを視察したこと、候補地としては Gabriel village と Mwelwa 村があがったが、Gabrie 村は広域が確保できなかったので Mwelwa に決めたこと、を説明した。

・村人からは「肥料の配給はないのか」との質問。

⇒今回は調査であって、支援活動ではないことを告げた。

・村人から「調査によって、現在耕作している畑への影響はないのか」との質問

⇒「調査は、現在休閑地となっている場所で実施するので、影響はない」と回答

・我々側からは「調査地はどのくらいの期間耕作していないのか」と質問した。

⇒Mwelwa 村の Headman いわく、60 年代に開墾したものの数年で利用しなくなり、それ以来農耕地としては使用していないらしい。

３－２. 現地調査

６月２１日（水）

調査地内の胸高直径 27cm以上の比較的大きい木をラベリングするとともに、GPS で位置情報を取得した。

６月２２日（木）－２６日（月）

前日の植生調査の結果から、大木の存在する範囲をできるだけ広くカバーするように調査地を設定した（面積約 17ha）。調査地内で約 40m 間隔で土壌調査。計 100 地点。各地点で 100cc コアサンプラーを用いて 0-5cm、5-10cm の土壌サンプルを採取した。また、オーガーを用いて 50cm の深さまで 10cm おきに現場土性と現場礫含量を調べた。試料採取地点の位置情報は、GPS で取得するとともに、周辺に存在する大木 2 本からの距離もできるかぎり測定した。今後、精密な測量により大木の位置を同定すれば、土壌試料採取地点の位置もより正確に同定できる。なお、GPS により測定された２点間の距離とメジャーで測定した距離の誤差は、せいぜい１ｍ程度であることを確認している。

６月２７日（火）

２２－２６日の調査の結果から調査地内の代表的な地点と森林と耕作地の境界線付近で土壌断面調査を行なった。

６月２８日（水）

ラベリングした木に関して、村人の協力を得、現地名で同定を行なった。

調査地の様子

土壌断面

30cm からプリンサイトを多量に含んだレキ層が出現

村人とのミーティングの様子

ザンビア・フィールド調査報告（吉村充則・山下　恵）
2007 年 8 月 22～9 月 5 日

1. 目的

ザンビア側共同研究機関の決定と打ち合わせ
土地利用・被覆解析のための現地踏査

2. ザンビアでの日程

8 月 22 日(火)　　夜、関空発
8 月 23 日(水)　　UAE(ドバイ)・南アフリカ(ヨハネスブルク)経由　夜、ザンビア(ルサカ)着
8 月 24 日(木)　　Immigration HQ Office、Mt. Makulu Research　Station
8 月 25 日(金)　　Survey Department、Meteorological Department
8 月 26 日(土)～29 日(火)　南部土地利用・被覆解析のための現地踏査
（Sinazeze/Sinazongwe/LivingStone/Gwembe）
8 月 30 日(水)　　南部土地利用・被覆解析のための現地踏査(Lusitu/Siavonga)
8 月 31 日(木)　　Survey Department、Central Statistical Office、Water Affairs Department
9 月　1 日(金)　　University of Zambia、Central Statistical Office
9 月　2 日(土)　　午後、ザンビア出国

3. 関係機関との打ち合わせ等

3-1. Immigration HQ Office

調査許可を受け取るのみの訪問。受け取り手順は、梅津さん作成の手順書通り。
ただし、建物入り口の混雑を無視して建物内に入る必要あり。また、手続き開始時間は、そこにいる女性の携帯電話で午前９時半より。
オフィシャルな窓口が開いている時間は、午前９：３０～１２：３０、午後２：３０～４：３０
受け取りの手順は、
Room16「Collection of Permits」にパスポートを持参し、申し出る。書類を捜してくれて、コピーを取って戻ってくるように指示される。
Room８でコピーを取ってもらう。係りが不在の場合、戻るまで待つしかない。
2 階の Room106 でパスポートにスタンプをもらう。
これだけに約１時間。実に非効率的。しかし、絶対的権力を行使されるので、黙って我慢するしかない。

Mt. Makulu Research　Station

Vice Director の Mr. Moses Muwale、GIS Specialist(?)の Mr.Austin Mombo と打ち合わせ。持参したプロジェクト全体とテーマ４の概要(添付資料参照)を説明。その後、同所の GIS システムを見学。搭載されているソフトは、ArcView3.2 と古い。その他、HP のプロッタ・A0 版スキャナ・ディジタイザで構成されているシステム有り。しかし、活用されている様子はまったくなく、カウンターパートとしては、力不足の感想を持つ。
また、Meteorological Department は、種々データを国内外問わず、データ量に応じて課金するシステムで販売していることを確認。したがって、データの無償供与等の便宜が Meteorological Department から得ることができなければ、同所と共同研究を実施するメリットのないことが確認できた。また、今後のデータ購入にあたっては、Mt. Makulu Research　Station が仲介を申し出てくれた。
さらに、訪問時点では確定していなかった Survey Department からの航空写真購入(後日、同所から便宜を得られることを確認)についても、同様、仲介いただけることが確認できた。

3-2. Survey Department

昨年面会した Survey General との面会予定であったが、留守だったため、Assistant Survey Genaral である Mr. Raynold Moyo と昨年も面会した Chief of Cartgrapher の Mr Mooka と、プロジェクト全体とテーマ４の概要を説明し、打ち合わせを行った。おおよその理解を得ることができ、プロジェクト実施にあたって、現在調整の進んでいる Mt. Makulu Research　Station と総合地球環境学研究所の間の MOU に同所も加わることで基本的合意を得た。文書に経費等記載しないことも確認済み。

したがって、テーマ４のザンビア側カウンターパートを Survey Department とすることとした。

また、滞在中、2 度の打ち合わせを行い、同所の持つ地形図や航空写真について便宜供与が得られることを約束した。今後の進め方については、打ち合わせ毎で議事録を作成し、両者で合意を確認しながら進めることとなった。MOU についても同様。また、現地調査についても、経費は総合地球環境学研究所が持つが、同行するとの確認が得られた。地図等を数枚供与してもらった。

私案ではあるが、

これから必要となる地形図・航空写真については、プロジェクトで１本化して Survey Department と対応したい。また、地形図・航空写真ともに無償供与が期待できるが、地形図程度は購入するほうがよいのではないか。また、すでに何枚かの地形図は重複購入しているので、早急に体制を構築したい。

3-3. Meteorological Department

事前に Mt. Makulu Research　Station での打ち合わせで、同所からデータを購入する場合の協力については得ていたので、表敬訪問といった位置づけで訪問した。Mr.Joseph Kanyanga と面会し、準備したプロジェクト資料およびテーマ４概要について簡単に説明した。Kanyanga 氏は、テレビの天気予報(当日夜放映)の収録に忙しいらしく、話しもそこそこに同所 Director の Mr. Maurice R. Muchinda のオフィスに連れていかれた。そこで、再度プロジェクトとテーマ４概要について説明したところ、Water Affairs Department で過去に実施された「Water Resources Master Plan 1994」が全国のさまざまな気象データを使っていると紹介された。また、Water Affairs Department の Director を訪ねれば話しをしてくれるだろうという情報を得た。

3-4. Central Statistical Office

6 月に訪問した梅津さん・櫻井さんより頼まれた Post Harvest Survey 2004/2005 について、データの受け取りに行く。しかし、最初の訪問では、すぐ準備ができないのでということ。週末には帰国するのでと事情を説明したところ、翌日に渡すとのことだったが、結局入手できず。話しでは、翌週にメイルで送るということだったので、櫻井さんに直接送って欲しい旨を依頼する。帰国後、確認したが未着とのこと。結局、どうなったかは不明。

3-5. Water Affairs Department

Meteorological Department の Director Mr. Maurice R. Muchinda に紹介されて、Mu l ungus h i House にある Water Affairs Department を訪問し、「Water Resources Master Plan 1994」について、Senior Hydrogeologist の Mr. Simon Kangomba に話しを聞いた。同プロジェクトは、JICA のプロジェクトとして実施され、八千代エンジニアリング１９９５OCT　ファイナルレポート「The study on The National Water Resources Master Plan in The Republic of Zambia」No.92 SSS JR 95-127 としてまとめられていることがわかった。今後、JICA へコンタクトし、同報告書を入手し、内容を把握する予定である。

4. ザンビア南部における土地利用/土地被覆

テーマ 4 サブテーマ 2 では、独立後の国策や人間活動による土地利用の変遷、および異常気象などによる農作物・植生への影響をモニタリングすることを主目的としている。この目的遂行のためには、現状の土地利用/被覆を把握することが必要となる。2006 年 8 月 26-30 日にかけて、ザンビア南部（Lusaka～カリバ湖周辺 Sinazongwe 地区～Choma～Livingstone～Gwenbe 地区、および Lusaka～Lusitu～カリバダム・Siavonga）における土地利用/土地被覆の視察を、GPS および Landsat 衛星画像を基にして行った。
図-1 は、GPS を用いて取得した踏査軌跡と衛星画像/空中写真/既存地形図等の幾何学的補正のため地上基準点(Ground Control Point :GCP）を、2001～2002 年に撮影された LANDSAT/ETM 画像データ 4 シーンに重ね合わせて表示したものである。

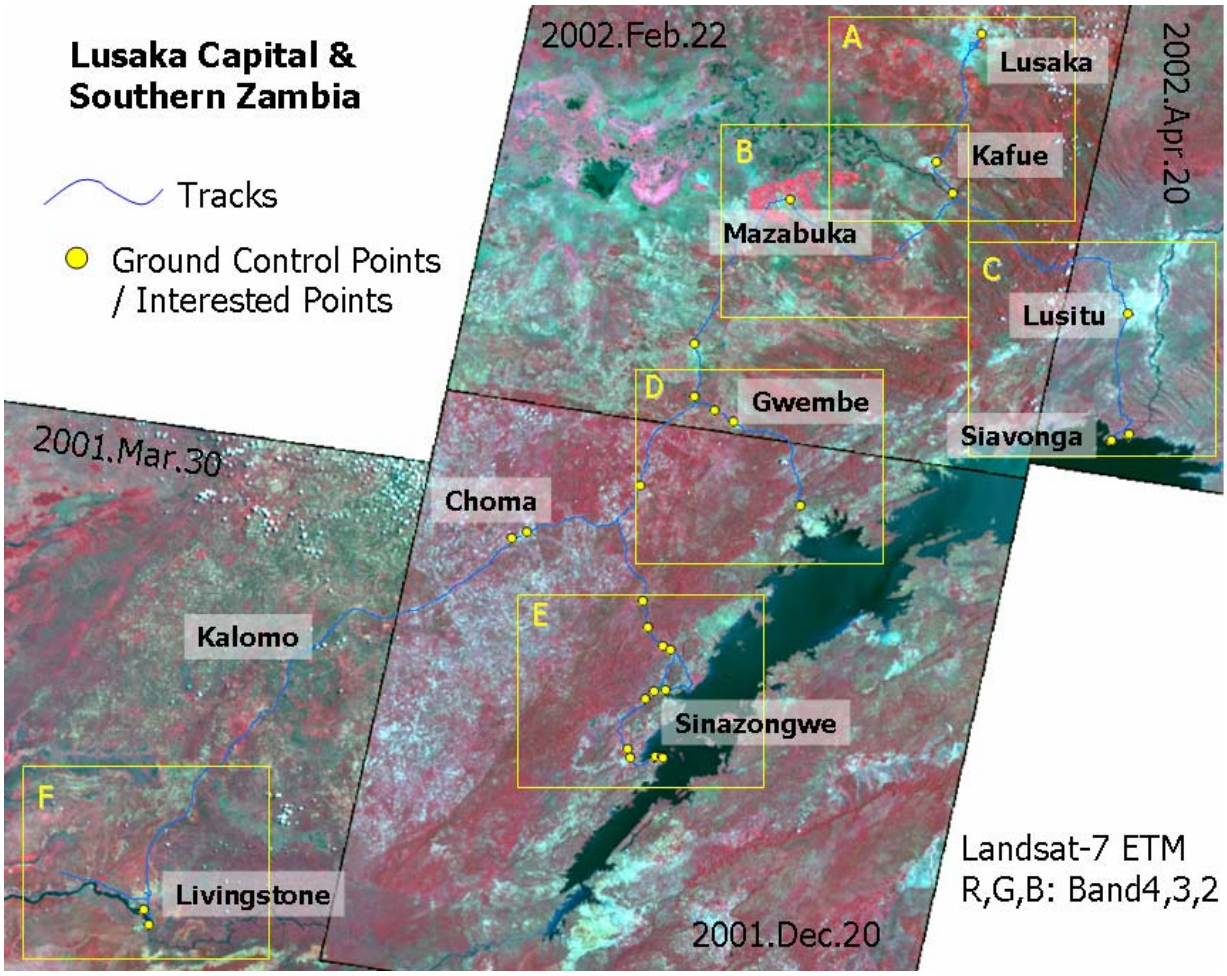


図-1.　ザンビア南部の衛星画像（LANDSAT-7/ETM）と踏査軌跡

LANDSAT7 号に搭載された ETM+ (Enhanced Thematic Mapper Plus)は、可視光域から短波長赤外域、および熱赤外域を 8 つの波長帯（バンド）に分けて、地表面の放射輝度を観測する光学センサーある。ETM センサーの持つ 8 つの波長帯は、バンド 1: 0.45~0.52μm(青)、バンド 2:0.53~0.61μm（緑）、バンド 3: 0.63~0.69μm（赤）、バンド 4: 0.75~0.90μm(近赤外)、バンド 5: 1.55~1.75μm(中間赤外)、バンド 6: 10.~0.90μm(熱赤外)、バンド 7: 2.09~2.35μm(中間赤外)、バンド 8: 0.5 2~0.90μm(緑から近赤外)で構成されており、地上分解能（解像度）は、バンド 1～5,7 の 30m、バンド 6 は 60m、バンド 8 が 15m である。図-1 の Landsat/ETM 画像は、RGB カラー合成において、バンド 4（近赤外）に R（赤色)、バンド 3（赤）に G（緑色)、バンド 2（緑）に B（青色）を割り当てたフォールスカラー画像で、赤色系に見えるところが

植生のある領域を示す。
以下、図-1 に示す A~F 領域を示しながら踏査概要をまとめる。

Lusaka～Sinazongwe（図-1 の A、B、E 領域）

A 領域：

ルサカ市から南へ 10km ほどで農地が広がる郊外に出る。所々、灌漑が行われ、鮮やかな緑色の農作物が乾期でも見られる。衛星画像上では、ルサカ市から南へ走る道路東側に見られる鮮明な赤色をした土地が灌漑農地である。さらに南へ進むとしばらく緩やかな起伏のある地形（画像上で陰影が認められる）となり、小さな村が点在する。植生は、密度が中程度の低木林である。ルサカから約 40km で Kafue に入る。鉄道と道路との交差点で GCP（Kafue Railway）を取得する。Kafue には、大きな工場（INFRASET ZAMBIA LTD.）があり、コンクリート建設の住宅が多数みられる。Kafue の中心から約 10km 南東に進み Kafue 川を渡る橋で GCP（kafue Bridge）を取得する。この橋は、1993 年 JICA プロジェクトで再建されたものである。橋から数 km 先で右折し、Choma/Livingstone 方面へと進む。

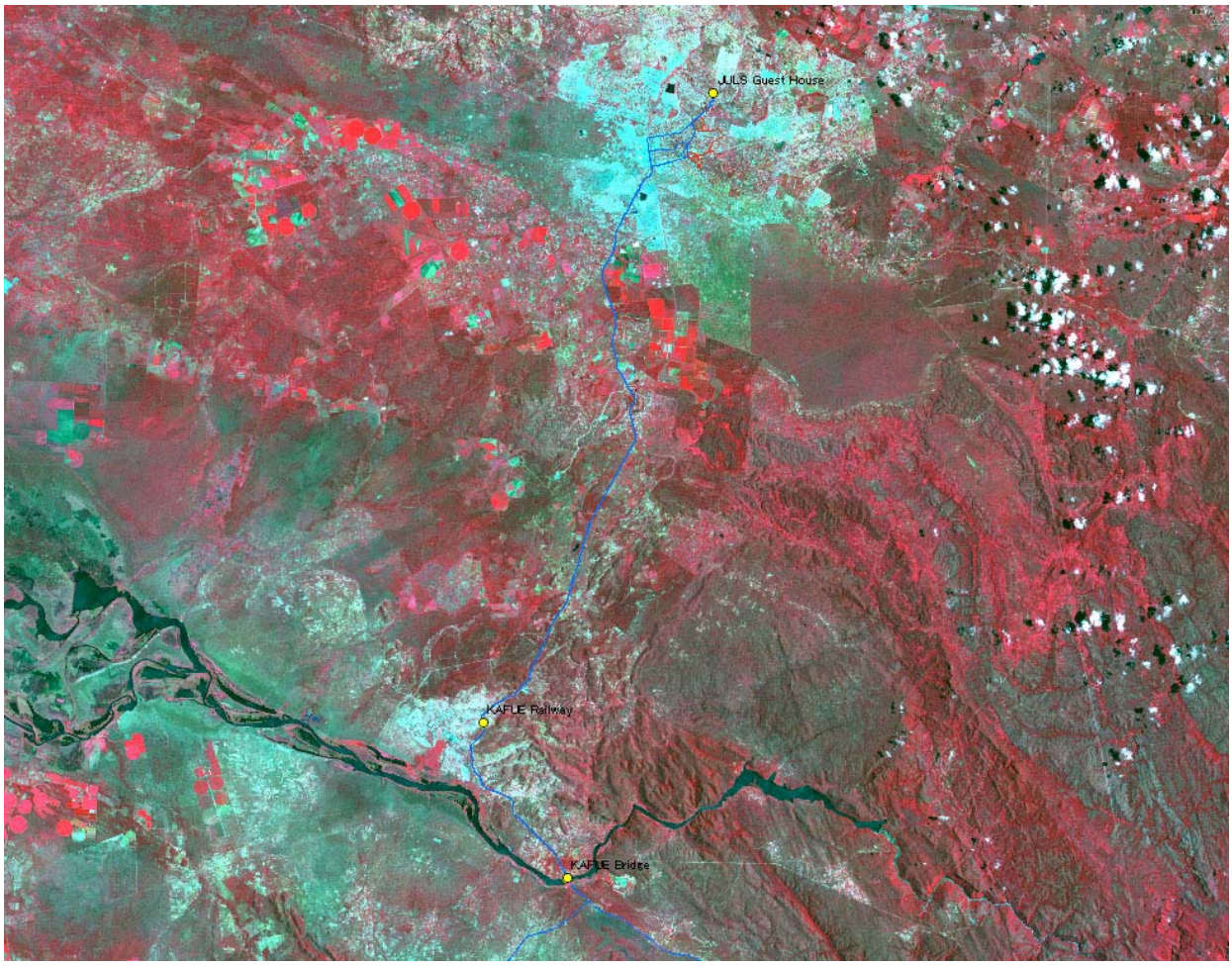


図-1_A. Lusaka 市から Kafue の街、Kafue River 周辺（画像の縦の長さが約 64km, 2002/2/22 撮影）

B 領域：

右折してから約 10km 区間は、道路両側に低木林（密度低い）が続き、ザンビアの典型的な家屋が点在し、所々に火入れをした形跡が見られる。その先に、北西－南東に連なる緩やかな丘陵地に入ると比較的密度の高い低木林が並び、道路からは家屋は見当たらない。丘陵地を越えて平地に入ると、広大な草原に村がみられる。草原から農地に土地利用は変わり、灌漑によるコーヒー園が道路東側に広がる。その西側には、村と牧草地がみられる。コーヒー園の先には柵で囲われた牧草地（DALIS PANCH の看板あり）が広がる。

さらに数キロ先から、道路の両側に、密度の低い低木疎林が広がり、DIMBA FARM の看板があちこちに見られる。約 20 数 km に渡り、道路との境界には柵で囲われたブッシュの光景が続く。
MAZABUKA の中心地より手前 6km くらいから、草地にかわり、村がみられる。
街の中心地には、鉄道との交差点があり、そこで GCP（MAZABUKA）を取得する。MAZABUKA の街を囲むように見られる広大な灌漑農地（画像上で鮮明な赤色をした幾何学模様）が見られる。道路近くから確認できたのは、サトウキビを成長段階に分けて栽培している一画であった。灌漑農地を抜けると、草地に所々低木と村が点在した光景に変わる。

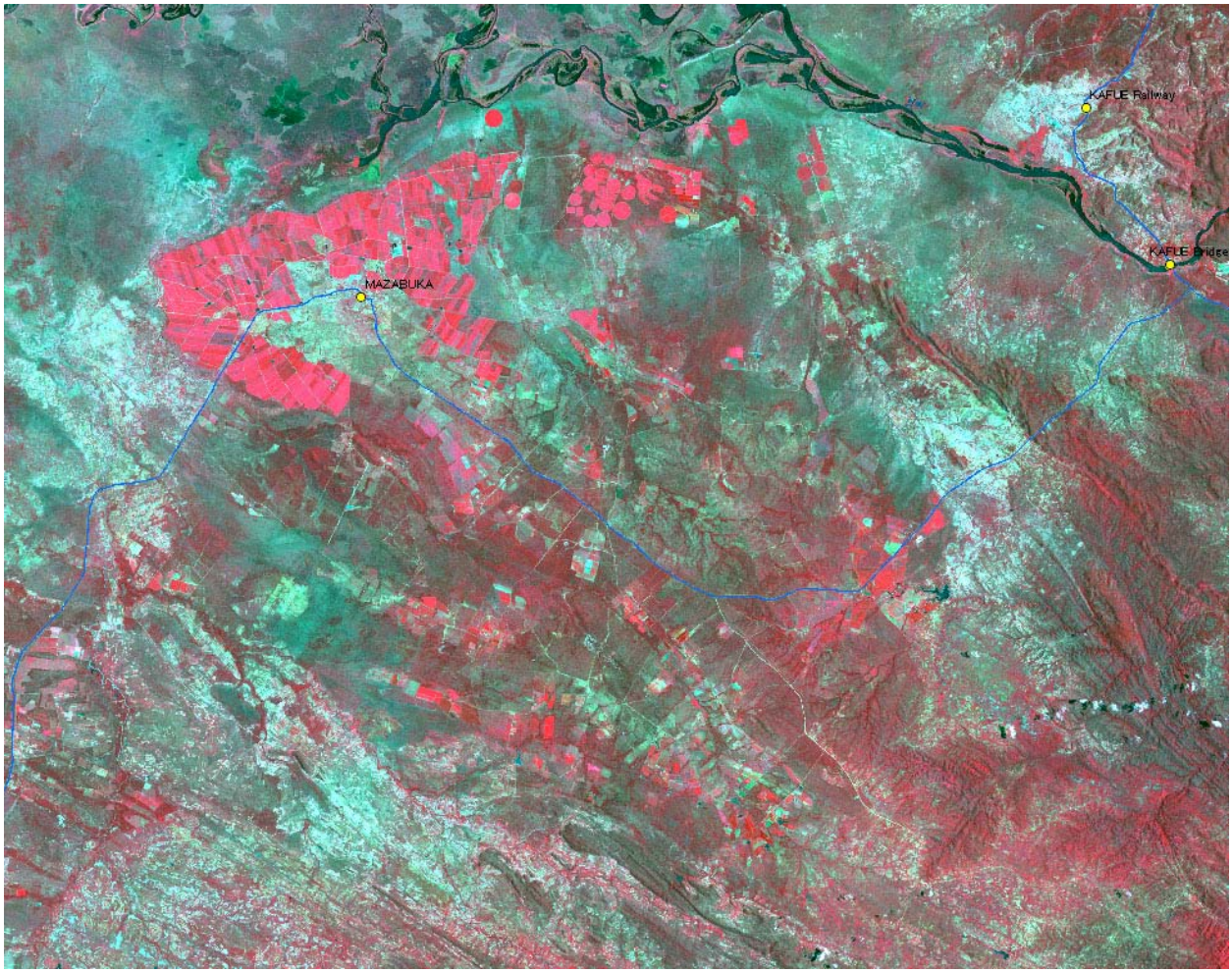


図-1_B. Kafue 川と MAZABUKA 周辺（画像の縦の長さが約 64km, 2002/2/22 撮影）

MAZABUKA から南へ約 120km の区間、Monze,Chisekesi,Pemba, Muzoka, Batoka の集落を通過し、Sinazongwe 方面へ左折する。この区間は、牧草地、低木林、草原に村が多く点在している。

E 領域（上）：
Batoka から左折して約 36km のところで Sinazongwe District に入る。この間、地形は平地から起伏のある丘陵地へ変わり中低木林が広がる。村のあるところは草地で、地形も比較的平らなところに見られる。
Sinazonge District に入って数 km のところに、Malabali という名の村がある(GCP:NAKAMURA)。ここには島田さんの学生（中村さん）が住み込みで調査を行っている。そこからカリバ湖方面へ 8km 先に、中国企業の炭鉱場へ右折する道路（GCP: COAL MINE）がある。さらに 2km 先で、Sinazeze の街。その先 1km のところで、左折すると、両側に低木林で覆われた丘陵が望める。カリバ湖畔近くの灌漑農地（ZAMBEEF の農場）が東側にみられる。この灌漑農地は、1990 年に撮影された Landsat 画像と比較すると規模が縮小していることがわかる。灌漑農地から数キロ先で、Sinazongwe の街に到着する。

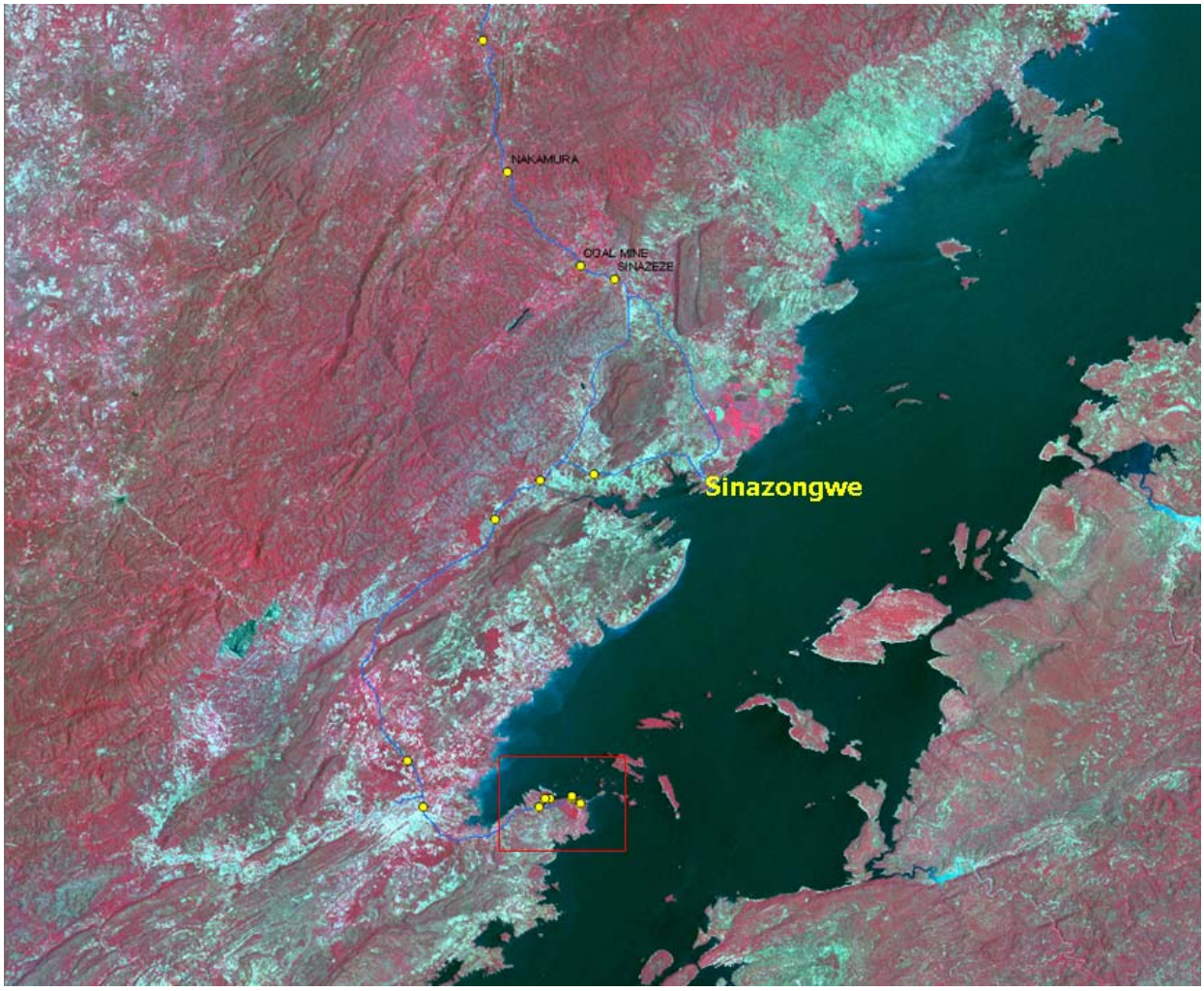
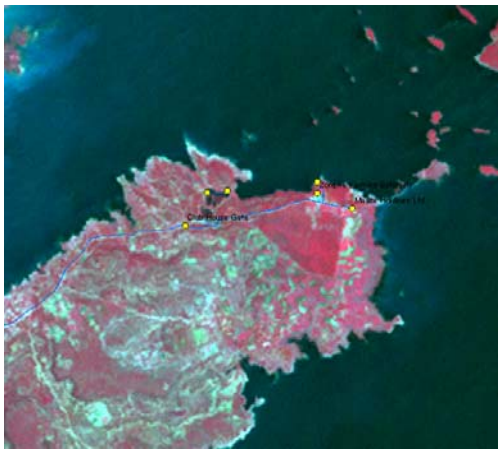


図-1_E. Sinazongwe 地区とカリバ湖（画像の縦の長さが約 64km, 2001/12/20 撮影）

Sinazongwe～カリバ湖～Livingstone (図-1 の E,F 領域)

E 領域（下）:



Sinazongwe の街から南西方面へ向かう。途中、カリバ湖へ流れる小川と道路が幾つか交差する。乾期のため、干上がった川もみられる。植生は、密度が中くらいの低木林が多く、バオバブの巨木も多い。Sinazongwe の街から 2 7 km くらいで左に曲がる道へ入る。Siatwinda, Siawsbi, Kanchindu の集落があり、村も点在する。画像上で白い小さな斑点に見えるのが村である。この先、道なりに進みながらカリバ湖畔を目指す。図-1_E の赤枠で囲んだ領域を拡大した画像を右に示す。ここは、市販の地図にも地名が記載されていないところだが、GPS を頼りに道なりに進むと、柵に囲まれたゲート（入場料を払うよう求められる）があり、その先に行くと、ワニ養殖場がある。南アフリカの養殖業者 Zongwe Farming Enterprise が 20 年前に建設し、ここで働く労働者用の住居も建てられている。養殖ワニは、ワニ革製品の原料として、日本・シンガポールに輸出されている。さらに奥には、小さな Market があり、養殖場の住人による小さな町となっている。湖畔の灌漑で作られた青菜も売られている。また、養殖場のとなりには、外国人向けのゲストハウス・ロッジ、クルージングなどのリクリエーション設備がある。

この後、来た道を戻り、Sinazeze,から北へ、Batoka で左折し、 Choma、Kalomo を経由して Livingstone へ向かう。Batoka から Choma,Kalomo までは、牧草地、低木林、草原が小さな村が点々と見られるが、Kalomo を過ぎると、大きな集落はほとんどなく、村も少ない。

F 領域：

Livingstone の南には Mosi National Park があり、植生は保護されている領域が多い。街から西へ向かう道路沿いにも、保護林として囲われている一画がみられる。Livingstone 以外に、大きな集落・街はない。画像上でも、大きな村の存在はほとんど認められない。地形的特徴として、Victoria Fall 下流には、プレート移動による大地の裂け目、侵食された谷が、画像上で多数確認できる。

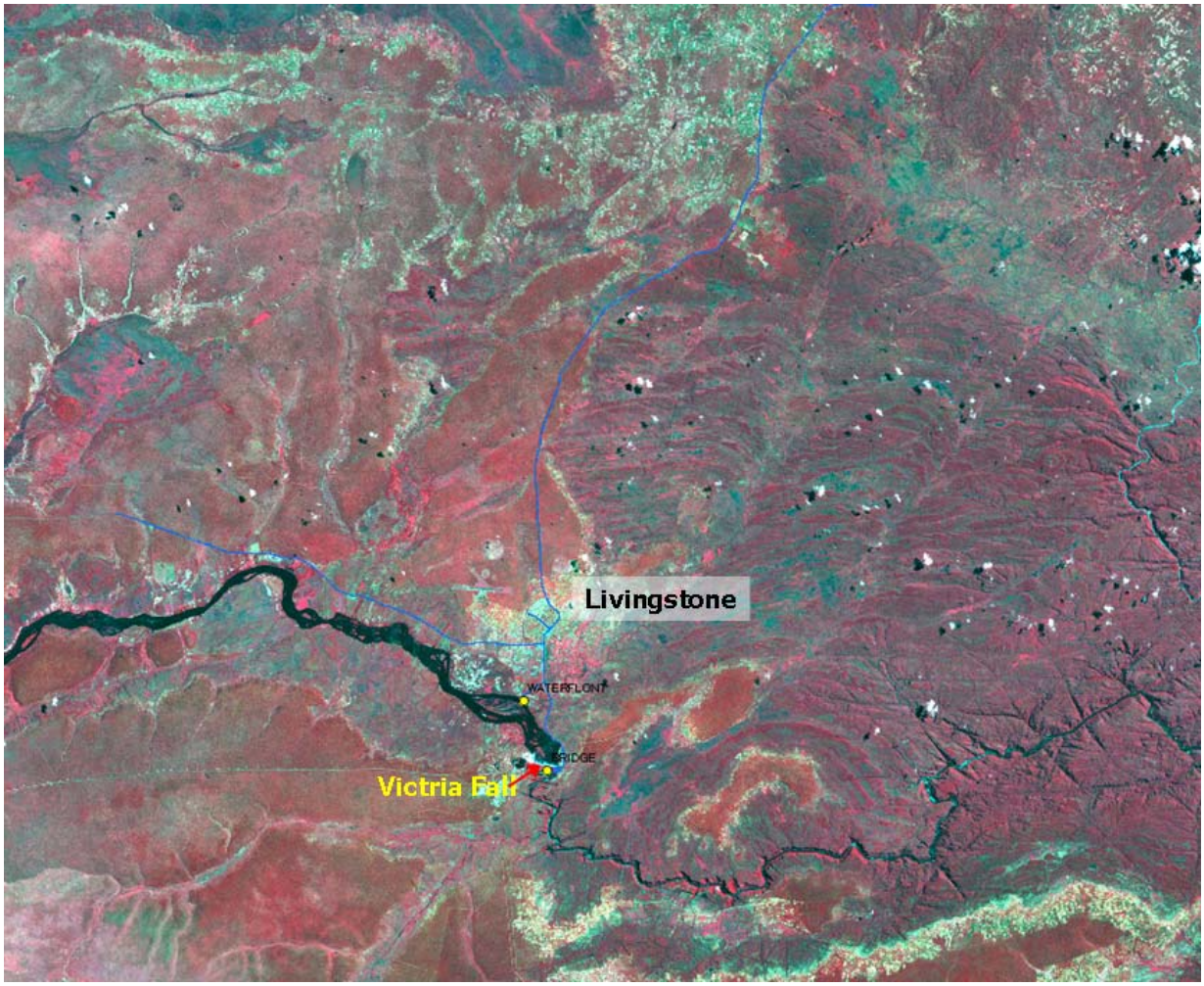


図-1_F. Livingstone とザンベジ川　（画像の縦の長さが約 64km, 2001/3/30 撮影）

Gwembe (図-1 の D 領域)

D 領域：

Gwenbe の街は、Lusaka-Livingstone を結ぶメインロード沿いにある Chiselesi から東へ入り 15,6km のところにある。街の中心すぐ手前に、DUNAVANT という大きな Cotton 集積場がある (GCP: DUNAVANT)。街の規模は大きいとは言えないが、集積場の近くは平原で、村も広範囲にわたって点在している。綿花を換金作物として育てていると思われる。

Gwenbe の中心地から南東方向へ 4km 進むと、平地から起伏のある山地に変わる。植生は、密度が中程度の中高木林が約 20km 続いている。この区間にも、小さな村の集まりが幾つか見られる。

山を下りると、Lukonde という集落があり、そこからもう一つ峠をこえると、Fumbo という集落がある。この先も再び起伏のある地形となり、山肌には岩場がみられる。道は、途中で建設中となり、これ以上先へは進めず、Gwenbe からのルートによるカリバ湖へのアクセスは、不可能となった（GCP: END）。

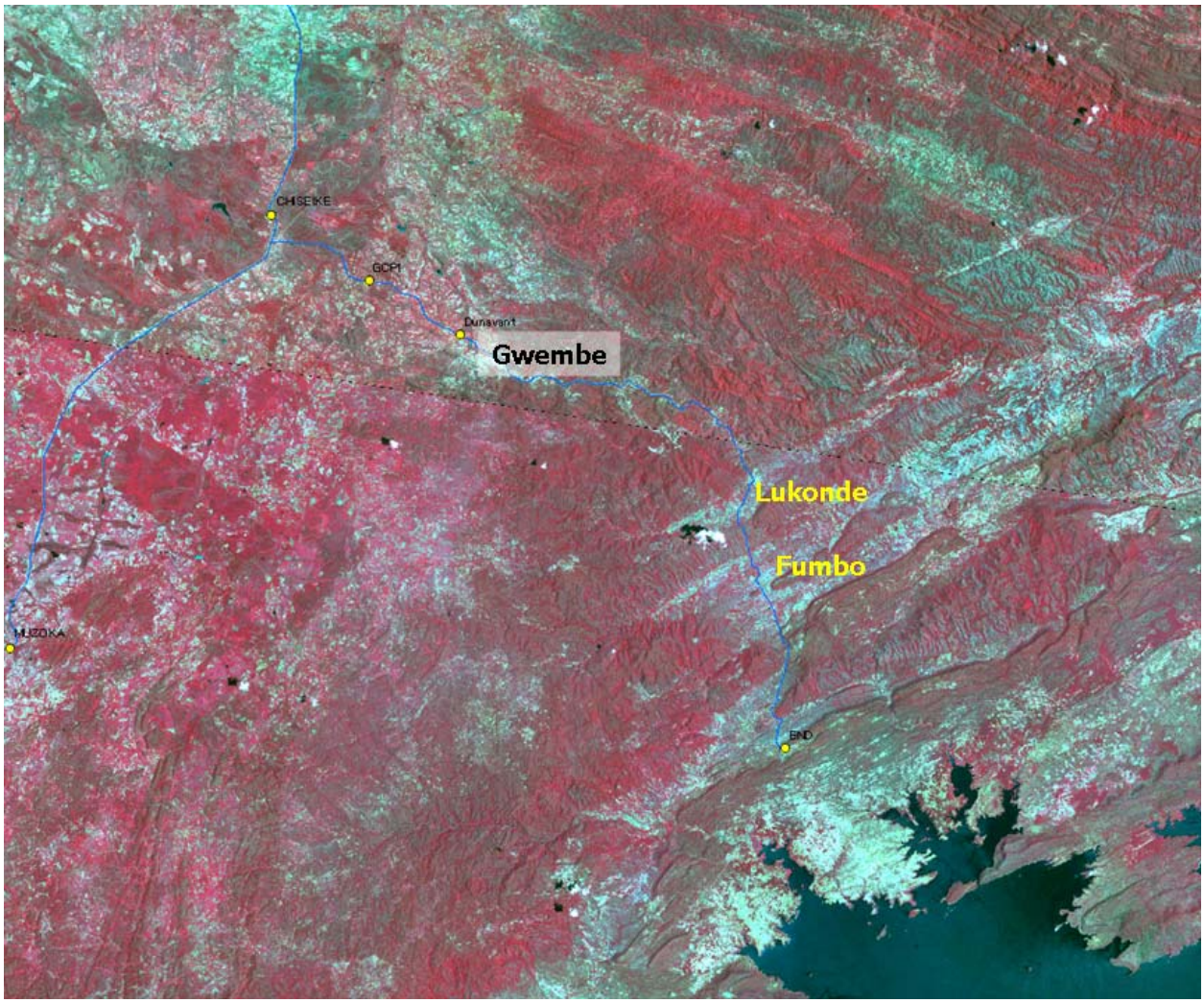


図-1_D. Gwenbe 地区　（画像の縦の長さが約 64km, 上:2002/2/22, 下:2001/12/20 撮影）

Lusitu～カリバダムと Siavonga （図-1 の C 領域）

Lusaka から Kafue 川を渡って直進し約 120km のところにカリバダム、Siavonga 方面へ右折する道がある。Kafue 川を渡ってからは大きな街はなく、小さな村は幾つか見られるが、比較的密度の高い中低木林で覆われた地域である。道路を右折する 800m ほど手前で、カリバダムからの大きな送電線と交差する。

右折して約 4km、中低木林が続く。その先は村と牧草地が混在する領域が約 10km 続き、赤土が露出した土地に変わる。ここが Lusitu である。街の中心には、ザンベジ川の支流 Lisitu 川が流れており、この橋で GCP を取得する。

橋で偶然会った現地の方に、この地域について話を伺う。近年、エイズ感染者の増加が問題になっている。また、土壌浸食の激しい地域で、1996 年には橋を超えるほどの洪水により広範囲で土壌が侵食された。したがって、ここでは、開発援助よりも、環境教育や保健衛生教育が必要であると。彼は、1988-99 の 10 年間、JICA の農業水資源開発プロジェクトの現地スタッフとして勤めた経歴をもつ方だった。

この橋の近くから 2km ほど入ったところに、島田さんの学生（伊藤さん）が住み込みで調査する村がある。周辺には１６の村があり、画像上でのはっきりと認められるように、広大な集落を形成している。

Lusitu から 40km 南に進むと、カリバダムと Siavonga 方面への三叉路がある。ここから東に 3km ほどでカリバダム、南西に 6km 行くと Siavonga の街がある。

カリバダムでは、イミグレーションで仮の出国スタンプを押された紙をもらい、ダムの見学ができる。ダムの真ん中で GCP を取得。
Siavonga の街は、カリバ湖畔に接した斜面に立地しており、家屋は、コンクリートはブロックで建てられたものがほとんどである。小魚を干したカペンタを作っている光景や、リゾート気分を味わえるロッジが幾つか見られる。カリバ湖の資源を利用した豊かさが、街全体で伺われる。

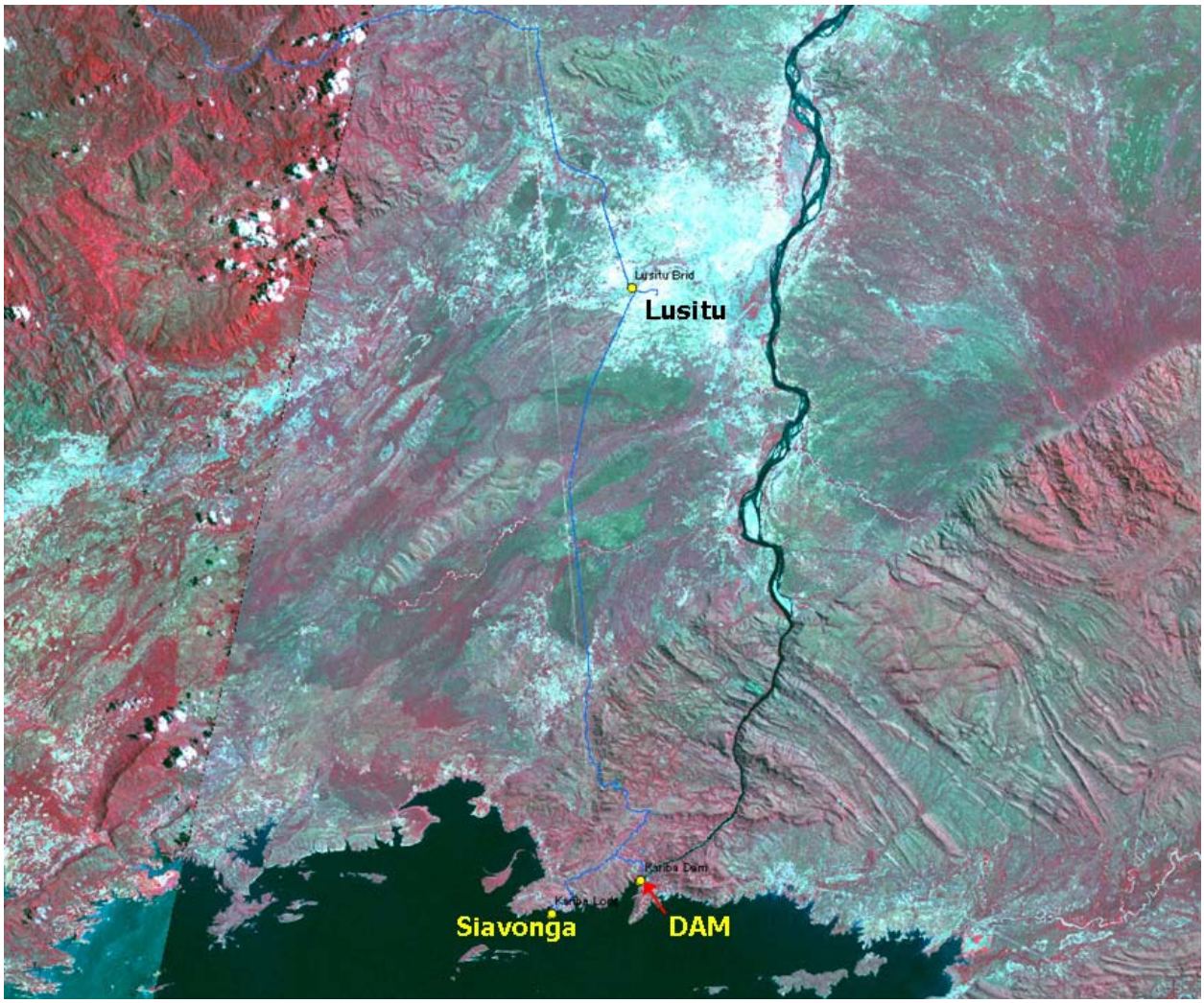


図-1_C. Siavonga 地区　（画像の縦の長さが約 64km, 左:2002/2/22, 右:2002/4/20 撮影）

平成18年度1－3PR（梅津PR）研究活動一覧												
2006	4	5	6	7	8	9	10	11	12	1	2	3
	13:00-17:00			10:00-12:00	16:00-17:30		13:00-17:00	11:00-17:00			15:00-17:00	
PR研究会	4月13日			7月3日	7月25日		10月4日	11月9日			2月22日	
				（第12回）	（第13回）		（第14回）	（第15回）			（第16回）	
コアメンバー会議	＊		6月2-3日WS					＊			＊	
ワークショップ			9:00-17:00					11/10: 10:00-16:(				
								テーマIV/WS				
フィールド調査		フィールド調査							フィールド調査			
PR報告書									PR報告書原稿締切		2月末製本	
予算計画	平成19年度					追加予算申請	追加予算決定		追加予算申請	H19予算計画		
	概算要求(4/12)					9月22日	10月上旬		12月上旬	特別予算申請		
PR関連行事	FSヒアリング3/					(FSヒアリング)			プロジェクト	雇用計画		評価委員会
	IS申請4/14					9月22日			研究発表会			PRヒアリング
	ISヒアリング4/26								12/13-15			(2/28-) 3/1
									京都テルサ			地球研
地球研行事		上賀茂新施設						地球研国際シン				
		開所式典						11/6-11/8				(FSヒアリング)
		地球研 5/26						京都国際会館				3月9日
フィールド調査日程												
真常			6/10-7/5									3/15-4/18
田中						ザンビア						
宮崎（院生）			6/15-7/5			大統領選挙						
野呂（学部生）			6/15-7/5			9月28日						
三浦												
柴田												
櫻井			6/10-6/17									
菅野												
島田					(8/9-8/25)							
伊藤					8/9-			2007年春まで調査を継続				
中村					8/9-			2007年春まで調査を継続				
半澤												
児玉谷												
荒木												
吉村					8/22- 9/5							3/7-3/24
佐伯												
山下					8/22- 9/5							3/7-3/17
山内								11/26-12/6				
梅津			6/10-6/19					11/21-12/6				3/7-3/17
Lekprichakul								11/21-12/6				3/7-3/30
谷田貝												
Palanisami				(7/1-7/9渡邉プロ)								
Geetha （招聘）		5/1-7/31	地球研									
久米									India	1/11-1/23		

Vulnerability and Resilience of Social-Ecological Systems – FY2006 PR Project Report

Project 1-3PR

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社会・生態システムの脆弱性とレジリアンス – 平成１８年度ＰＲ研究プロジェクト報告

プロジェクト１－３ＰＲ

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2007 年 3 月

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