Understanding Agricultural Vulnerability, Human Behavior and Relief in Southern Province:
Thinking of Rural Farmer's Resilience

[1]Mitsunori Yoshimura, [2]Megumi Yamashita, [3]Keiichiro Matsumura, [4]Hidetoshi Miyazaki, [4]Yudai Ishimoto
[1]Pasco Corporation, [2]Survey College of Kinki, [3]Rikkyo University,
[4]Research Institute for Humanity and Nature

1. Preface of Understanding Agricultural Vulnerability, Human Behavior and Relief

Mitsunori Yoshimura
Pasco Corporation

A vicious cycle of poverty and environmental degradation is a major issue of global environmental problems. Especially in semi-arid tropics (SAT) including Sub-Saharan Africa and South Asia where the majority of the poor is concentrated, poverty and environmental degradation is widely prevalent. People in this area largely depend on rain-fed agricultural production systems and their livelihoods are vulnerable to environmental variability. The environmental resources such as vegetation and soil are also vulnerable to human activities. In order to solve these global environmental issues, a key factor is a recovery from, or a resilience of human society and ecosystems to, the impacts of environmental variability. The general concept of vulnerability expresses the multidimensionality of disasters by focusing attention on the totality of relationships between the social situations and environmental forces, produces a disaster. The major research question of vulnerability is methodology, such as: measuring and assessing vulnerability, including finding appropriate indicators for various aspects of vulnerability, up- and downscaling methods, and participatory methods. Especially in the social vulnerability, it is focus on the problems of complex human interactions, vulnerability of groups' people, and shocks like natural hazards, climate change, and other kinds of disruptions. Our final goal is to identifying factors affecting resilience and the ways to enhance the resilience of rural people to various horrible environments. Human activities are affected by both social and ecological environments. Conversely, human activities themselves affect both social and ecological environments. Thus there is a cross-interaction among them. Especially social and ecological environments are vulnerable to human activities. And sometimes total system including human activities recover or does not recover from any shocks.

From the mentioned backgrounds, we have been conducting various field investigations at Southern province, Zambia in order to understand what rural farmer's resilience is. As one of the common results of FY2009, we had established the approach to resilience. For an empirical approach to resilience, we focus on the mechanism and the speed of recovery in food consumption and livelihoods of agricultural households after shocks such as drought and flooding. The theme 4 has been conducting the visualization of spatial pattern of resource use from the agricultural household point of view.

Figure 1-1 shows our study area is located in Sinazongwe district, Southern province of Zambia. Here is located in Semi-Arid Tropics climate zone. The long term averaged annual rainfall in Sinazongwe is 695mm/yr. As for the field investigation, we set the study sites A, B and C where are located in the lower terrace, middle escarpment and upper terrace, respectively. This is the common study sites for our research project; thus many rain-gauges were installed at Sites A, B and C. The targets of field survey are total five villages; ASn and ASm (Site A), BKa and BCh (Site B) and CSa (Site C)

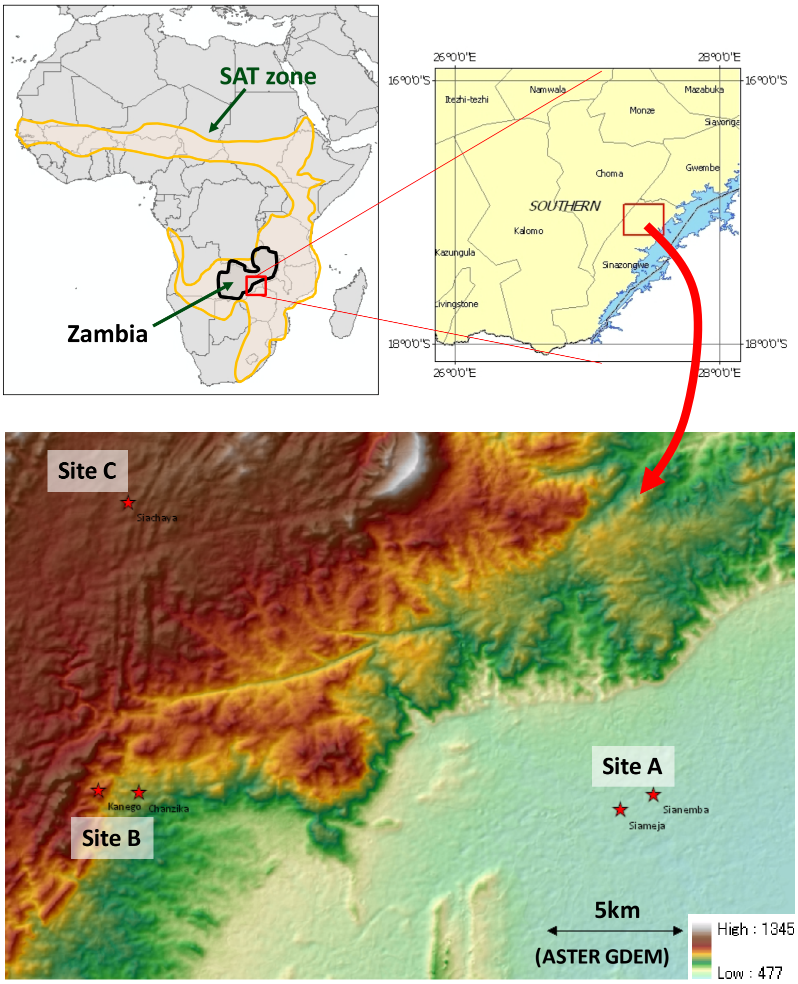


Figure 1-1. Our field sites in Southern province of Zambia

In this year, we conducted the field investigation data integration focus on understanding an agricultural vulnerability, human behavior and relief in Southern province in order to think the rural farmer’s resilience. At the beginning of this year, we had discussed the concept of resilience in human activities and how to clarify the capacity at the household livelihood level. According to discussed approach which is illustrated in Figure 1-2 as the conceptual diagram of transition in potential production and behaviors to the climate change effects. In this paper's the climate change effect was the extreme heavy rain.

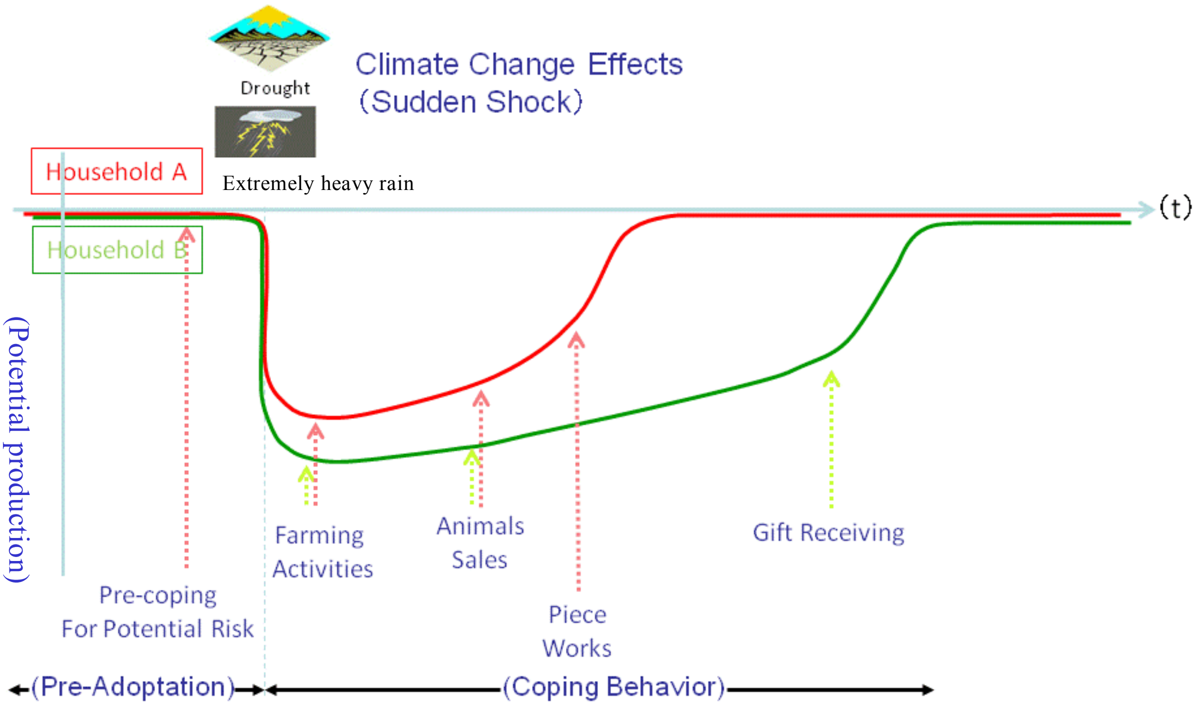


Figure 1-2. The Concept Diagram of Transition in Potential Production and Behaviors

In this figure, pre-adaptation for potential climate change risks and coping behavior of Household A and B are compared. Household A has much asset and labor, and Household B does not have. The horizontal axis corresponds to the time and the vertical axis corresponds to the potential production of all livelihoods activities. Detailed considerations are discussed in Chapter 2. The subsequent chapters discuss the various behaviors depicted in Figure 1-2. In Chapter 3, the multi-spatial and temporal data integration is discussed as the potential risk, an adaptation in land use and coping behavior in pre- and post shocks periods in farm activities is discussed in Chapter 4, and supports and requests for receiving gifts through mobile phone as social networks coping behavior is discussed in Chapter 5 respectively. In Chapter 6, we focused on the social institution and resilience for food shortage risk. In final Chapter 7, we conclude the results of understanding agricultural vulnerability, human behavior and relief as Postface.

2. Resilience of Rural Farmers and Approaches for Clarifying Capacity:
The Level of Household Livelihood

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

Abstract

Resilience, in the context of this study, refers to insusceptibility to damage and the ability to recover after damage. Insusceptibility has two aspects, comprising robustness and flexibility in response to shock. This study sought to clarify the relationships between resilience and several other important concepts. Here, I describe an approach for clarifying the capacity for resilience. In addition, I examine the sequence of adaptation and coping behavior in the time period following a specific shock, with a particular focus on the resilience of rural farmers at the level of household livelihood.

2.1. Introduction

Resilience, in the context of this study, refers to insusceptibility to damage (Holling et al., 1995) and the capacity to recover after damage (Ellis, 2000). Insusceptibility is comprised of two aspects; robustness, and flexibility in response to shock.

Section 2.2 clarifies the relationships between resilience and several other important concepts which are discussed in resilience and vulnerability studies (Adger, 2000; Resilience Alliance, 2007; Terner et al., 2003; Watts and Bohle, 1993); capacity, external factors, exposure, assets, vulnerability, shock, disturbance and risk. Section 2.3 describes an approach for clarifying the capacity for resilience. Finally, section 2.4 discusses the sequence of adaptation before and coping behavior following a specific shock. This study has a particular focus on the resilience of rural farmers at the level of household livelihood.

2.2. Relationships between resilience and other concepts

Figure 2-1 and 2-2 illustrate the relations between resilience and several other important concepts at the level of household livelihood. This section describes the relationships between resilience and other concepts, providing examples to illustrate each concept.

In this study, resilience consists of three components; capacity, external factors and assets. The term exposure is used as a substitute for external factors in vulnerability studies (Bohle, 2001; Chambers, 2006). Household risk is composed of potential risk and manifested risk. Emergent risk may lead to a change in the properties of potential risk. Potential risk can be thought of as vulnerability, emergent risk can be restated as disturbance.

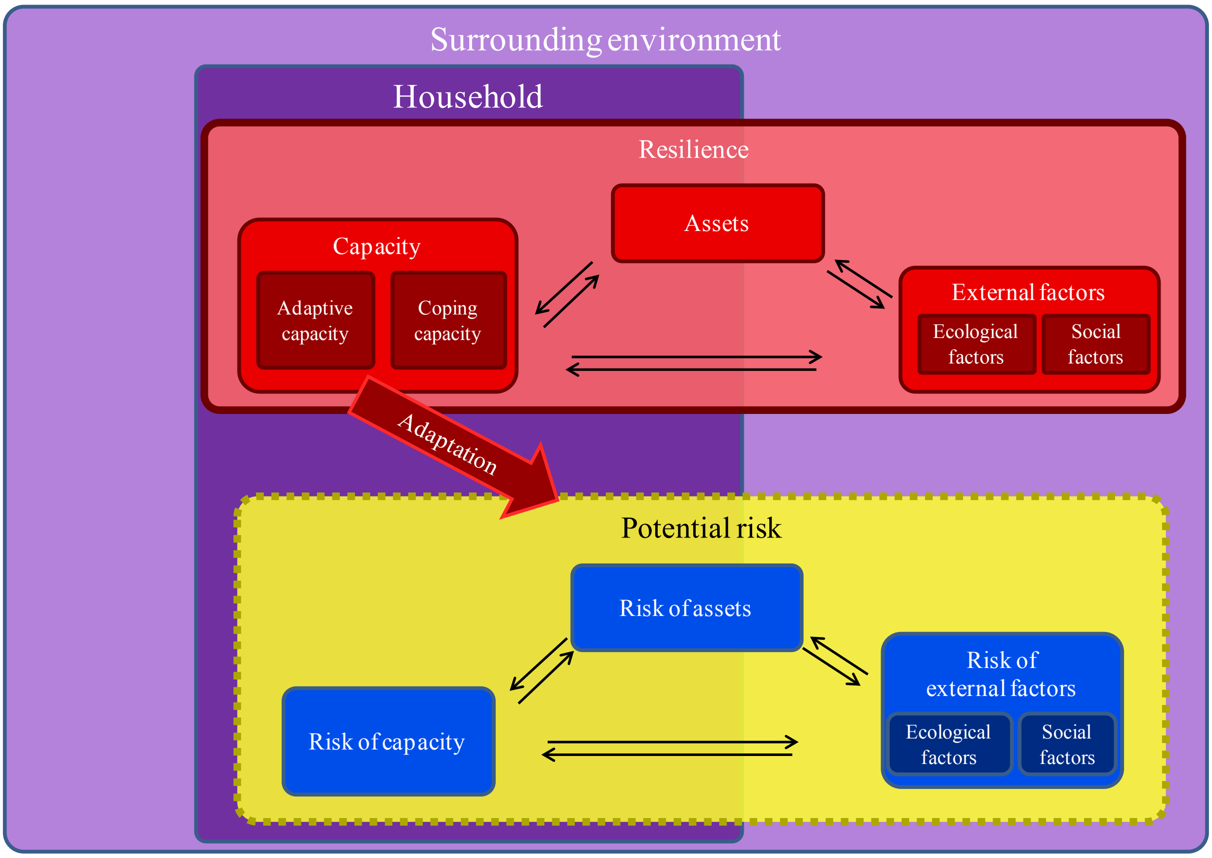


Figure 2-1. Relationship between resilience and other concepts

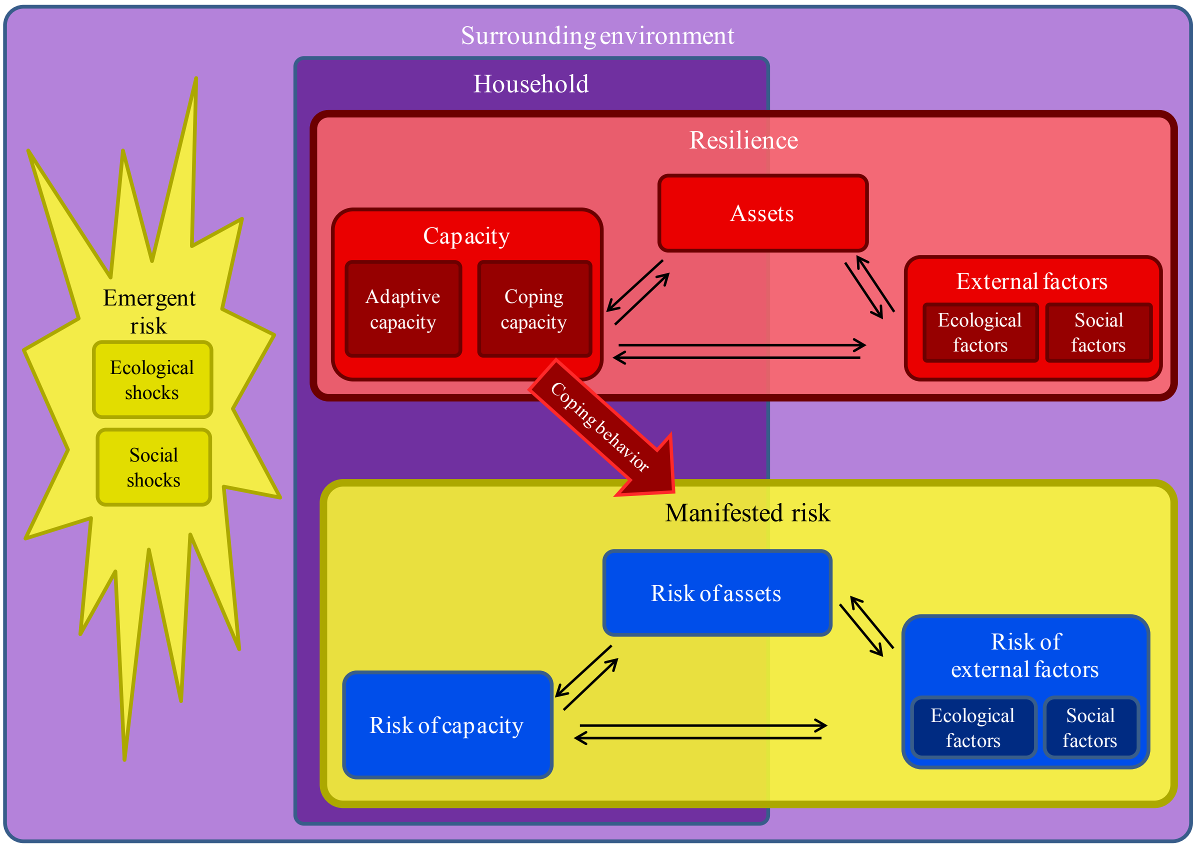


Figure 2-2. Relationship between resilience and other concepts: changed properties of potential risk by emergent risk

Various potential risks are related to each component of resilience; low capacity, negative external factors and insufficient assets. When emergent risk is more extensive than expected, potential risk is manifested; that is, Figure 2-1 shifts to Figure 2-2. Emergent risks can be divided into ecological shocks and social shocks. Ecological shocks include light rain, heavy rain, disease epidemic, insect damage, bird damage, other animal damage, and so on. Social shocks include political, economic, cultural and legal changes etc.

External factors can be divided into ecological factors and social factors. Ecological factors include geographic and climatic factors, etc. Social factors include political, economic, legal, historic and cultural changes etc.

Capacity is divided into adaptive capacity to potential risk before shock and coping capacity with manifested risk after shock.

Three components determine whether resilience is in a high or low state at the level of household livelihood: capacity, external factors and assets. In cases where capacity is high, external factors are positive and assets are sufficient, the state of resilience is high.

Figure 2-3 shows a conceptual diagram representing resilience of rural farmers at the level of household livelihood. In the figure, the X-axis represents assets, the Y-axis represents external factors, the Z-axis represents assets, and the volume of the cube on sides X, Y and Z-axes represents resilience. As each component improves, each axis lengthens, and as volume increases, resilience also increases.

For example, if rainfall (an external factor) is extremely bad (i.e. drought or flooding), agricultural production may fall to a low level. However, if people with a high capacity for resilience can practice suitable farming technology to offset the rainfall conditions, the reduction in agricultural production may be absorbed or cancelled out.

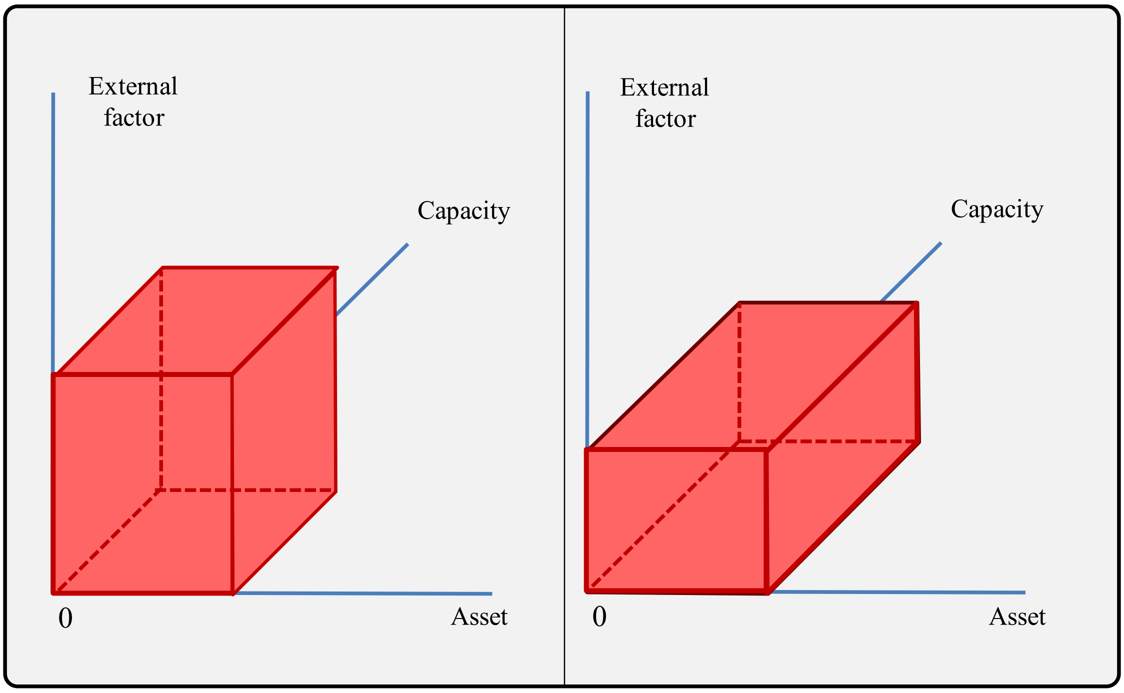


Figure 2-3. Three components determining whether resilience is in high or low state.

2.3. Approach to clarify capacity

The quality of prediction and analysis of external factors has been significantly increased in recent years with improvements in meteorological data, satellite image data and socioeconomic data. Meanwhile, a standardized method of analysis for determining capacity as an internal factor has not yet been established (Shimada, 2008). As such, this study focuses on capacity as one component of resilience.

Capacity itself is difficult to measure and observe. However, when capacity is considered in terms of the behavioral adaptation of farmers to potential risks before a shock occurs, and the ability to cope with the manifested risk after shock, it can be measured and observed. The current report empirically analyzes evidence of adaptation and coping behavior by farmers in the Southern Province of Zambia, located in a semi-arid tropical region with fluctuating rainfall, as a case study for clarifying the mechanisms underlying capacity.

2.4. Adaptation and coping behavior in time series

Adaptation and coping behavior varies according to the nature of a shock. The current report focuses on extremely heavy rain as an ecological shock, and analyzes farmers' behavior across time, in terms of how they adapt and cope at the level of household livelihood.

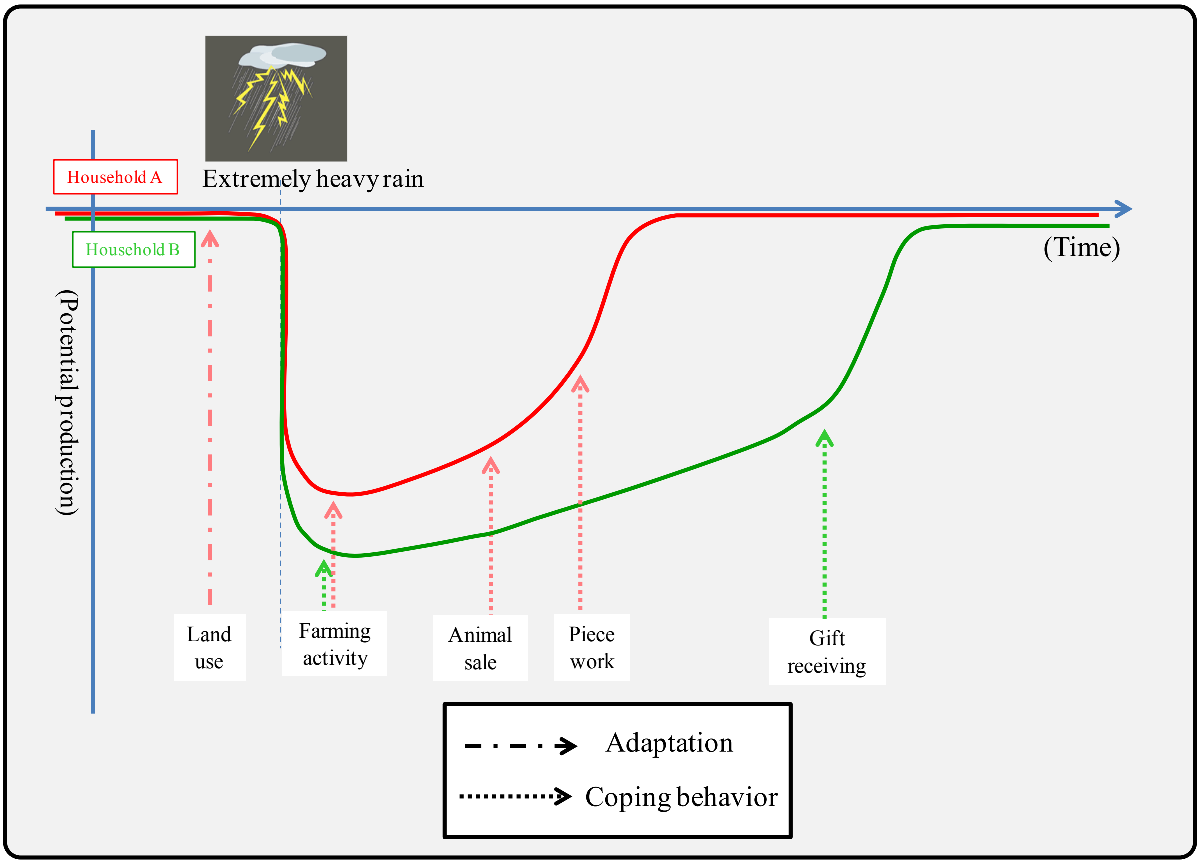


Figure 2-4. Conceptual diagram of transition in potential production and behaviors to extremely havy rain

Figure 2-4 shows a conceptual diagram of the transition in potential production and behaviors in response to extremely heavy rain. In this figure, the adaptation and coping behavior of Household A and B are compared. Household A has a relatively large amount of assets and labor, both of which are lacking for Household B. The horizontal axis represents the time, and the vertical axis represents the potential production of all livelihood activities Figure 2-4.

As shown in Figure 2-4, Household A adapts to the potential risk of geographical factors with land use, in contrast with Household B, which does not. Following the extreme rain event, Household A suffers less of a decline in potential production relative to Household B. Household A copes with the post-shock decline by undertaking additional farming activity, animal sale and piecework, so that potential production reaches pre-shock level. Meanwhile, Household B copes by undertaking additional farming activity, but cannot sell any animals or practice piecework. Eventually Household B is compensated by gifts through a social network.

References

Adger, W. N. 2000. Social and ecological resilience: are they related?. Progress in Human Geography. 24. 347-364.

Bohle, H. G. 2001. Vulnerability and Criticality: Perspectives form Social Geography. IHDP Update 2/2001. Newsletter of the International Human Dimensions Programme on Global Environmental Change. 1-7.

Chambers, R. 2006. Vulnerability. Coping and Policy (Editorial Introduction). IDS Bulletin. 37-4. 33-40.

Ellis, F. 2000. Rural Livelihoods and Diversity in Developing Countries. Oxford. Oxford University Press.

Holling C. S., D. W. Schindler, B. W. Walker, and J. Roughgarden 1995. Biodiversity in the functioning of ecosystems : an ecological primer and synthesis. Perrings C. A. , K.- G. Mdler, C. Folke, C. S. Holling, and B.- 0. Jansson (eds.). Biodiversity Loss: Ecological and Economic Issues. Cambridge University Press. Cambridge. 44-83.

Resiliencce Alliance. 2007. Assessing and managing resilience in social-ecological systems: A practitioners workbook.
available at http://www.resalliance.org/index.php/resilience_assessment

Shimada, S. 2008. Introductory analysis of social vulnerability in rural Africa. E-journal GEO. 3-2. 1-16. (in Japanese)

Turner, B. L., R. E. Kasperson, P. A. Matson, J. J. McCarthy, R. W. Corell, L. Christensen, N. Eckley, J. X. Kasperson, A. Luers, M. L. Martello, C. Polsky, A. Pulsipher and A. Schiller. 2003. A Framework for Vulnerability Analysis in Sustainability Science. Proceedings of the National Academy of Sciences of the United States of America (PNAS) 100(14): 8074-8079.

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

3. Multi-spatial and Temporal Data Integration for Understanding Agricultural Activity and Vulnerability:
A case study of rural farmer's villages

Megumi Yamashita
Survey College of Kinki, Osaka, Japan

Abstract

This chapter describes field investigations and geo-spatial/temporal analysis of livelihood at the village level, with a particular focus on agricultural activities, using a multi-disciplinary approach. As a basic analysis, the integration of all data collected so far has been carried out to understand the situation at the level of the household or village, in terms of adaptation and capacity to cope with a risk caused by an unexpected ecological or social shock.

3.1. Introduction

This research sought to clarify the relationships between social-ecological vulnerability and human activities from a multi-disciplinary point of view using geo-spatial information in combination with social and economic analyses. To this end, it was necessary to collect geo-spatial and temporal data relevant to people's livelihood and the environment in which they live.

We collected crop and field data by conducting field investigations, aerial photographs and satellite images, and integrated and analyzed the data to understand agricultural activity and its vulnerability to risks.

The study area covered sites A, B and C, located in Sinazongwe district, Southern province.

3.2. Data collection and analyses

3.2.1. Obtained and collected data list

Table 3-1 shows a list of all geo-spatial data we have obtained and collected so far. Since FY2007, we have carried out a field investigation to document the boundaries of all crop fields of all households in five villages. We also obtained aerial photographs taken around our study area in 1970, 1980 and 1991 by the Survey Department of Zambia. Additionally, we obtained satellite images obtained by optical sensors with middle-high resolution to identify seasonal changes in the pattern of land use / land cover and the effects of natural vegetation and cultivated land from 1972_3 to the present. These satellite images cover our study area (including Site A, B and C). Data were processed to have the same map coordinates using the universal transverse mercator (UTM) system (Zone35 South, WGS84) map projection.

Pre-processing and analysis were conducted in FY2010, for the data obtained and collected mainly after 2006.

Table 3-1. Geo-spatial data for our study site area

Aerial photos/ crop allocation data	Satellite images						
	Satellite/Sensor		Resolution (m)	Obs. Date	Season	Remarks	Geometric correction
1970 Aerial photos	Landsat	MSS	80	1972/11/23	From dry to rainy		
	Landsat	MSS	80	1973/3/11	Rainy		
1980 Aerial photos	Landsat	TM	30	1986/11/17	From dry to rainy		
	Landsat	TM	30	1987/2/21	Rainy		
1990 Aerial hotos	Landsat	TM	30	1990/3/1	Rainy		
	Landsat	TM	30	1995/1/26	Rainy		
	Landsat	ETM	30/15	2001/8/30	Dry		
	Landsat	ETM	30/15	2001/10/1	End of Dry		
	Landsat	ETM	30/15	2001/12/20	Rainy		OK
	Terra	ASTER	20	2002/2/6	Rainy		OK
	Landsat	ETM	30/15	2002/2/22	Rainy		
	Landsat	ETM	30/15	2002/5/13	Harvesting		
	Landsat	ETM	30/15	2002/8/17	Dry		
	Landsat	ETM	30/15	2002/10/20	End of dry		
	Landsat	ETM	30/15	2002/11/21	From dry to rainy		
	Terra	ASTER	20	2002/11/21	From dry to rainy		OK
	Terra	ASTER	20	2003/4/30	End of Rainy	Cloud coverage 10%	OK
	Terra	ASTER	20	2003/6/1	After Harvest		OK
	Terra	ASTER	20	2003/7/3	Dry		OK
	Terra	ASTER	20	2003/11/24	From dry to rainy		OK
	Terra	ASTER	20	2004/1/11	Rainy	Cloud coverage 10%	OK
	Terra	ASTER	20	2004/7/21	Dry		OK
	Terra	ASTER	20	2004/8/22	Dry		OK
	ALOS	PRISM	2.5	2006/7/19	Dry	Covering siteA only	OK
	ALOS	AVNIR-2	10	2006/9/3	Dry		OK
Rainy crop data 2007/8	ALOS	AVNIR-2	10	2007/9/6	Dry		OK
	ALOS	AVNIR-2	10	2007/10/22	End of dry		OK
	ALOS	AVNIR-2	10	2008/4/23	Harvest	Cloud coverage 10%	OK
Dry crop data 2008	ALOS	AVNIR-2	10	2008/6/8	End of harvest		OK
	ALOS	AVNIR-2	10	2008/9/8	Dry		OK
Rainy crop data 2008/09	ALOS	PRISM	2.5	2008/10/24	End of dry	DEM / covering siteB and C	OK
	ALOS	AVNIR-2	10	2008/10/24	End of dry		OK
	ALOS	AVNIR-2	10	2009/3/11	End of rainy	Cloud coverage 10%	
	ALOS	AVNIR-2	10	2009/4/26	Harvest		OK
Dry crop data 2009	ALOS	AVNIR-2	10	2009/9/11	Dry		OK

3.2.2. Crop allocation map

Field investigations for crop allocation mapping were carried out for more than 220 households in the villages of ASn, ASm (Site A), BKa, BCh (Site B) and CSa (Site C) in two rainy seasons of 2007_08 and 2008_09 and two dry seasons of 2008 and 2009.

To generate the crop allocation map, we used a portable global positioning system (GPS) to measure boundaries at a sub-field level that recognized different crops at Sites A, B and C. In addition, we conducted interviews with all households to obtain information about field names, topography, soil type, crops, cultivated varieties and types of fertilizer, to understand households' coping strategies related to climate variations. The boundaries of crop fields and attributes such as the names of crops and their owners were converted to the general geographic information system (GIS) data format with a Shape file (.shp).

Furthermore, we determined whether each crop field had been damaged by a natural disaster, such as drought or flood, and which crops were replanted after damage.

3.2.3. Generation of Digital Elevation Model

To generate a Digital Elevation Model (DEM) and ortho aerial photo images of the large scale of our study area, we used aerial photos taken in 1991 with a scale of approximately 1 : 30,000. However, because an area around site C was not completely covered, we also used a stereo pair of ALOS/PRISM images taken on 2008/10/24 from nadir, forward and backward views.

We processed the stereo pairs of both aerial photos and ALOS/PRISM images. We used XYZ coordinates of UTM (Zone35 South, WGS84) read from Google Earth as the ground control points (GCPs) for extra orientation. Figure 3-1 shows the Digital Elevation Model (DEM) around our study sites. The grid size of the DEM was 5 m.

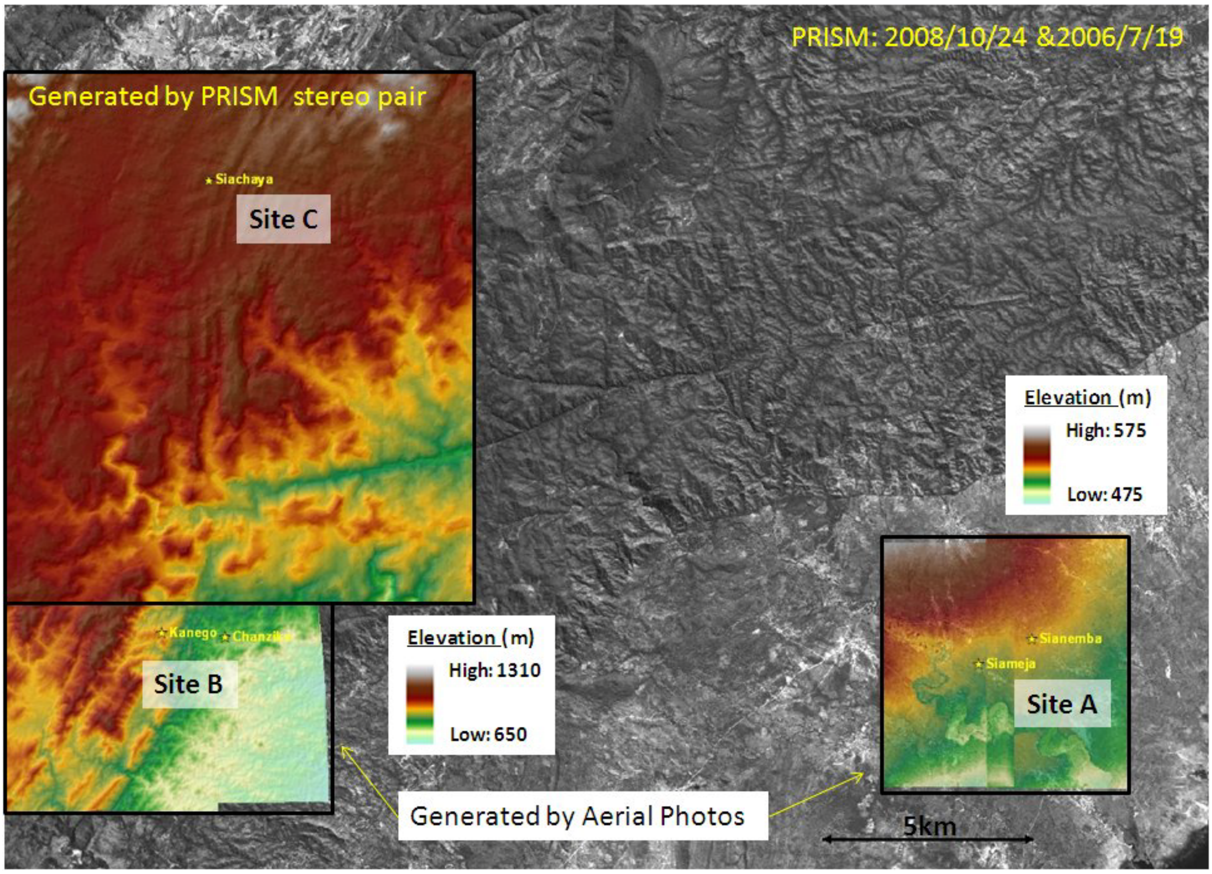


Figure 3-1. DEM generated by aerial photos and ALOS/PRISM stereo pair

3.2.4. Geometric correction for satellite images

Multi-spectral satellite images are useful for recognizing seasonal land surface conditions. In FY2010, we processed the geometric correction for all ALOS/AVNIR-2 images. The AVNIR-2 sensor has four spectral bands of visible Blue (band1), Green (band2), Red (band3) and Near Infrared (band4). Here, we used the same map coordinates from Google Earth as the ground control points (GCPs) for geometric correction. The location accuracies of the geometric corrections for all images were less than one pixel (10 m).

Figure 3-2 shows the results after geometric correction of ALOS/AVNIR-2 false color images taken on 2008/9/8, 10/24, 2009/9/11 in the end of dry season and 2009/4/26 at the end of the rainy season. These images are different visually between the ends of the dry and rainy seasons.

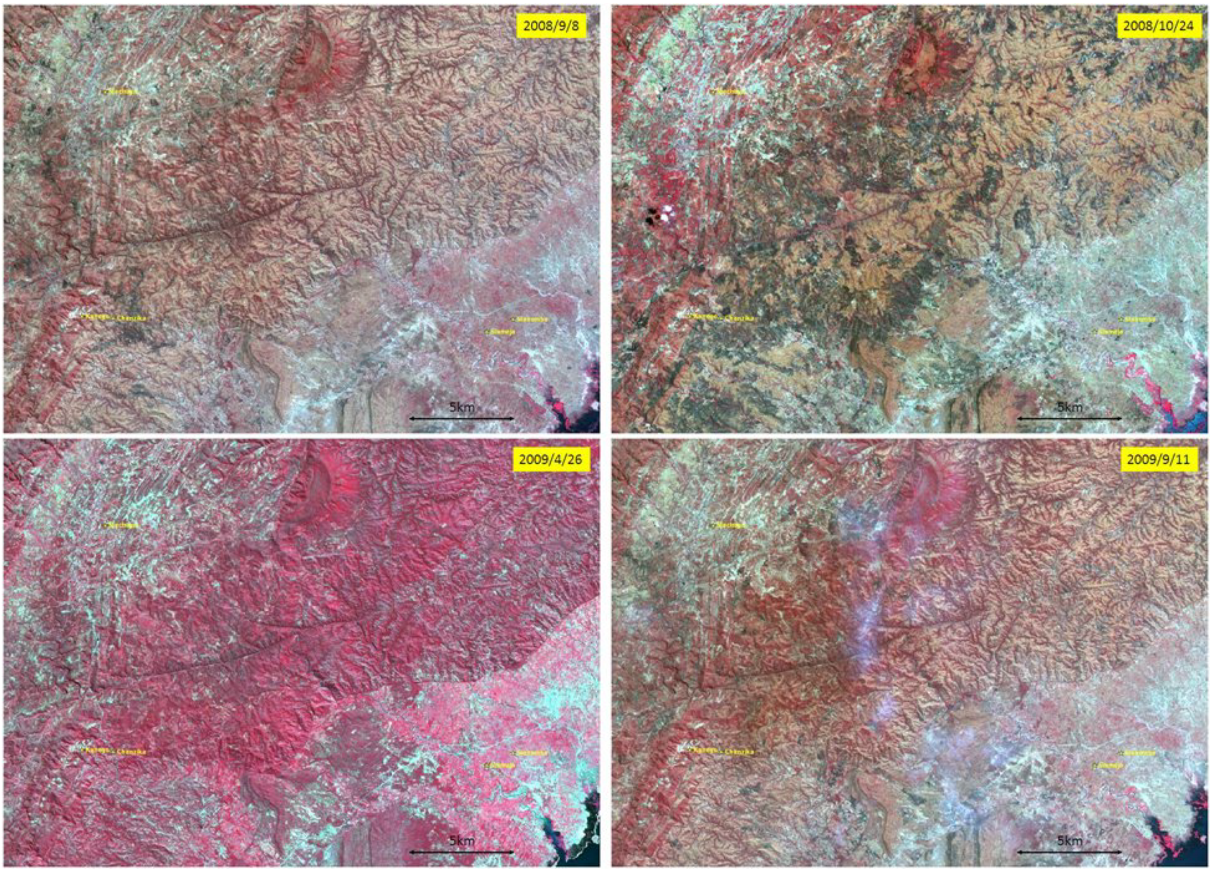


Figure 3-2. Samples of geometric corrected ALOS/AVNIR-2 false color images (RGB:b432)

3.2.5. Additional data

We also collected location data for all of the households we examined, and other facilities such as schools, churches, watering points, water pumps and markets/shops, using portable GPS. Data regarding the main roads and streets commonly used in these areas were also measured with GPS and entered by visual interpretation on the aerial photographs and the ALOS/PRISM ortho images.

Figure 3-3 illustrates the distribution of the households and other commonly used facilities. These kinds of location data can be used to analyze the relationship between the locations of households and crop fields and accessibility to facilities and natural resources. The accessibility of facilities in BKa and BCh (site B), which were established in the 1990's, is more difficult than access at other sites. However, the forest resource has been largely retained in site B, providing an advantage over some other areas. Therefore, some of households in site B have another livelihoods such carpenter, plank and so on.

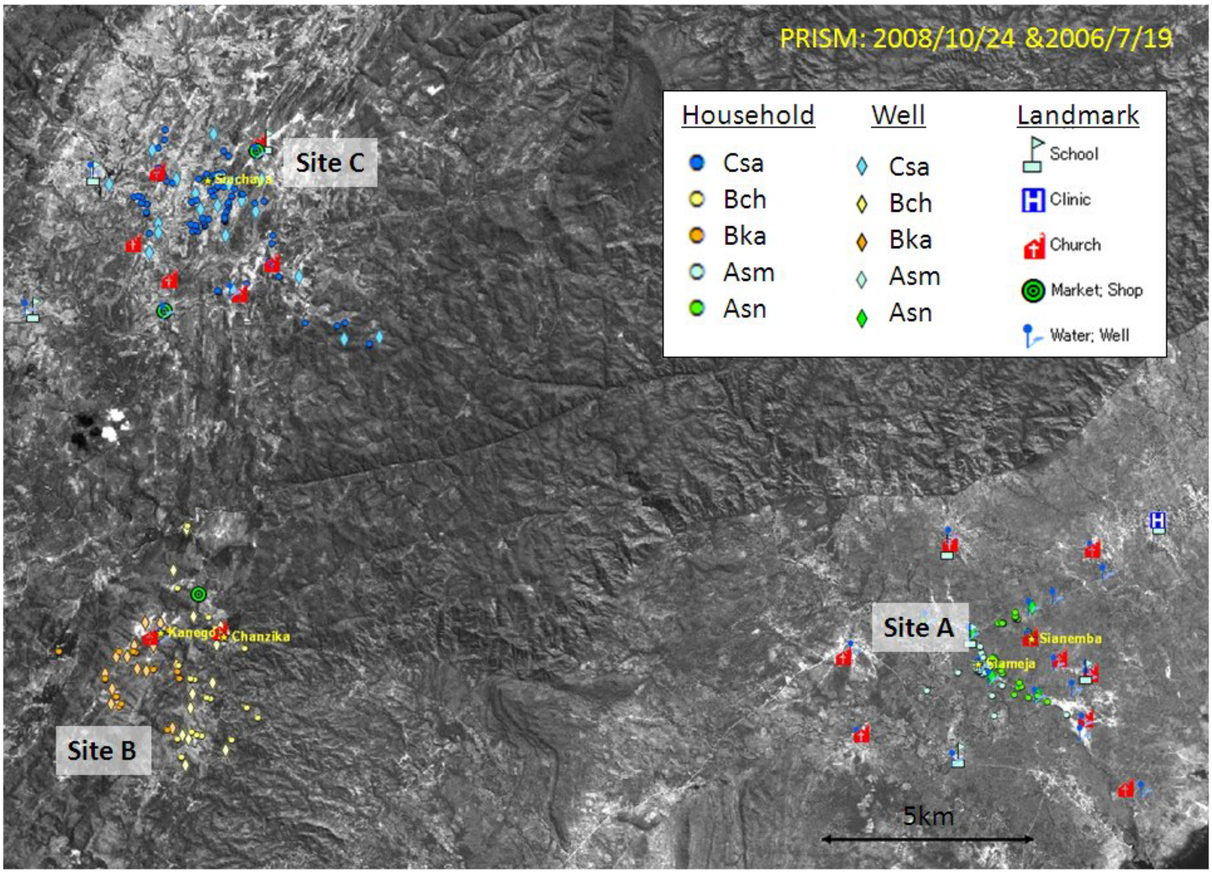


Figure 3-3. The locations of the examined households and commonly used facilities

3.3. Results and discussion

3.3.1. Rainy crop area from 2007_08 to 2008_09

The characteristics of the crop field location were different at each study site. At site C, almost all of the crop fields were distributed along the mountain ridges and the gentle slope of the hill. The crop fields at site B were distributed around very steep hillsides. The terrain at site A is basically flat, and the soil is more fertile than that at sites B and C.

Figure 3-4 shows the crop allocation map at site A during two rainy seasons of 2007_08 and 2008_09. The ALOS/PRISM image is shown in the background. The areas shown in green indicate the overlapped fields of both rainy seasons in 2007_08 and 2008_09.

Figure 3-5 shows a graph of the total crop field area in five villages during two rainy seasons of 2007/2008 and 2008_09. Total crop area in the 2008_09 rainy season appeared to decrease compared to the rainy season of 2007_08. More than 67% of rainy season crop fields in 2008_09 overlapped with the crop fields of the 2007_08 rainy season.

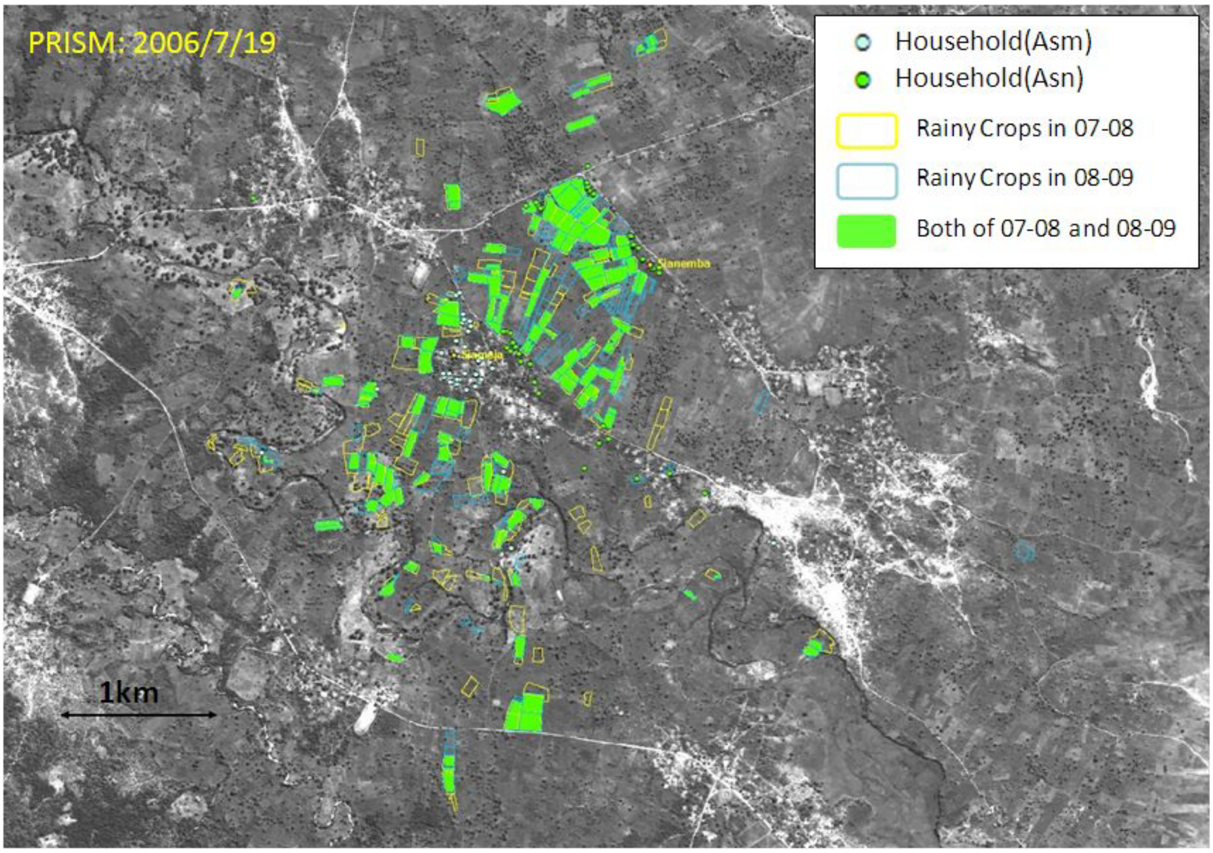


Figure 3-4. Crop field distribution at site A during two rainy seasons of 2007_08 and 2008_09

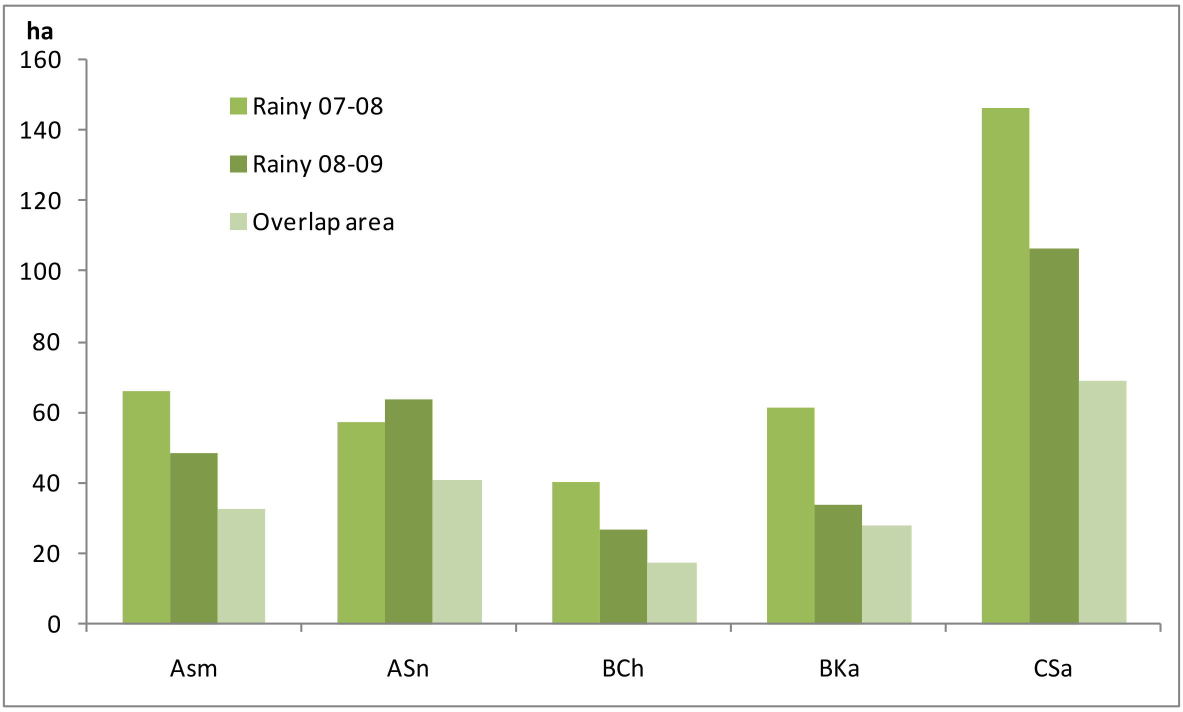


Figure 3-5. Total crop field area during two rainy seasons of 2007_08 and 2008_09

3.3.2. Topographical features of agricultural land use

To examine the topographical conditions of each households' crop fields, the slope was calculated from the DEM and classified into seven classes: Flat (0-1, units: degree), very gently sloping (1-3), gently sloping (3-8), sloping (8-15), steep (25-40), very steep (more than 40), in accord with the Handbook for soil survey (Japanese Society of Pedology, 1978). The mountain ridges and small valleys or thalwegs were detected with the method of water flow accumulation (Jackson and Domingue, 1988).

Figure 3-6 shows the results of slope classification. It is easy to recognize the flat, gently sloping and steep areas at each site.

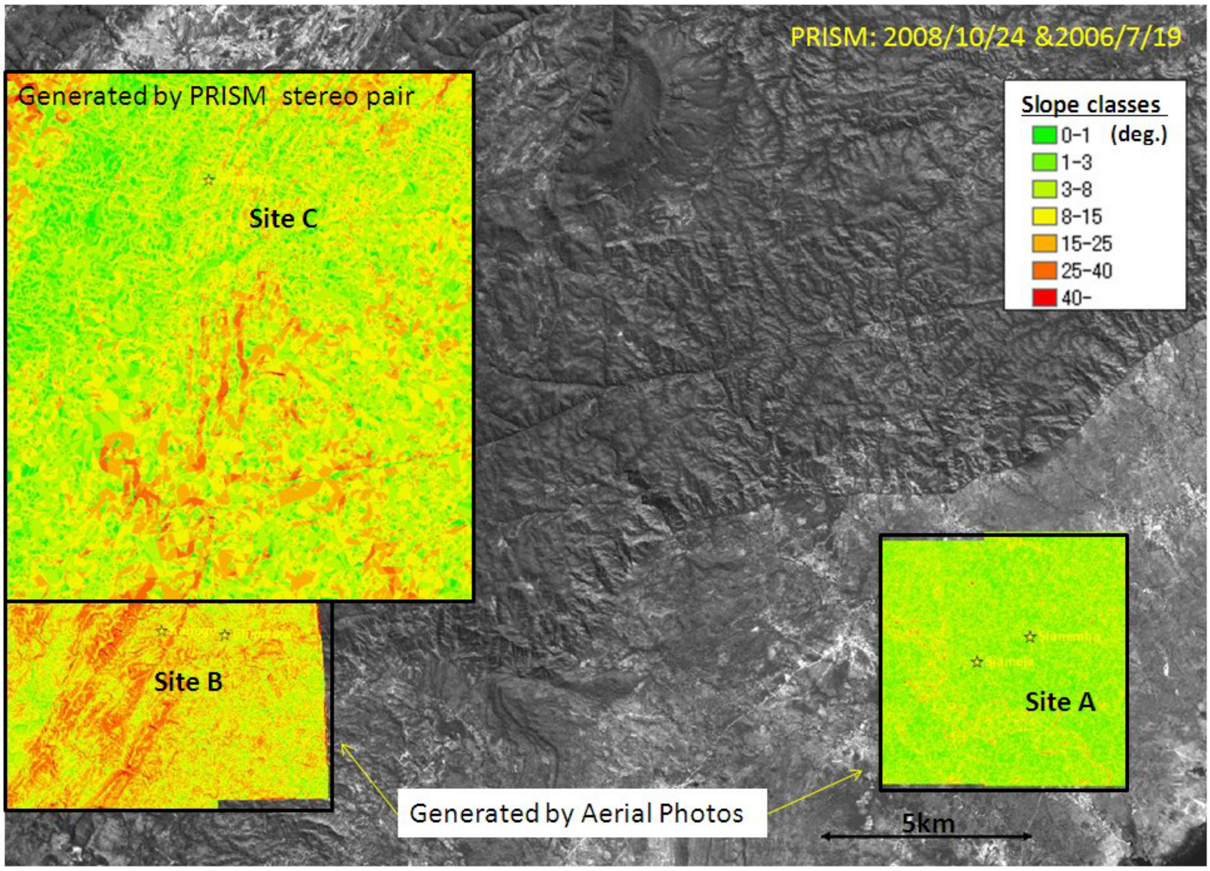


Figure 3-6. Slope classification

Figure 3-7 shows the topographic features of mountain ridges and valleys / thalwegs and the crop field distributions at site B as an example. At site B, all crop fields were located in topographical areas featuring mountain ridges, hill sides and valleys / thalwegs. We analyzed the areas of seven slope classes, mountain ridges and valleys / thalwegs for each crop field. Therefore, we were able to determine the topographical situation of the crop fields of each household in assessing *ex ante* adaptation for ecological risks such as drought and heavy rain. Adaptation at the household level is discussed in Chapter 4.

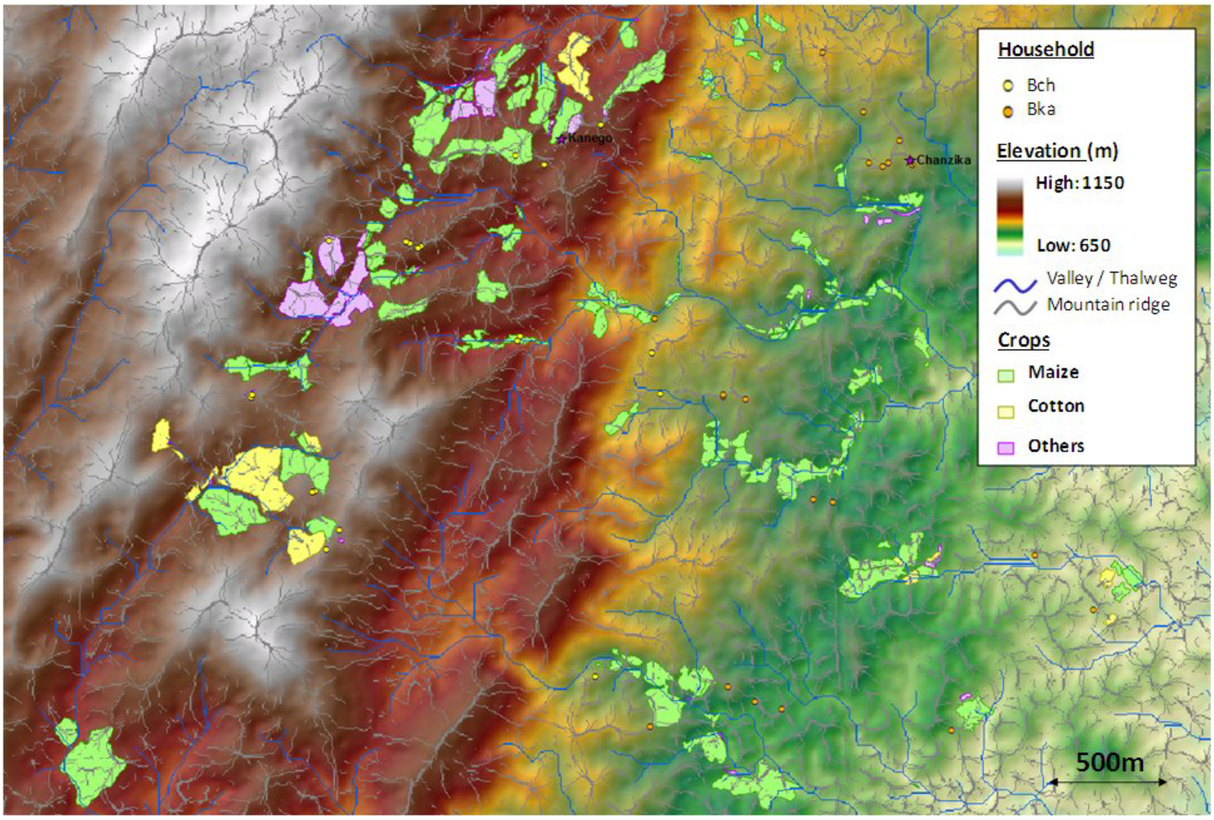


Figure 3-7. Topographic structures and crop fields in part of site B

3.3.3. Seasonal land use / cover characteristics

According to the crop calendar constructed from Miyazaki's interviews about periods of land preparing, planting weeding and harvesting at three sites, the land preparation involved clearing and burning rainy crop fields, performed from September until the beginning of November. In addition, many pictures were taken in the various seasons at three study sites. Figure 3-8 shows samples of the pictures taken on 2007/9/13 in the dry season at Bka.

Figure 3-8. Samples of pictures taken on 2007/9/13 in BKa (by Miyazaki)

Comparing field data with the geo-corrected ALOS/AVNIR-2 images shown in Figure 3-2 allows the characteristics of land use / land cover in each season to be understood. In Figure 3-2, the false color images taken on 2008/9/8 and 10/24 show the charcoal color. These areas show the land cover situation after the burning. In addition, smoke and haze can be seen in the image taken on 2009/9/11. The image taken on 2009/4/26 appears redder than other images on the whole, and the areas around our study sites reveal brightness at that location. The brightness areas on this image show the crop fields after harvesting. These findings suggest that it might be possible to automatically distinguish between cropland and natural vegetation fields using these seasonal characteristics.

3.4. Predicted results in FY2011

We plan to collect and analyze various types of multi- spatial and temporal data in FY2011.

First, the classification of land cover/use in rainy and dry seasons around three study sites will be carried out using ALOS/AVNIR-2 images, crop calendar and field pictures as ground truth data. Second, spatial analysis of the land cover/use and topographical features will be performed. We will then examine the potential risks and ecological shocks at the level of villages or study sites.

References

Japanese Society of Pedology. 1978. "Handbook for soil survey" (Dojou chousa handbook, in Japanese). Tokyo: Hakuyusha.

Jenson, S.K., Domingue, J.O. 1988. Extracting topographic structure from digital elevation data for geographic information system analysis. Photogrammetric Engineering & Remote Sensing. 54, 1593-1600.

Yamashita M., Miyazaki H., Ishimoto Y. & Yoshimura M. 2010. Multi-temporal and spatial data integration for understanding the livelihood in village level. International Archives of the Photogrammetry, Remote Sensing and Spatial Information Science, Volume XXXVIII, Part 8, 827-830.

4. Adaptation and Coping Behavior of Farmers during Pre- and Post-Shock Periods

Hidetoshi Miyazaki
Research Institute of Humanity and Nature, Kyoto, Japan

Abstract

Farmers use both on-farm and off-farm-based coping strategies to mitigate the impact of heavy rain. The choice of coping behaviors tends to vary with access to resources. As an example of on-farm-based coping behaviors, farmers can change land use patterns by switching crops. As an example of off-farm-based coping behaviors, heavy rain affected farmers can compensate for lost income by selling livestock and fishing.

4.1. Introduction

When assessing farmers' adaptation and coping behavior as elements of household resilience, it is important to clarify how farmers actually adapt to climate variability during the pre-shock period, and how they cope during the post- shock period.

In this chapter we describe adaptation strategies in land use, and coping behavior in terms of on- and off- farm activities.

4.2. Adaptation to climate variability

Figure 4-1 illustrates the relation between maize harvest and three characteristic rainfall amounts. Figure 4-1 a), b) and c) show an adequate rainfall year, a drought year and a heavy rainfall year, respectively. Maize fields are distributed around different topographic positions including ridges, slopes and valley bottoms. In an adequate rainfall year, maize harvest is a normal harvest for each topographic position. In a drought year, we expect fields on valley and slope near the valley to retain an adequate harvest, while fields on ridges and slopes near ridges are unlikely to produce an adequate harvest because of a shortage of rainfall. In heavy rainfall years, however, we expect fields on ridges and slopes near ridges to acquire adequate harvest, but fields on valley and slope near the valley may not acquire adequate harvest because of flooding. These predictions were confirmed by field experience from 2007_08 to 2009_10.

Thus, the maize harvest varies every year depending on rainfall and topographic position. Thus, if a farmer possesses maize fields at each topographic position, they can avoid severe negative consequences of climate variability such as drought or heavy rainfall. However, not all farmers have access to fields at all topographic positions. Therefore, it is important to know where each household's fields are located when considering their adaptation to climate variability.

Table 4-1 indicates the potential risk of heavy rainfall for a rainy season maize field, for each household in 2007_08. The number in parentheses indicates the potential risk of heavy rainfall. We supposed that if a farmer has three maize plots of the same size, the potential risk can be estimated by three numbers as follows. The value is 1 for a ridge plot, 2 for a slope plot and 3 for a valley plot.

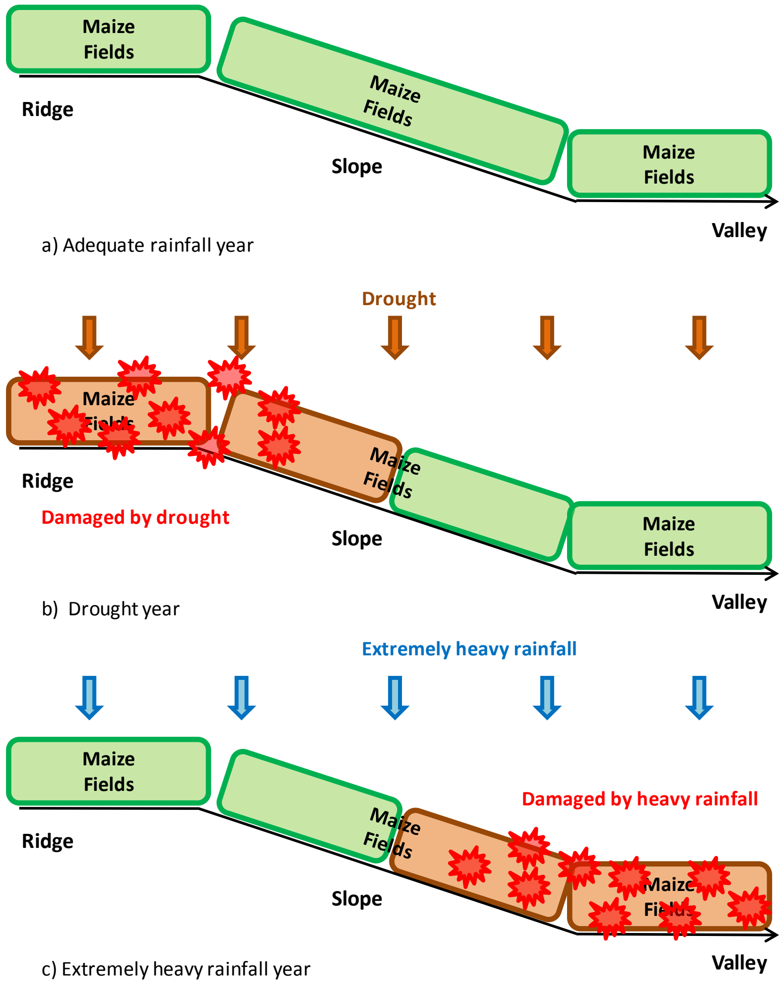


Figure 4-1 Relationship between maize harvest and three characteristic rainfall amounts, a) Adequate rainfall year, b) Drought year and c) Extremely heavy rainfall year

Table 4-1 Potential risk of heavy rain at rainy season maize fields in 2007_08

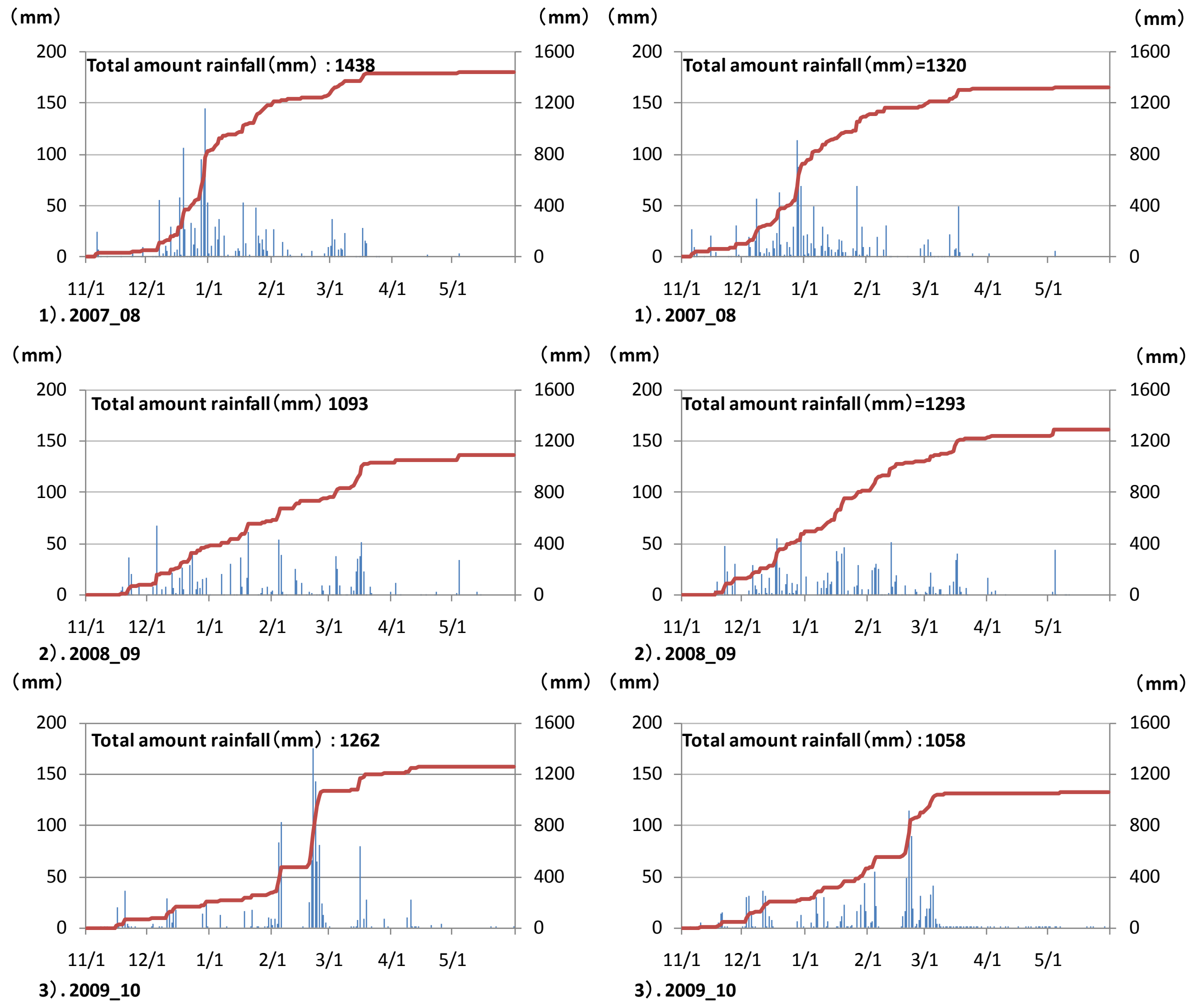
	Households Number	Valley (9.0)		Slope and valley (7.5)		Slope (6.0)		Ridge and valley (6.0)		Ridge, slope and valley (6.0)		Ridge and slope (4.5)		Ridge (3.0)	
Site B	37	0	0%	0	0%	0	0%	0	0%	35	95%	2	5%	0	0%
Site C	81	0	0%	16	20%	29	36%	1	1%	19	23%	16	20%	0	0%

If potential risks are larger, it is more likely for a crop to be damaged by heavy rain. Conversely, smaller potential risk indicates higher resilience. At Site B, almost all households possessed maize fields at all topographic positions. However, at Site C, the location of maize fields tended to be biased to a slope. Comparison of the two sites reveals that Site B has greater resilience than Site C. However, this estimation is tentative. Future studies should make topographic maize harvest classifications on the basis of topographic features, soil nutrient content and slope angle.

4.3. Coping behaviors in terms of on-farm activities during the post shock period

4.3.1. Rainfall between 2007_08 and 2009_2010

Figure 4-2 shows the daily rainfall and daily accumulation rainfall at Site A and Site C. At Site A, total amounts of rainfall of 2007_08, 2008_09 and 2009_2010 were 1,438 mm, 1,093 mm and 1,262 mm respectively. At Site C, the amounts were 1,320 mm, 1,293 mm and 1,058 mm, respectively. As is mentioned in our previous report, many of the fields at each of our study sites were damaged by heavy rain in 2007_08. Many fields were also damaged by heavy rainfall in 2009_2010. At each site, total amount of rainfall was highest in 2007_08. However, the total amount of rainfall in 2008_09 was higher than in 2009_2010 at Site C. This means that the damage to fields caused by heavy rainfall was not determined by the total amount of rainfall alone, but rather the rainfall pattern, as can be seen at the end of December in 2007_08 and the end of February in 2009_10.

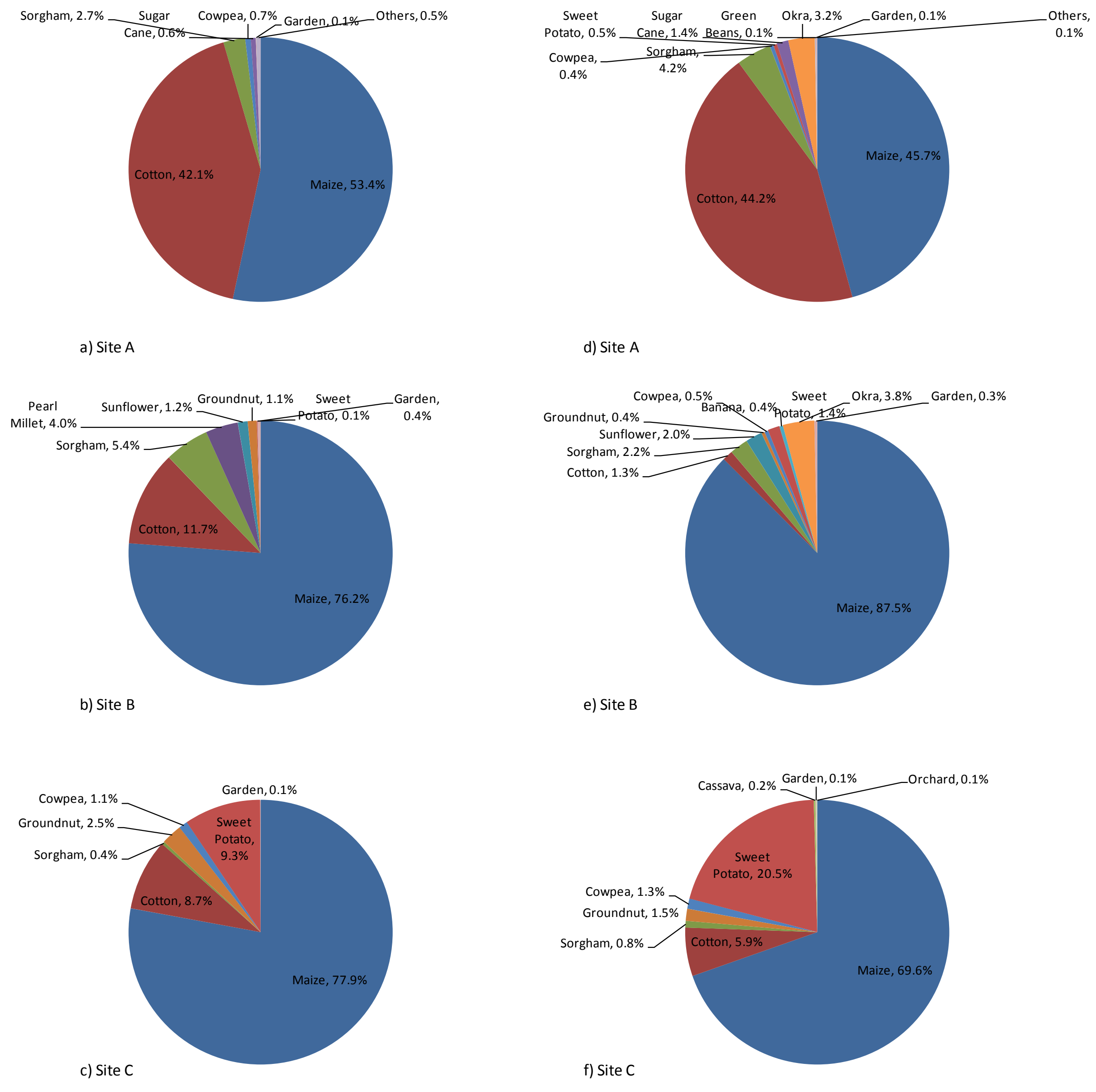


a). Site A b). Site C

Figure 4-2 Daily rainfall and daily accumulated rainfall at a) Site A, and b) Site C

4.3.2. On-farm activities at each site from 2007_08 to 2008_09

Figure 4-3 shows on-farm activities at each site from 2007_08 to 2008_09. At all sites, maize was most dominant staple food crop. At site A, cotton was the second most common crop in both years. In 2007_08, cotton was second, but in 2008_2009 the ratio of cotton grown was decreased due to the additional labor and chemical inputs required compared to other crops, leading to a selling off of cotton crops at site B. Sweet potato is the second-most dominant crop at site C. At this site, sweet potato is a more important cash crop than cotton. These differences of on-farm activities among three sites depend on meteorological conditions, soil conditions and access to the market and the main roads.



1) 2007_08 2) 2008_09

Figure 4-3 On-farm activities at each site from 2007_08 to 2008_09

4.3.3. Coping behaviors related to on-farm activities during the post shock period

Approximately 20% of maize fields were damaged by heavy rainfall in 2007_08. As a coping response to heavy rain damage, between 30% and 80% of damaged fields were abandoned. (Figure 4-4) In some fields, farmers switched or replanted crops. At site A, many farmers sowed maize seeds again. In site B, many farmers switched to planting groundnuts and maize during the dry season. At site C, many farmers switched to sweet potato. Thus, coping behaviors in response to heavy rain damage were markedly different at each site.

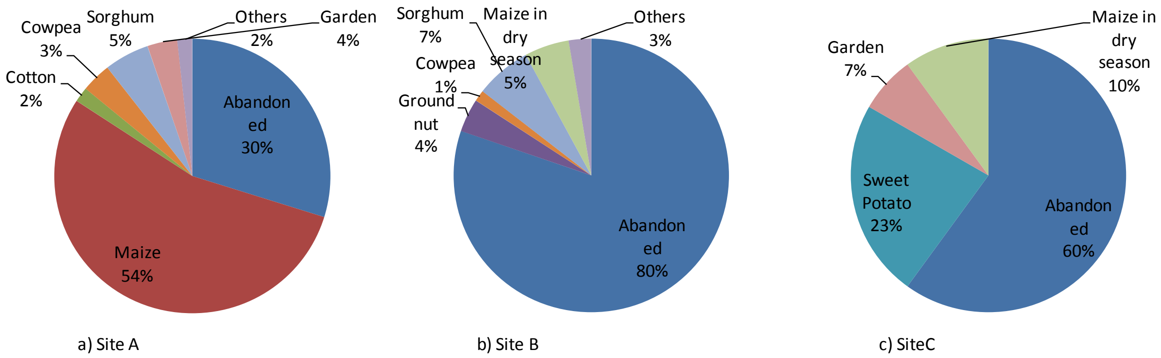


Figure 4-4 Coping behaviors related to on-farm activities following heavy rain damage

4.4. Coping behaviors in off-farm activities during the post-shock period

4.4.1. Coping behaviors in off-farm activities at the site-level

Table 4-2 shows site-level coping behaviors to damage from heavy rain through non-agricultural activities. The table shows the number of households that started new non-agricultural activities because they could not sell maize due to a shortage of maize production in 2008. 65% of households sold animals as a coping behavior. (Figure4-5) At site A, elderly households commonly asked for financial assistance from relatives. At site B, the number of households selling planks increased.

Table 4-2 New non-agricultural activities for households that were unable to sell maize due to the shortage of maize yields in 2008

	Housholds	Animal	Poultry	Fish	Local Beer	Plank	Others
SiteA (n=69)	16	10	1	1	0	0	4
SiteB (n=33)	7	6	1	0	0	5	0
SiteC (n=91)	6	2	0	1	1	0	0
Total	29	19	2	2	1	5	4

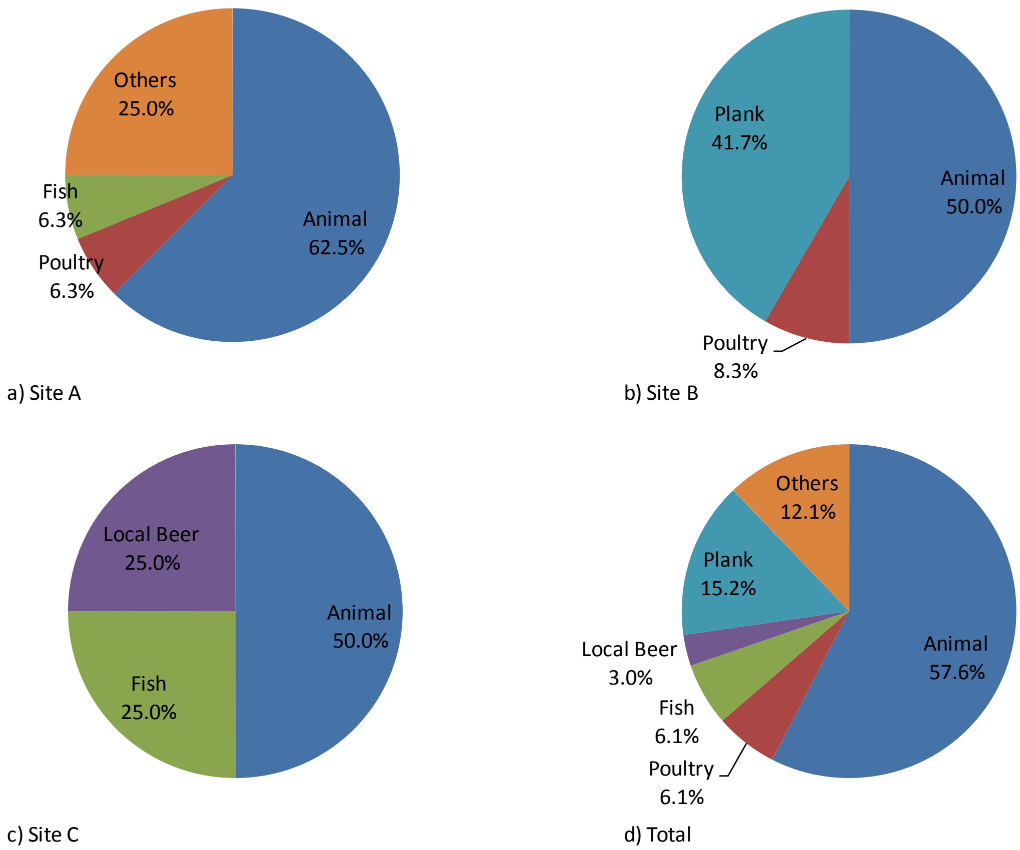


Figure 4-5 Coping behaviors in off-farm activities at the site-level for households that were unable to sell maize due to the shortage of maize yields in 2008

4.4.2. Coping behaviors related to off-farm activities by household-level

Table 4-3 shows household-level coping behaviors. Table a) shows data for 2007. Table b) shows data for 2008. The numbers in each row indicate the percentage distributions of cash income sources in each year, summing to 100%. After the fields were damaged, income was obtained by selling animals, fish, and local beer in 2008.

a) 2007

2007	Maize	Cotton	Vegetable	Animal	Poultry	Gather ing	Fish	Local Beer	Carpenter	Plank	Piece Work
Csa 5	20.0	30.0	20.0		15.0						15.0
Csa 21	15.0		50.0		15.0						20.0
Csa 24	5.0	20.0	20.0		5.0						50.0
Csa 33	11.1		5.6		11.1	16.7			38.9		16.7
Csa 59	5.0		10.0	45.0	5.0					35.0	
Csa 85	10.0	30.0	15.0	20.0	10.0						15.0

b) 2008

2008	Maize	Cotton	Vegetable	Animal	Poultry	Gather ing	Fish	Local Beer	Carpenter	Plank	Piece Work
Csa 5				100.0							
Csa 21			100.0								
Csa 24		10.0	10.0	70.0	5.0		5.0				
Csa 33			20.0		15.0	15.0		50.0			
Csa 59		1.0		95.0	4.0						
Csa 85		70.0	15.0	5.0	10.0						

Table 4-3 The cash income situation in 2007 and 2008 for households experiencing crop damage from heavy rain at Site C

5. A Preliminary Report on Support and Requests for Gifts via Mobile Phones:
A Case Study of Rural Tonga People in the Southern Province of Zambia

Yudai Ishimoto

Research Institute for Humanity and Nature, Kyoto, Japan

Abstract

In Zambia, the penetration and prevalence of mobile phone use has dramatically increased in recent years. This study focused on the mobile phone as a rapidly spreading tool for communication, and sought to clarify how rural Tonga people utilize mobile phones to receive support.

The results revealed several key findings regarding support and requests for gifts via mobile phones among Tonga people: 1) People with insufficient funds for making calls on their mobile phones often encourage others to call them by "paging" others' phones. 2) In cases where a household member has no mobile phone, they can often access the mobile phone of another household. 3) Cash and food are often requested via mobile phones. 4) Most requests are made over a long distance. 5) Many requests occur between parents and children boarding elsewhere, and between villagers and urban relatives.

5.1. Introduction

The prevalence and penetration of mobile phone use in Africa has rapidly increased in recent years. Figure 5-1 shows growth in the number of subscribers and penetration of mobile phones in Africa over the 6-year period from 2002 to 2007 (Blycroft Limited. 2008). The number of mobile phone subscribers grew from 49.10 million in 2002 to 280.69 million in 2007. A similar tendency has been seen in Zambia, a country in southern Africa.

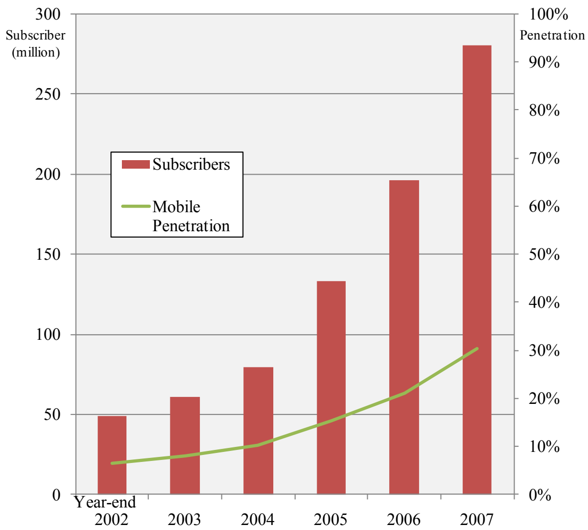


Figure 5-1 Mobile subscribers and penetration in Africa

Source: Blycroft Limited. (2008) *African Mobile Factbook 2008*, Blycroft Publishing, Craven Arms.

Figure 5-2. Tonga woman using a mobile phone

Ecological factors cause fluctuations in food production and income in rural villages in the semi-arid tropics (SAT). The Tonga people live in the SAT region in the Southern Province of Zambia. In addition to difficulties created by ecological factors, rural Tonga people have limited or no access to insurance markets or administrative social security.

If problems such as poor harvest occur in this context, they may be compensated via social networks, which function as a kind of insurance. The present study focused on the use of mobile phones as a rapidly spreading tool for communication, and sought to clarify how rural Tonga people utilize mobile phones to receive support. This preliminary report is part of an ongoing research project.

5.2. Research Outline

The research sites were located in areas of lower flat land ("Site A"), middle slope ("Site B"), and upper flat land ("Site C") in the Sinazongwe area, Southern Province, Zambia. Tonga people constitute the majority of residents at each of these sites.

Interviews were conducted through a questionnaire, administered on alternating weeks. The research period covered 168 days, from early August 2009 to early July 2010. The specific research topics of interest were the details of calls and short message service (SMS) messages, including the reason for contact, and information about the person contacted.

5.3. A Case Study of Household E at Site A

This section examines the mobile phone use of the householder of Household E (Householder E) at Site A, and discusses the features of cell phone use in the study area.

Over the entire study period, Householder E's mobile phone was utilized 355 times for calls, and eight times for SMS messages. Of these calls, 272 were received, while 83 were made from Householder E's phone. Of the SMS messages sent, seven of the messages were received from others, and only one was sent from Householder E's phone. Thus, Householder E's phone was predominantly used to receive calls and messages.

5.3.1. "Paging"

This section discusses the use of "paging" of mobile phones. Paging is a technique of mobile phone use, where a number is dialed but the phone is left to ring only once. In Zambia, most mobile phones are prepaid, meaning that it is not possible to make a call unless sufficient funds have been paid in advance. However, paging requires little phone credit, so can be used to alert another person that contact is desired. Paging thus allows a person with insufficient funds to encourage another phone user to call them.

Figure 5-3 shows the frequency of Householder E's phone calls involving conversations, in comparison with the number of calls used for paging. The monthly ratio of paging relative to calls ranged from 14.3-28.1% across months. A total of 281 calls involving conversations and 74 paging requests were made. Thus, the ratio of paging was 20.8% over the entire study period.

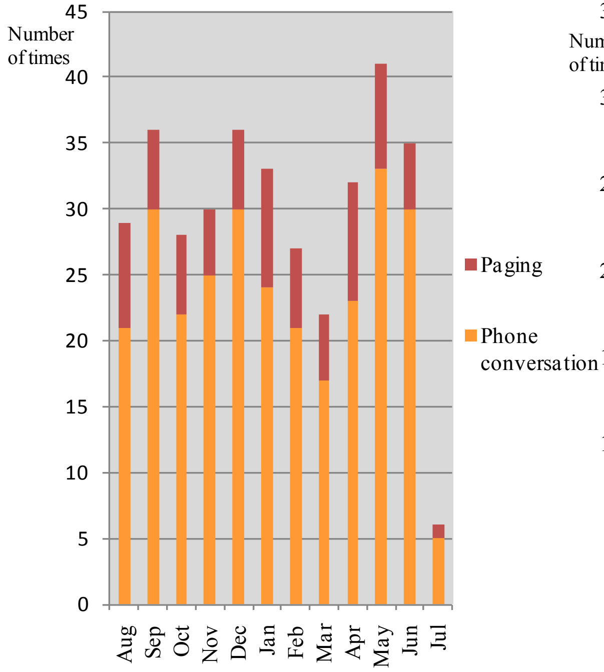


Figure 5-3. Breakdown of phone calls

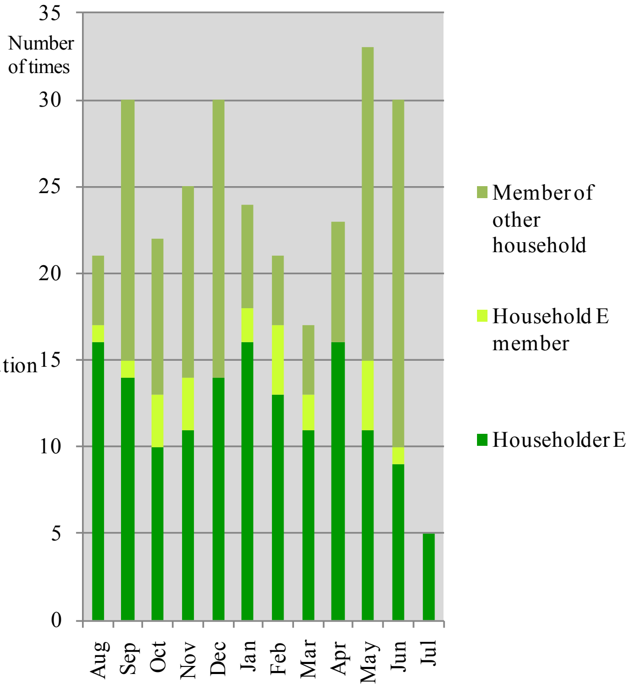


Figure 5-4. Breakdown of attribution for user of Householder E's phone conversations

5.3.2. Borrowing mobile phones

This section discusses the practice of borrowing mobile phones. Figure 5-4 shows the number phone conversations held by Householder E, Household E members and people who were not members of Household E, using Householder E's phone. Monthly ratios varied widely. Of 281 phone conversations, 146 were held by Householder E, 21 by other members of Household E, and 114 by people who were not members of Household E. The ratio of use by people who were not Household E members relative to all phone users was 40.5%. Thus, in cases where household members have no mobile phone, they are commonly able to access mobile phones of other households.

5.3.3. Requests for gifts via mobile phones

This section discusses the practice of requesting gifts using mobile phones. Figure 5-5 shows the frequency of phone conversations that were made to request a gift. Requested gifts commonly consisted of cash, food and other items. These requests were divided into cases where the user of Householder E's phone made the request, and cases where a gift was requested from them. The total frequency of phone conversations involving a request was 20 of 281. Requests for cash were the most common, occurring 14 times (70% of requests).

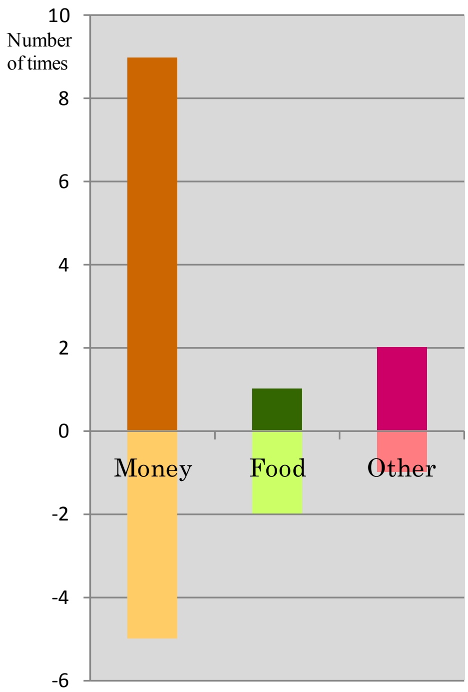


Figure 5-5. Types of gift items requested via Householder E's mobile phone

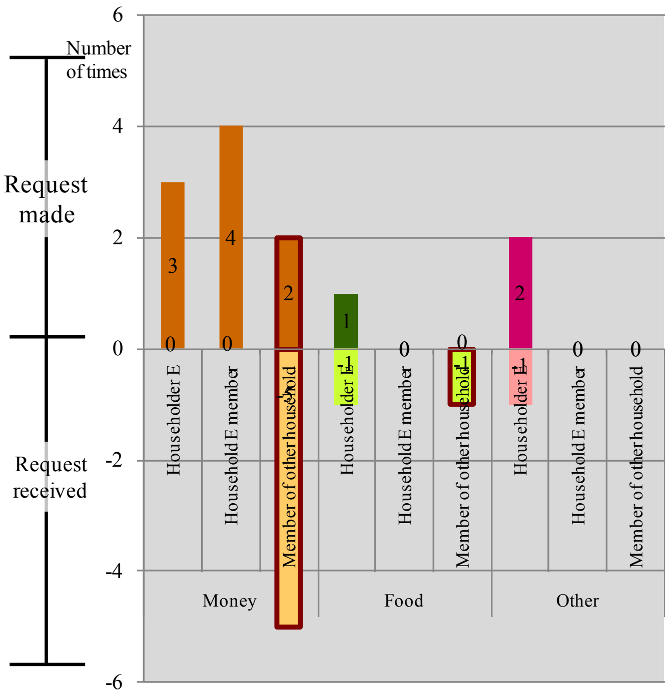


Figure 5-6. Breakdown of requests made and received by users of Householder E's mobile phone

Figure 5-6 shows a breakdown of for the requests made and received by users of Householder E's mobile phone. Requests for gifts occurred eight times in conversations involving Householder E, four times in conversations of other Household E members and eight times in conversations of people who were not members of Household E. Thus, 40% of requests involved phone users that were not Household E members, and seven of these were requests for cash.

Figure 5-7 shows the spatial distribution of people who made requests via Householder E's mobile phone. The left section of the figure shows a neighborhood map around Household E, while the right section shows a large-scale map. These maps indicate that most requests were made over long distances.

Finally, the details of distant requests were analyzed. In all cases where something was requested of the person using Householder E's phone, an item was requested from parents living within the study area by children who were boarding elsewhere. In cases where requests were made by the person using Householder E's phone, an item was requested of an urban relative by a person living in the study site. These requests usually involved close relatives such as brothers, sisters, parents and children.

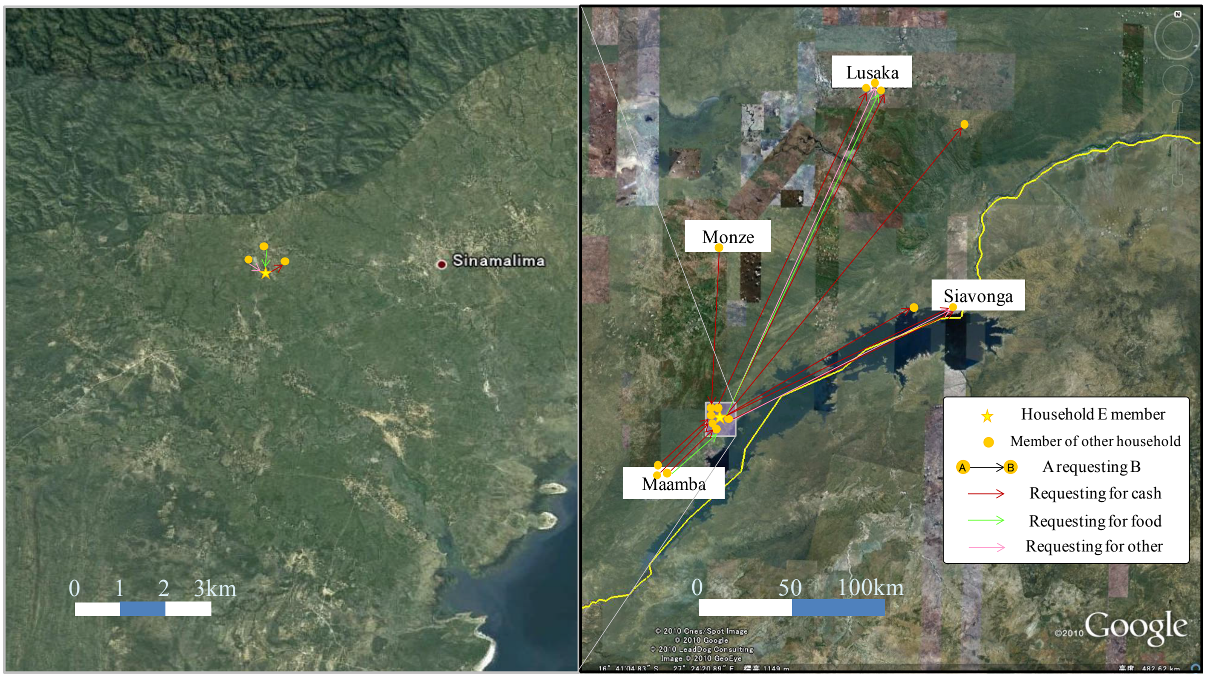


Figure 5-7. Spatial distribution of people requesting and being requested gifts via Householder E's mobile phone

5.4. Key Findings

The current study revealed several key findings regarding support and requests for gifts via mobile phones among Tonga people:

1) People with insufficient mobile phone funds can encourage others to call them using the paging technique.
2) In cases where household members have no mobile phone, they can often access the mobile phone of another household.
3) Cash and food are often requested via mobile phones.
4) Most requests occur over a long distance.
5) Many requests are made between children boarding elsewhere and their parents in the village, and between villagers and urban relatives.

Reference

Blycroft Limited. 2008. African Mobile Factbook 2008. Blycroft Publishing. Craven Arms.

6. Social Institutions and Resilience for Food Shortage Risk:
Food Relief Activities in Southern Province, Zambia

Keiichiro Matsumura
Rikkyo University, Tokyo, Japan

Abstract

To mitigate the impact of natural disasters, the Zambian government and non-governmental organizations instituted several types of food relief program. This paper examines these activities in terms of resilience for rural farmers, particularly focusing on a case in the Sinazongwe district between 2005 and 2008. The case study reveals that the relief food was extensively distributed by the government and NGOs to the population, seeking to avert a food shortage. However, at the same time, it was clear that the timing and targeting of the food aid was far from well-managed. To enhance the resilience of rural farmers, it is necessary for aid providers to respond in timely fashion to food crises, and to help farmers recover from the most vulnerable situations. The case in Sinazongwe, however, suggests that food relief programs seeking to cope with food shortage risks are severely limited, and must be reconsidered as social institutions to promote resilience.

6.1. Introduction

We conducted field research examining food relief programs in the Sinazongwe district to analyze social-ecological resilience in rural Zambia. Several types of relief programs have been implemented by the Zambian government, UN agencies and NGOs, including emergency food aid and disaster management projects. By examining these programs, we sought to determine how such policies contributed to the social-ecological resilience of rural communities, and how national and international organizations have been involved in this process. Thus, the main purpose of our research was to reveal the role of food security institutions in providing local farmers with resilience to overcome vulnerability in drought-prone areas.

To achieve this goal, it is necessary to analyze African rural communities in a multi-level context. In recent years, African agrarian communities have built an interactive network with external agencies such as the market, government policy, and NGOs, for securing resources. However, the ways in which development policies and social institutions impact on rural livelihoods remain unclear. To answer these questions, the resilience and vulnerability of African rural communities must be reconceived in terms of a wider perspective, considering government policies and the activities of NGOs, as well as households' efforts within their communities.

In this paper, we focus on a case study of food aid in the Sinazongwe district from 2005-08. By analyzing documents collected in the Sinazongwe district and the offices of NGOs, in combination with interviews with government officials, NGO staff and local farmers, we sought to reveal how relief food was delivered to villagers after the 2004/05 drought and the 2006 flash flood, and to determine the consequences of the implementation of food aid programs for rural communities.

6.2. The Government's risk assessment and food relief 2005-08

As mentioned in my annual report for FY2007, the Sinazongwe District Disaster Management Committee (SDDMC) made an appeal in December 2005, stating that an average 75% crop failure was experienced in most parts of the district, and that the southern end of the District was the worst affected due to the low rainfall (recorded below 190 mm; SDDMC, 2005). The government's Disaster Management and Mitigation Unit (DMMU) and the Vulnerability Assessment Committee (VAC) attempted to determine the population affected by the drought (for details of the DMMC and VAC, please refer to my FY2008 annual report). The VAC began an assessment in the rural areas of the southern half of Zambia from April 2005, and published a report in June 2005 (ZVAC 2005).

The VAC report concluded that a total population of 1,232,661 people in the rural areas of Zambia (excluding commercial farmers) were likely to face food insecurity, and would require 118,335 metric tons of cereal for a period of 8 months (July 2005 – February 2006) in 27 districts covering Lusaka, Central, Southern, Western and Eastern Provinces. They estimated that the cereal needs in Sinazongwe district and the number of persons at risk in the 2005/06 marketing season was respectively 667 metric tons of cereal, and 6,944 persons over the subsequent 8 months.

In contrast, the 2005/06 production season was generally good, though characterized by excessive rain in some parts of the country which resulted in the flooding of some low lying areas (ZVAC 2006a). In the Sinazongwe district, excessive rains caused flash floods to wash away some crops along riverbanks, and breached earth dams. The district office submitted damage reports to the government twice; the first on a breached earth dam in March, and the second on the district's flood damage in April. A rapid assessment was conducted by VAC in June 2006. However, Sinazongwe district was not included as a target of the survey, and no risk or needs were reported (ZVAC 2006a). Thereafter, the VAC report published in December 2006 finally estimated the food shortage risks and needs in the Sinazongwe district: it was predicted that 41,125 persons would be at risk, and 987 metric tons cereal would be required for the next two months.

Table 6-1 shows the number of people at risk and needing cereal in the Sinazongwe district, as estimated by the VAC in 2005-08. In June 2006, March 2007, August 2008 and February 2008, neither food shortage risk nor cereal requirement was reported in the Sinazongwe district. In the 2006/07 production season, production in the Southern Province increased marginally over the previous season despite experiencing prolonged dry spells during part of the growing season, while production substantially increased in valley areas including Sinazongwe (ZVAC 2007b). Although the 2007_08 rainy season started well with the southern half of the country experiencing an early onset, rainfall increased substantially from November 2007 to January 2008, resulting in widespread heavy rain that caused floods (ZVAC 2008). The VAC report of June 2008 estimated that 21,898 people were at risk, and that 1,642 metric tons of cereal would be needed for the next 6 months in Sinazongwe district (ZVAC 2008). The report noted that the maize price in Sinazongwe was abnormally high (up to

K1,900/Kg; more than twice that of April 2007) indicating a possible food shortage risk.

Table 6-1. Risk and needs assessment of Sinazongwe district from VAC reports 2005-08

Month/ Year	Number of persons at risk	Cereal requirement (metric tons)
June 2005	6,944	667 (for 8 months)
June 2006	-	-
December 2006	41,125	987 (for 2 months)
March 2007	-	-
August 2007	-	-
February 2008	-	-
June 2008	21,898	1,642 (for 6 months)

Source: VAC reports 2005-08 (ZVAC 2005, 2006a, 2006b, 2007a, 2007b, 2008)

Table 6-2. Actual food distribution by the government in Sinazongwe district 2005-08

Month/ Year	Number of beneficiaries	Distributed cereal (metric tons)
June 2005	7,926	100
September 2005	12,500	150
November 2005	4,833	58
April 2006	2,483	29.8
May 2006	6,917	83
March 2007	41,083	493
October 2007	12,500	150
August 2008	7,980	100
December 2008	14,743	182

Source: Documents collected from Sinazongwe district office and KDF

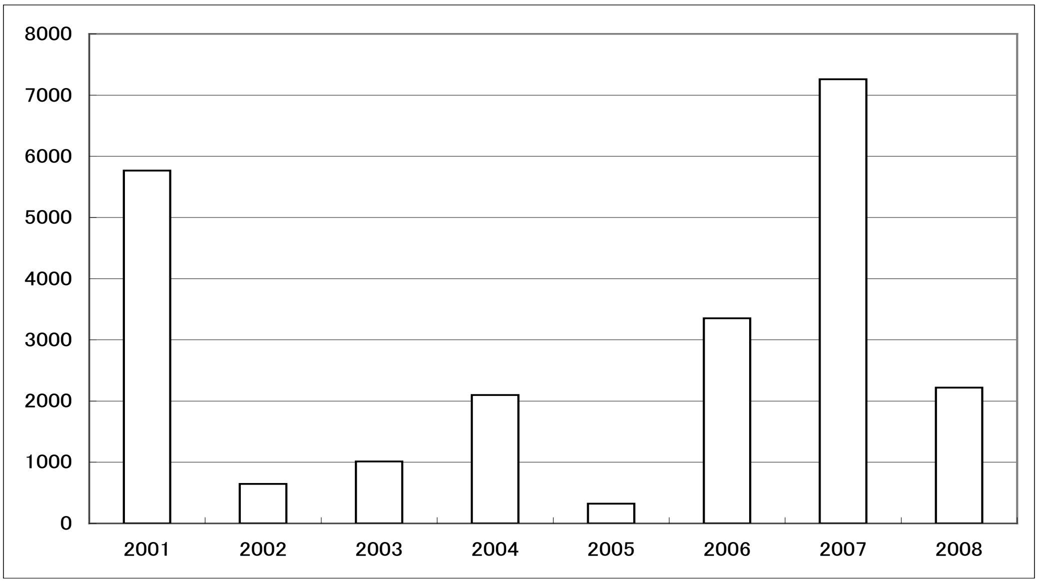


Figure 6-1. Estimated annual maize production in Sinazongwe district 2001-08 (mt)
Source: District Agriculture Coordination Office of Sinazongwe District

Table 6-2 shows the actual amount of the government relief food and the number of beneficiaries in Sinazongwe district. The food relief delivered to Sinazongwe was distributed among the population by a local NGO, the Kaluli Development Foundation (KDF). The data in Table 6-2 were derived from several documents and records in Sinazongwe district office and the KDF office.

Comparing the actual amount of food relief with the needs assessment of VAC reveals considerable gaps between them. First, the amount of distributed cereal was much less than the cereal needs estimated by the VAC. In 2005 and 2008, for example, the actual food relief was less than half and less than one fifth, respectively, of the predicted food requirement. In contrast, even though there was no reported need for cereal in 2007, especially after the harvest season (from March to April), a substantial amount of food was distributed twice in March and October.

Figure 6-1 shows the annual production of maize in Sinazongwe district estimated by the District Agriculture Coordination Office (DACO). According to this estimation, the 2007 harvest was much better than that of the other years. Even under these good agricultural conditions, the total amount of food relief in 2007 was substantially greater than that in 2005, a severe drought year. The main reason for this mismatch was that the delivery of relief was delayed to the extent that it was not completed before the harvest in 2007.

6.3. NGO food relief 2005-06

After the severe drought in 2005, several NGOs, including the Red Cross Society (RCS), Catholic Church (CC) of Maamba Parish, Christian Council of Zambia (CCZ), Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), and World Vision (WV) started their own food relief programs in Sinazongwe district. All NGOs terminated their programs by July 2006.

In June 2005, GTZ initially responded to requests made by the Ministry of Agriculture and Cooperatives to assist food insecure households in Sinazongwe district (GTZ 2006). However, it was in September 2005 that the emergency appeal came into effect at the GTZ headquarters. The number of beneficiaries was targeted as 3,000 households, although the food request was dependent on the availability of financial resources of GTZ. In November, GTZ started their relief food distribution for 3,011 households with 150 mt maize gain, 75 mt maize-cassava meal mix, 7.5 mt sorghum seed, 15 mt maize seed, and 7.5 mt cowpea seed.

The response of other NGOs was also delayed. On 18 October 2005 RCS launched an appeal for emergency food in Southern African countries (RCS 2006). The food security operation of RCS sought to assist up to 1.5 million vulnerable beneficiaries in seven countries (Lesotho, Malawi, Mozambique, Namibia, Zambia and Zimbabwe) with provision of food assistance. Even by the end of March 2006, however, the registration of targeted beneficiaries in Sinazongwe was still not completed. Furthermore, due to the delay of permits to allow food entry into the country, it was not until April 2006 that RCS finally started relief food distribution to a total of 2,199 households (16,000 beneficiaries), 317.615 mt maize meal, 51.139 mt beans, 16,000 liters of cooking oil, 88.132 mt high energy protein supplements (HEPS).

Table 6-3. Relief food distributed by NGOs in Sinazongwe district 2005-06 (mt)

Month/ Year	CC	GTZ	CCZ	WV	RCS	Total
August 2005	1					226.83
September 2005		225.83				
November 2005						
December 2005	14.63					14.63
January 2006	14.63	150.55				165.18
February 2006	14.63		20			34.63
March 2006			20			20
April 2006			20	79	144.82	243.82
May 2006				78.72	172	250.72
June 2006				23.45		23.45
July 2006				138.73		138.73
Total	44.89	376.38	60	319.9	316.82	1117.99

Source: Documents collected in Sinazongwe district office (only on cereal grain and meal)

Table 6-3 shows the timing of NGO relief operations and the amount of food distributed by each NGO. More than half of the food aid was implemented after the 2005/06 harvest. This means that the relief food did not reach the affected population during the most severe period of the 2004/05 drought. Consequently, in spite of a rapidly changing situation surrounding rural households and agricultural activities, the relief of the government and NGOs continued with the same scale of food aid even after the recovery from drought or flood.

6.4. Conclusion: Social institutions and resilience for food shortage risk

Examining the relief activities of the government and non-governmental organizations after the 2004/05 drought revealed that actual relief activities were frequently delayed, and not operated in a timely manner, even when the effect of a natural disaster was recognized through risk assessments and/or emergency appeals. On the one hand, in terms of an initial response to the food shortage risk, government relief operated quickly to some extent. In contrast, it took large international NGOs such as WV and RCS much longer to start their operation at the local level. On the other hand, the government relief activities were so sporadic and poorly coordinated that there were large gaps between the initial risk assessment and actual food aid.

As Ishimoto argues in chapter two, the resilience of rural households can be defined in terms of the time taken to recover from an unexpected shock. This means that social institutions such as food aid agencies should mitigate the food shortage risk at an initial phase and enhance the resilience of rural households to recover from shocks as soon as possible. It is true that various relief programs can partially contribute to the avoidance of the disastrous consequences caused by natural hazards. The case study of Sinazongwe, however, revealed severe operational problems and inefficiency in those relief activities with a great time gap (Figure 6-2). Most importantly, to support households in recovering from a shock, it is necessary to match the coping strategies of rural farmers.

The relief program against food shortage risk in Africa is heavily dependent on food aid. As discussed above, it takes a substantial amount of time for aid organizations to provide the enormous amounts of food required by local populations, and difficulties are involved in procuring the necessary amount of food at a given time. As Miyazaki and Ishimoto point out in their chapters, individual farmers adopt various kinds of coping strategies, such as shifting crop varieties, selling livestock, temporarily working as waged laborers, and utilizing social-networks. Food shortage risk cannot always be avoided by relief food provision and agricultural development policies. In terms of the resilience of rural farmers, it can be argued that relief activities that are heavily dependent on food aid should be reconsidered. The most important goal in providing an effective relief is to support farmers' own voluntary efforts by providing opportunities that can be utilized at the time of a food shortage.

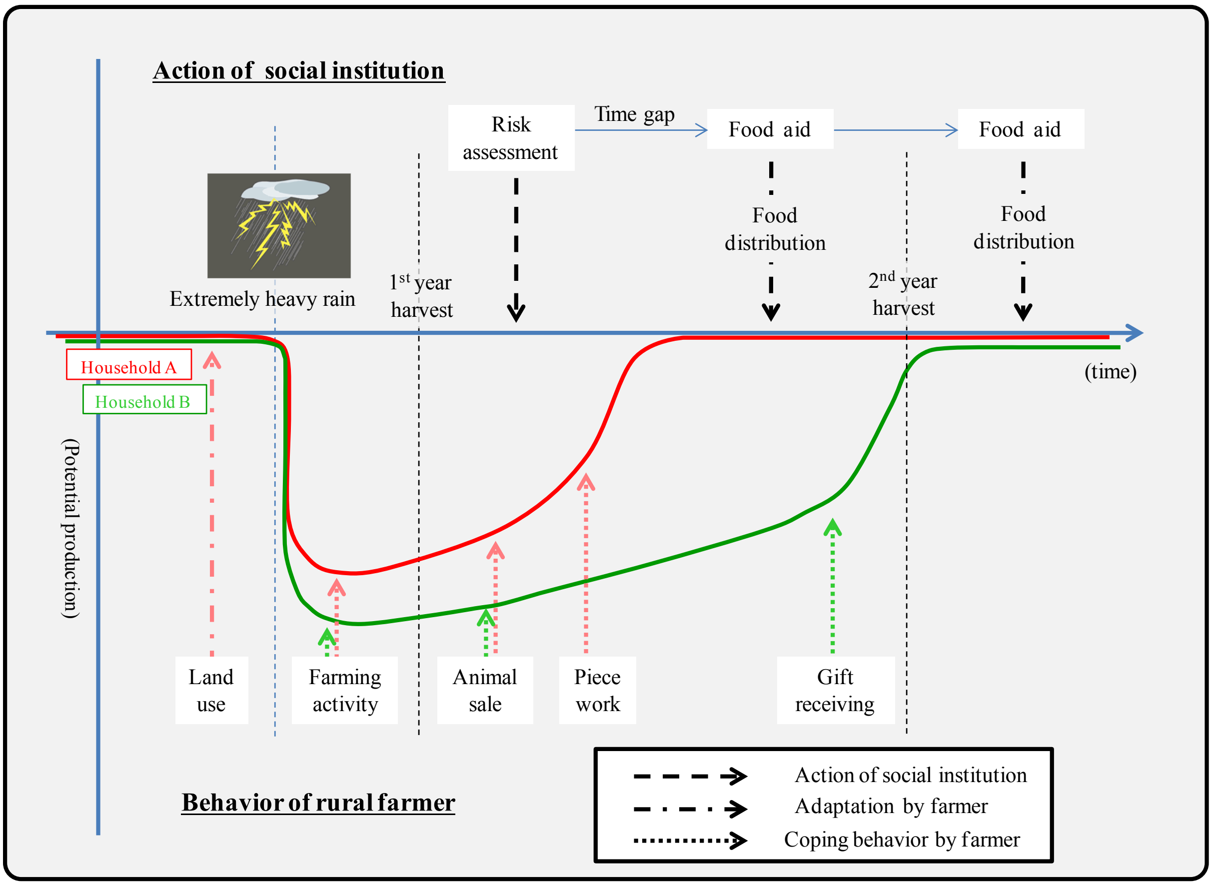


Figure 6-2. Comparison of farmer's behavior with social institution's action in response to extremely heavy rain

* This figure is revised figure 2-4 by K. Matsumura.

References

Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ). 2006. "Emergency GTZ Relief Programme 2005/2006". (An unpublished report submitted to SDDMC meeting on 21 February 2006).

Red Cross Society (RCS). 2006. "Terms of Reference for Real Time Evaluation: Southern Africa Food Insecurity Appeal No: 05EA023". (An unpublished document of RCS Maamba branch used at the evaluation meeting on 5-6 May 2006).

Sinazongwe District Disaster Management Committee (SDDMC). 2005. "Food Situation and Availability: Brief Report Presented to World Food Programme Representatives Visiting Sinazongwe District on 17th December 2005". (An unpublished document)

The Zambia Vulnerability Assessment Committee (ZVAC). 2005. "Vulnerability and Needs Assessment June 2005". Lusaka: ZVAC.

The Zambia Vulnerability Assessment Committee (ZVAC). 2006a. "Rapid Assessment on the Effects of Rainfall on Livelihoods June 2006". Lusaka: ZVAC.

The Zambia Vulnerability Assessment Committee (ZVAC). 2006b. "Rapid Assessment on the Verification of the Food Security Situation, December 2006". Lusaka: ZVAC.

The Zambia Vulnerability Assessment Committee (ZVAC). 2007a. "Rapid Flood Impact

Assessment Report, March 2007”. Lusaka: ZVAC.
The Zambia Vulnerability Assessment Committee (ZVAC). 2007b. “In-depth Vulnerability and Needs Assessment Report on the Impact of the Floods and/or Prolonged Dry Spells, August 2007”. Lusaka: ZVAC.
The Zambia Vulnerability Assessment Committee (ZVAC). 2008. “Multi-Sectoral In-Depth Vulnerability and Needs Assessment, June 2008”. Lusaka: ZVAC.