EEPSEA
2016-RR4

Self-Protection against Flood in Cambodia

Chou Phanith

WorldFish

Published by WorldFish (ICLARM) – Economy and Environment Program for Southeast Asia (EEPSEA)
EEPSEA Philippines Office, WorldFish Philippines Country Office, SEARCA bldg., College, Los Baños, Laguna 4031 Philippines; Tel: +63 49 536 2290 loc. 196; Fax: +63 49 501 7493; Email: admin@eepsea.net

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ISBN: 978-971-9680-29-1

Front cover photo: Rice field diversification with corn and reed in Lvaem district, Kandal province, Cambodia. Photo by Chou Phanith

Suggested Citation: Chou P. 2016. Self-protection against flood in Cambodia. EEPSEA Research Report No. 2016-RR4. Economy and Environment Program for Southeast Asia, Laguna, Philippines.

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February, 2016

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ACKNOWLEDGMENT

I am grateful to the Economy and Environment Program for Southeast Asia (EEPSEA) for the funding support and to the Environmental Economics Unit (EEU), University of Economics Ho Chi Minh for facilitating the administrative process and venue for meetings during the research protocol designs.

My appreciation also goes to Dr. Herminia A. Francisco and Dr. Pham Khan Nam for their coordination, guidance, and support for this project. Likewise, my gratitude goes to Prof. Peter Martinsson and Dr. Ferdinand M. Vieider for their enthusiasm, helpful comments, and recommendations. This study would not have been completed without the expertise and practical knowledge they generously shared.

Also, I would like to thank my colleagues, Jiang Chong, Phumsith Mahasuweerachai, and Truong Cong Thanh Nghi for their cooperation and commitment throughout the project.

I also thank all my research assistants and enumerators for their hard work, discipline, and outstanding fieldwork during the pretest and full survey.

My appreciation also to the Royal University of Phnom Penh (RUPP) Prof. Lav Chhiv Eav, Former Rector of RUPP, Dr. Chet Chealy, Rector of RUPP, Dr. Um Ravy, Vice Rector of RUPP and Dr. NGIN Chanrith, Dean of Faculty of Development Studies, RUPP for their support.

We are indebted to the local government units of Lvea Aem district, Preak Kmeng and Peam Oknha Ong commune councils and village chiefs for allowing us to conduct the study.

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EXECUTIVE SUMMARY

People in Southeast Asia are regarded as the vulnerable groups to natural disasters who suffer the most from these events. Flood, drought, typhoons, and other natural hazards result in loss of human life and damages to infrastructure, agriculture, and environment. The current policies and actions of government agencies, nongovernmental organizations (NGO), and other stakeholders are not always responsive to these disasters. This research investigated (1) the change in Cambodian's preference for self-protection and insurance against natural disasters, (2) how groups can influence communities toward self-protection and insurance investments, (3) the collective investment to reduce the expected losses associated with natural disasters, and (4) the existing social institutions in Cambodian communities that improved their voluntary contribution to the protection against disasters' interdependent risk.

The results showed that flood in Cambodia occurs with uncertainty and at different intensity every year. The flooding season generally starts from June to early December; but the peak flooding season, when the water level is at its highest, is around September until October. Flood is regarded as the worst among the natural hazards that directly affect people's livelihoods. Based on the survey done in this study, the farmer respondents were knowledgeable about flood characteristics, which accordingly prompted the local communities at the site to adopt structural and nonstructural mitigation strategies. In structural mitigation, the local people built their houses 6 meters above the the ground to keep family members, animals, and properties safe from flood. They also contributed money, labor, or materials in order to build temporary shelters or evacuation areas on higher grounds, which they use during flood events.

In terms of nonstructural mitigation strategies, farmers acquired their information about the water level from the Chaktomuk gauging station. Likewise, most of them monitored warning information from media as part of their disaster risk reduction strategy. Farmers also shifted to diversified farming and based their farming activities on the flooding period in order to reduce the risk of damaging their agricultural products. The main crops like rice and reed were cultivated during dry season; other short-term crops were also cultivated continuously for extra benefits. Crop diversification on the same land was also practiced to reduce potential losses. Moreover, more than half of the respondents' household also accessed micro-credit to increase their investments in agricultural inputs.

The local people had very good social relationship and community initiative. They accorded all agencies that provided relief with very similar level of expectation and equal importance. Neighbors/people in the community helped each other during evacuation, in house maintenance, or in food sharing.
The government helped build infrastructure and provided emergency response and preparedness initiatives. NGOs also did the same but on a smaller scale than that of the government. Buddhist monks also provided shelter, food, and micro-constructions to vulnerable people during flood disasters.

1.0 INTRODUCTION

1.1 Background

Environmental conservation and economic development can be achieved sustainably while controlling for the complexities, risks, uncertainty, and dilemma that natural disasters pose.
However, environment and economic managers need the cooperation of all the relevant institutions and local communities in order to strike a balance between economic development and environmental conservation and to manage and mitigate the risks and uncertainties associated with the changing environment and climactic conditions. Natural disasters have the most severe impact on people's livelihood

activities that hinders economic development. This creates socioeconomic problems such as food insecurity, poverty, and social dilemma (Bildan 2003; UNEP 2007). Accordingly, the question as to how and what can be done to cope with these disasters still remains.

The people in Southeast Asia are regarded as vulnerable groups who are always affected by natural disasters (Bildan 2003; Hongyan et al. 2011). Flood, drought, and other natural hazards cause loss of human life and damages to infrastructure, agriculture, and environment (Bildan 2003; UNEP 2007). However, the current policies and actions of government agencies, nongovernmental organizations (NGO), and other stakeholders are not always responsive to those disasters.

Cambodia has rich water sources in the Mekong River and Tonle Sap Lake. The Lower Mekong, Bassac, Upper Mekong, and Tonle Sap River (which flows from the Tonle Sap Lake) are the four main rivers that converge at the Chaktomouk Junction in Phnom Penh. However, these rich water bodies also make Cambodia the most disaster-prone country in Southeast Asia. Natural hazards, especially flood and drought, always affect this Kingdom (NCDM 2012b; Rinbo 2009; WFP 2011). The floodwater in Cambodia comes mainly from the upper and middle regions of the Mekong River. Intensified rainfall brings more water to the river and other water bodies. The poor management of flood-prone area also increases the risk of flooding. If the water level is high, then farmers can only plant a single crop per year (Rinb 2009).

About 80% of Cambodians are farmers who depend on subsistence agriculture for their livelihood. Thus, they usually experience hunger, poverty, and even loss of life when such disasters occur (WFP 2011). Natural disasters also affect social welfare, damage infrastructure and houses, and cause losses in farming products. This vulnerability hinders poor Cambodian communities from recovering from the devastation caused by previous floods and droughts (Rinbo 2009).

In response to the situation, the Royal Government of Cambodia met with international donors (i.e., World Food Programme and Food and Agriculture Organization) and other NGOs in order to formulate responsive strategies to alleviate the condition. Under the coordination of the National Committee for Disaster Management (NCDM), concerned agencies at the national and provincial levels convened to develop joint responses to help vulnerable people to cope with such conditions (NCDM 2012b). In relation to this, the National Poverty Reduction Strategy (NPRS) of Cambodia explicitly identified natural hazards, particularly floods and droughts, as critical factors that continue to increase the socioeconomic vulnerabilities of the rural poor in Cambodia. In this context, a series of cooperation and coordination mechanisms were enacted to facilitate collective efforts to better understand the impacts of those disasters on all sectors of society and to identify strategies that would enable communities to respond to these disasters appropriately (CSD 2002).

However, despite the well-coordinated efforts within institutions, the outcomes have not been very efficient because people still suffered from the disasters. To date, there has been no report as to why the cooperation was not very successful.

1.2 Hypothetical Framework

A natural hazard becomes disastrous when it adversely impacts vulnerable people, resulting in damages to and disruptions in community functions (Abarquez and Murshed 2004; Cannon 2008; O'Brien et al. 2008; UNISDR 2009). Natural hazards such as floods, drought, cyclone, or earthquake can trigger disaster when social structures cannot mitigate the hazards and reduce the risk (ISDR 2007; Kelman 2010; Torrente, Zhang, and Le-Huu 2008). Natural hazards cannot be stopped; but the risks can be mitigated, vulnerability can be reduced, and the impacts can be minimized (Abramovitz et al. 2001; Asghar, Alahakoon, and Churilov 2006). This can be achieved through strong community resilience and sustainable ecosystem for sustainable development and risk reduction (Abramovitz et al. 2001; ISDR and UNEP 2004).

There are many components and processes for building efficient programs that would reduce the vulnerability and risk exposure of vulnerable communities (ISDR 2012). Many developing countries, UN agencies, and authors have introduced various frameworks to deal with disasters. The Disaster Crunch and Release Model introduced by Wisner et al. (2004) showed the relationship between hazards and the conditions of vulnerabilities that cause a disaster. It also showed the process on how to mitigate hazards and reduce vulnerability by creating strong social structures and processes that can influence politics, economics, and culture. There are more frameworks that show the process of hazard assessment, risk management, and disaster management actions such as the frameworks of Hyogo, the United Nations International Strategy for Disaster Reduction, and Asghar et al. (2006).

These frameworks show that the collective actions of all stakeholders, particularly that of the local community, are needed in order to mitigate the hazards and reduce vulnerability of communities. Local people need to work together to determine the hazards present in their location. The risks and the community's capacity for advance planning should also be identified for efficient risk mitigation, preparedness, responses, and recovery actions. Accordingly, this research determined the extent of how households and communities work together to protect themselves from flood events.

1.3 Objectives

This study investigated the self-protection behavior of the local communities in Lvea Aem district, Kandal province, Cambodia and their preference toward insurance against natural disaster risks. Specifically, the study aimed to

1. Explore the baseline issues and problems brought by flood and other associated natural disasters;
2. Investigate the local communities' change in preference for self-protection and insurance against flood as the magnitude and probability of a loss change;
3. Evaluate the social relations for collective actions against flood; and
4. Investigate collective investments for reducing expected losses associated with flood.

2.0 DESCRIPTION OF THE STUDY SITE

2.1 Overview of the Flooding Situation in Cambodia

Flood in Cambodia mainly comes from the upper and middle reaches of the Mekong River. When rainfall intensifies, thereby adding more water in the river and in other water sources already swelling, flood occurs when the excess water spills into surrounding areas (ISDR and WB 2009; Mao 2005).

There are two common types of flood in Cambodia (NCDM and MoP 2008). The first type is the Mekong flood, which is common and has the most serious impact because of its long duration. This happens when the rainfall in the upper catchments accumulates throughout the rainy season, which then causes a slow but steady rise in the water level. This happens regularly and brings more water into the river, lakes, streams, and other water reservoirs until the water bodies overflow, thereby flooding the lowland and other surrounding areas (NCDM and MoP 2008; WFP and NCDM 2003). The other type of flood is the flash flood, which happens when heavy rainfall (due to continuous rains) from the mountain areas flows into the streams and tributaries of the Mekong River and other water ways. Although this kind of flood lasts for a few days only, it often causes severe damages to crops and infrastructure (NCDM and MoP 2008).

Lvea Aem is a district in Kandal province that completely surrounds (but not included in) the national capital of Phnom Penh (Figure 1). It is a rural area located along the Mekong River, and is very near to the capital city. Lvea Aem has 16,841 families with a total population of 77,097. Around 78% of the total households are farmers whose livelihoods are based on fishing; raising livestock; and producing rice, long- and short-term crops, and vegetables (NCDD 2011). The district is always affected by the heavy floods coming from the Mekong River for six months every year. A study by the Asian Development Bank (ADB) on community self-reliance and flood risk reduction reported that Lvea Aem district was regarded as the most vulnerable area to natural disasters, particularly to flood events (ADB 2007; MoP 2006).

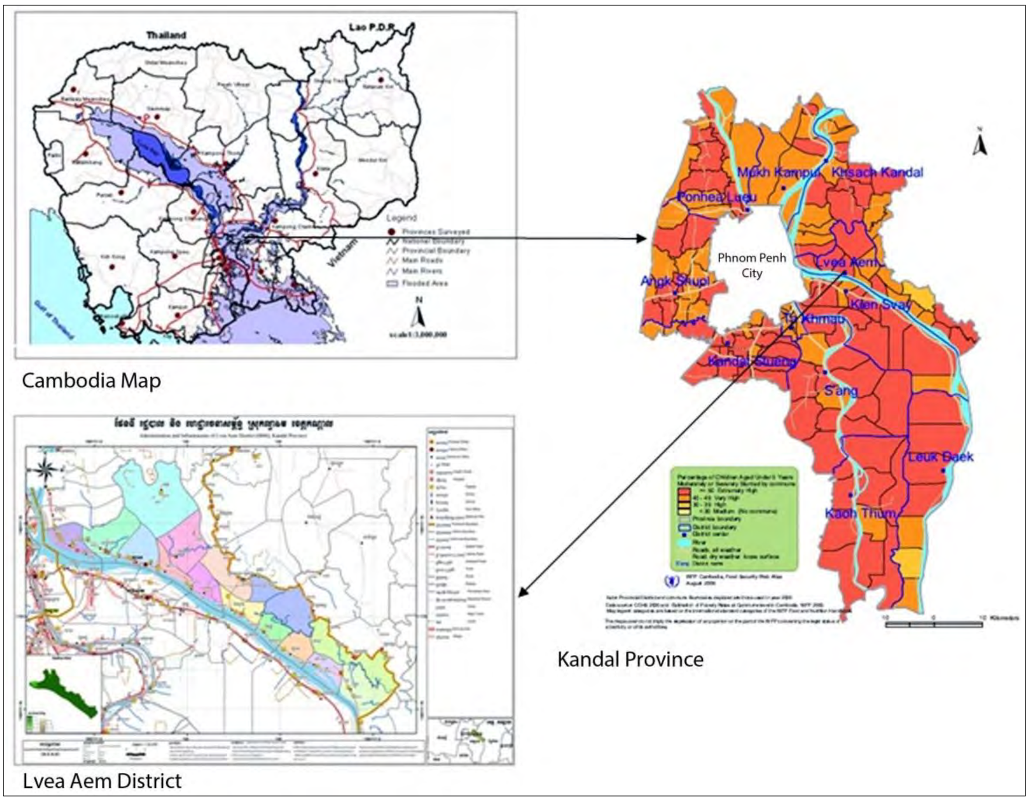

Figure 1. Map of study site

Two communes suffering from similar impacts of flooding, but with different livelihood activities, were selected in this study: (1) Prek Kmeng commune, where most of the residents are farmers and depend on dry rice crop farming and fishing; and (2) Peam Oknha Ong, where the local residents depend on dry rice crop farming and trading. Other livelihood activities, such as fruit and vegetable crop production and animal husbandry, are being done in both communes. However, the impacts of flooding are more severe in Preak Kmeng than in Peam Oknha Ong.

Preak Kmeng commune is affected for six months every year by the heavy floods coming from the Mekong River. These events are not accompanied by strong winds (except for the flood in 2000 and 2011), only high floodwater levels . The most seriously affected farming activities at that time were fruit crop production and animal husbandry. Currently, the most important livelihood activities at the commune are dry rice crop farming and fishing.

Although Peam Oknha Ong commune share a similar flooding issue with Preak Kmeng, the impacts of such flooding on Peam Oknha are less severe because it is situated in a higher location than Preak Kmeng. The livelihood activities at Peam Oknha Ong commune are also similar to that of Preak Kmeng. However, many Peam Oknha Ong farmers have other small businesses, such as producing and selling fish, fruit, animal products, cake, and others. The products are collected from their own commune and other communes nearby for distribution to Phnom Penh City.

2.2 Characteristics of the Study Sites

Based on the previous ADB study on community self-reliance and flood risk reduction, Lvea Aem district was regarded as one of the most vulnerable areas to natural calamities, particularly to flood events (ADB 2007; MoE, GEF, and UNDP 2005). The district has a total land area of 26,092 ha, with flooded forest areas of 1,746 ha; cultivated area of 10,425 ha; construction area of 990 ha; and other land area of 12,931 ha (NCDD 2011) (Figure 2). The main occupation of the local people is farming, followed by craft works and services; around 11.61% of the total households have no clear occupation (NCDD 2011). Around 25% of the total families have access to electricity for lighting, whereas around 80% use battery instead. Most of local people (87%) can watch TV to get news update or for entertainment (NCDD 2011).

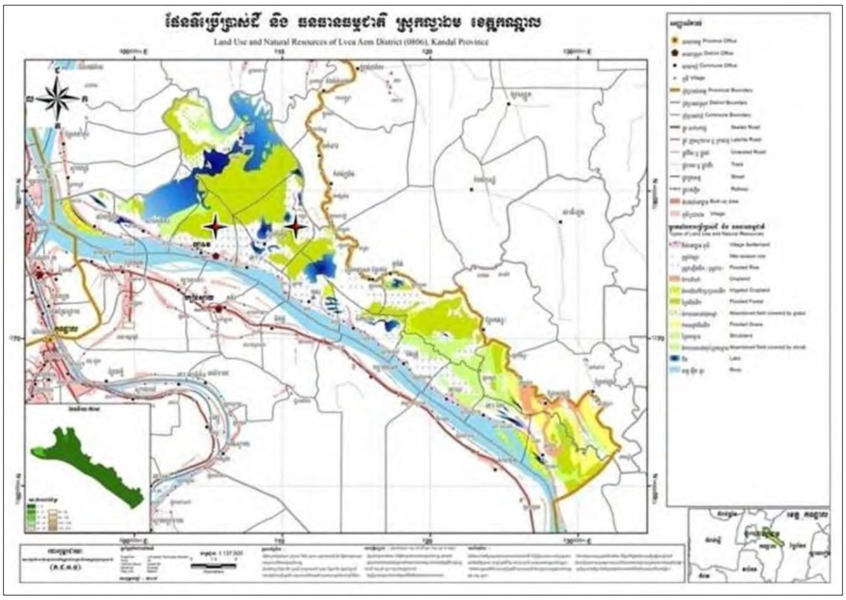

Figure 2. Map of land use and natural resources of Lvea Aem district

Source: NCDD (2010)
Note: Red stars are the selected communes

Drainage, bridges, roads, and water ways are very important in reducing the impacts of flood and in improving the livelihood activities of communities through transportation facility. There are many kinds of drainage and bridges at the study sites, such as single pipe culvert, double pipe culvert, box pipe culvert, wooden bridge, concrete bridge, and bale bridge (NCDD 2011).

3.0 OVERVIEW OF THE LOCAL FLOODING SITUATION AND LOCAL HISTORICAL DATA

3.1 Flood Determinants

Among the flood events that have occurred in Cambodia, the 2000 and 2011 floods had the most severe impact on Cambodian farmers' livelihood. The flood intensity level during these two events was very high, and the floodwater remained high for a long period of time. These events adversely affected the production of rice, fruit, and vegetable crops; livestock-rasing activities; home gardening; and caused damages to properties. The flood came suddenly at high intensity, the floodwater remained high for a long time, and it was accompanied by strong winds.

Based on the households interview conducted in this study, both farmers and fishermen were adverse to flood because of its negative impacts. The fishermen could hardly catch fish at the Mekong River because of the strong wind and waves. Farmers who grew rice crop, vegetables, and fruit trees and those who raised livestock could hardly cope with the losses in their farm.

The flood events from 2006 to 2010 were not regarded as serious because the floodwater level during that period had not been high and the flood had flowed slowly. As Figure 3 shows, the floods from 2006 to 2010 did not significantly affect the local people. Farmers were able to harvest their produce and evacuate their animals to safety. People were not concerned about the impact of the flood then because they could still farm and catch fish. However, because they had ignored the possible impacts of floods and accordingly had failed to prepare for them, this led to serious disaster when one of the worst flood events in Cambodia hit in 2011. Most of the crops were destroyed, and many livestock were killed. Houses and critical infrastructures were also damaged. Essentially, the 2011 flood significantly affected the the socioeconomic stability of the communities.

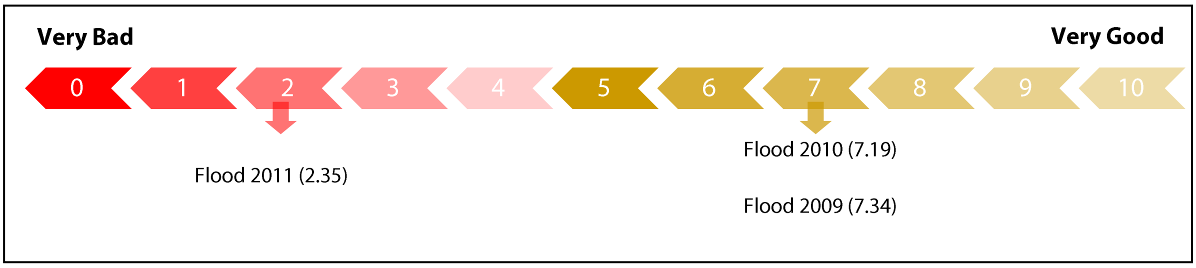

Figure 3. Impact level of the 2011 flood on the local people's livelihood

Note: 0 level very bad; 10 level is very good

3.2 Historical Data

The worst floods in Cambodian history, which was technically monitored by the Mekong River Commission in collaboration with the Department of Hydrology and River Works (DHRW), occurred in 2000 and 2011. The water level at that time was higher than the alarm level (10 m), but still below the total flood level (Figure 4).

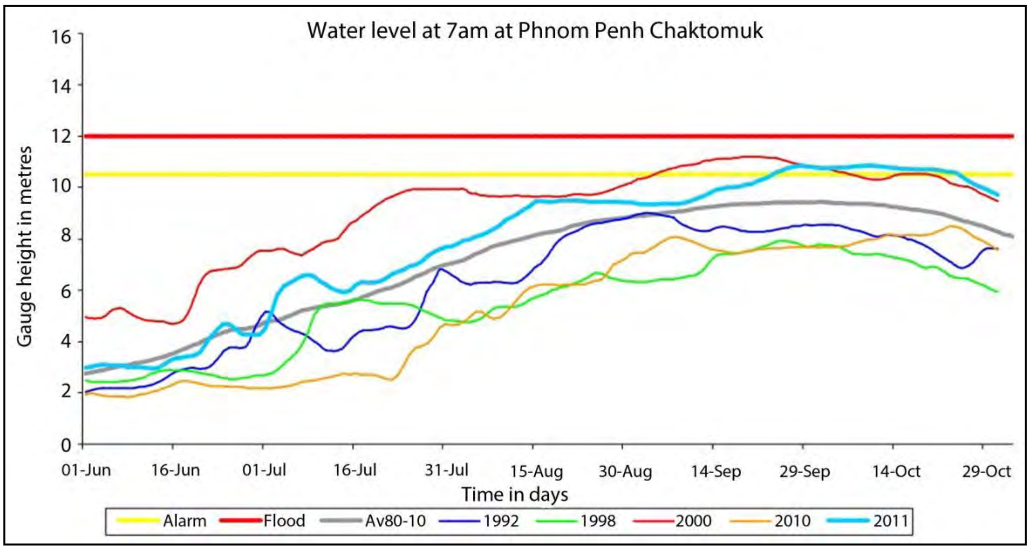

Figure 4. Historical hydrology of Chaktomuk gauge station

Source: MRC (2011)

The graph shows that the water level during the period 2006–2011 and in 2000 and 2011 did not reach the flood level. The farmers assessed that at a 12-meter water level, the whole surrounding area would be flooded, and the local people living along the Mekong River would be the first and most affected groups. The farmers' assessment and the data were in contrast, since the floods in 2000 and 2011 were the worst although the water level at that time was below 12 m.

3.3 Gauging Station

There are eight existing gauging stations that measure the water level in Cambodia's territory along Mekong River, namely, Stung Treng, Kratie, Kampong Cham, Phnom Penh Bassac/Chaktomuk, Phnom Penh Port, Koh Khel, and Neak Luong (MRC 2012). The Phnom Penh Bassac/Chaktomuk gauge station, which measures the water level of Phnom Penh and the surrounding area including the study sites (i.e., Lvea Aem district), were used in this research. Chaktomuk gauge station is located on 13041'00" latitude and 107015'00" longitude (DHRW 2009). The map from MRC (Figure 5) shows the location of the station.

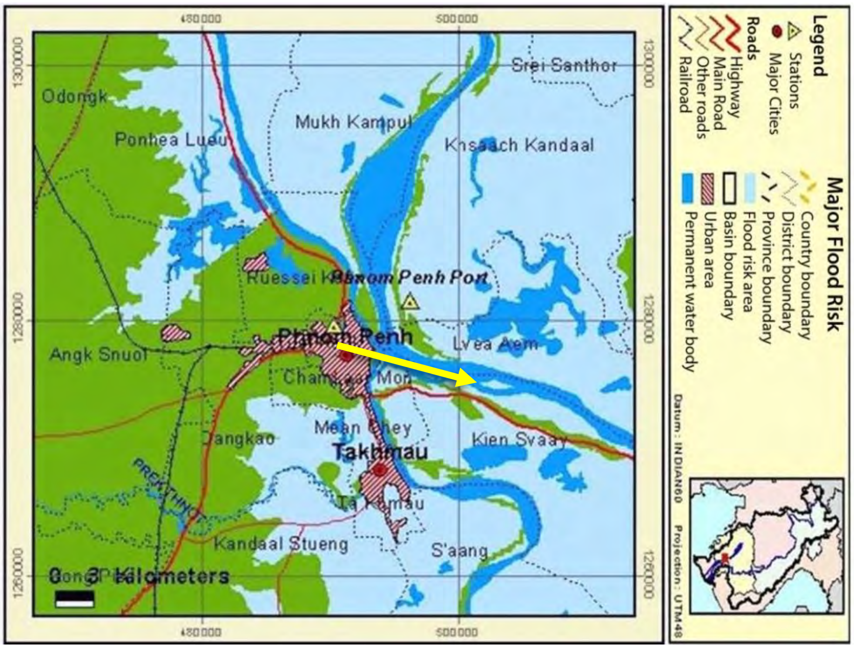

Figure 5. Location of Chaktomum gauge station and Lvea Aem

Source: MRC (2012)

In the past 32 years since 1980, the year 2000 reached the highest water level, followed by 2001 and 2002, which also reached the warning level. However, the flood in 2011 was also serious because it reached 0.16 m higher than the warning level.

4.0 RESEARCH METHODOLOGY

4.1 Description of Experiment and Survey Conducted

4.1.1 Study site selection

The study sites were chosen based on a cross-country research objective and based on the flood intensity in that specific country. Previous studies and reports from ADB, the Ministry of Environment, and NCDM were used to evaluate the flooding situation in Cambodia. Lvea Aem district was selected as the research site because it is regarded as the most vulnerable zone to flood. The district is a flood-prone area from Mekong River and other streams, and its socioeconomic activities have always been affected by the yearly flood.

Another criterion used to select the study sites was the impact of flood on farmers. Some farmers were slightly affected while others had the worst experience. Preliminary survey was done to collect baseline information. Semi-structured interview were conducted among the district governor, commune chiefs, and local people living in the district. Data from the preliminary study were cross-checked with that of the previous study of the location. Preak Kmeng (which had experienced the worst damage due to flood) and Peam Oknha Ong (which had experienced lesser damage) were selected to represent the district as well as Cambodia.

Preak Kmeng commune has 591 households from two villages (Preak Kmeng village and Tuol Trea village), and both villages were chosen randomly for the study (NCDD 2011). Peam Oknha Ong commune, on the other hand, has a total of 1,830 households living within five villages. Three villages that had experienced the worst damages due to flood were selected in this study. Each sample was selected randomly from the upper, middle, and lower villages.

4.1.2 Sampling procedure

Sampling procedures were strictly designed and executed. This study covered two communes (i.e., Preak Kmeng and Peam Oknha Ong) in the Lvea Aem district, Kandal province, Cambodia where severe flooding had occurred in the past. A total of 200 agriculture-based farm households (100 each from Preak Kmeng and Peam Oknha Ong) were randomly selected from the targeted villages (Table 1). The researchers identified the respondents' strategies to reduce their losses from flood, and determined the extent of damage to livelihoods that they had endured due to the flood.

The household heads who had met the requirements were gathered by the local guides. The respondents were informed in advance of the research objectives and the time frame. The rights of the respondents, either to accept or reject the interview, were observed. The enumerators made a second attempt if the respondent had not been available during the first visit. Accordingly, another respondent was selected anew if the second attempt had failed. The interview was done at the respondent's house.

Table 1. Total sampling selection

Prek Kmeng Commune		Peam Oknha Ong Commune	
Village Name	**Sample Size**	**Village Name**	**Sample Size**
Prek Kmeng	50	Prek Ta Ong 1	33
Tuol Trea	50	Prek Ta Ong 2	33
		Peam Ta Erk	34
Total	**100**		**100**

4.1.3 Data collection and analysis

Secondary data were collected from as many sources as the researcher could get in order to get the overall socioeconomic information, history of water level from gauging stations, and flooding history from relevant institutions (e.g., NCDD, NCDM, Ministry of Water Resources and Meteorology, MRC, ADB, FAO). Primary data collection using questionnaire were gathered from individual interviews. The software Statistical Package for the Social Sciences were used to analyze the data. Some qualitative data from the key informants interviewed, synthesis information, and control data were used for cross checking.

4.2 Economic Models

In order to analyze the flooding situation at the study sites and the existing local capacity of the local communities to cope with flood disaster, some economic variables were designed as follows:

1. Socioeconomic profile of the respondents to determine their existing resources and available capacity against flood;
2. Respondents' knowledge to prepare for, respond to, and recover from the flooding based on their experiences and assessment;
3. Respondents' income sources in order to evaluate their financial capacity, which were then correlated with the attitudes and households strategy to reduce their risk exposure to flooding;
4. Risk reduction (early warning system management, farming changes and micro construction); and
5. Local initiative to weigh the relief level that farmers expect when disaster occur.

5.0 RISK MANAGEMENT AND ECONOMIC CONSEQUENCES FROM FLOODING

5.1 Socioeconomic Profile

The average age of the respondents in Lvea Aem district, Kandal province was 42 years. All respondents were Khmer ethnic who believed in Buddhism. Half of them had only primary school education, whereas 24% also attended secondary school. The illiteracy level was around 12% among the total respondents. Most of the households interviewed were into farming-based activities, whereas others had businesses or services to generate income (Table 2).

Table 2. Profile of respondents

Components	Mean-Frequency
Number of respondents	200 household heads
Gender	48% (male)
Average age	42 years
Educational level	Primary school (52%) Secondary School (24%) Did not attend formal education (12%)
Main occupation	77% farmers/gardeners
Religion	99% Buddhism
Origin	100% Khmer origin
Marital status	88% married
Average household size	5 people

Most of the respondents owned at least one television, one bicycle, and multiple phones. One in three households had a set of DVD/VCD player, boat with engine, and boat without engine; whereas one in two households owned one motorcycle for transportation. Almost half of the households interviewed had electricity, whereas the other half used battery to light their homes. For cooking, the respondents used firewood from trimmed trees. Households also had access to numerous water sources for cooking and drinking such as canal or river, private tap, private well, rain water, and other available sources.

The household respondents generated income from numerous sources and had an average household income of about KHR 934,700 per month (around USD 230). About 37.55% of their total monthly income came from farming, followed by fishing at 20% (Figure 6). Other income sources were from salaries and wages, remittances, animal husbandry, and income from land lease or rental. On average, household spending was KHR 708,800 (USD 175), with almost 38% of the total household expenses accounting for food.

The respondents were also busy attending social functions, especially wedding parties, funerals, and religious ceremonies; and spent around 21% of their income for these activities (Figure 6). Likewise, they spent almost the same amount for education and health care. However, the average total expenses per month did not include the agricultural production costs; hence, there was not much for savings. High-income households who owned large farmlands and machine boats generated more income. Low-income households regularly avail of microfinancing to buy agricultural inputs. Some low-income households were landless, and their only source of income was from hired labor, which was uncertain and low paying.

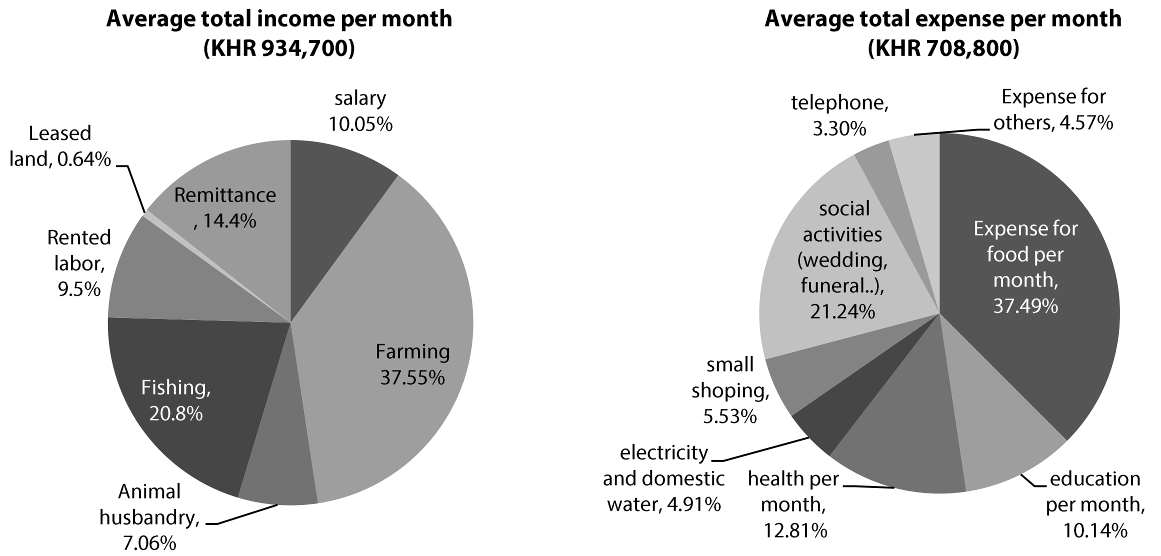

Figure 6. Average income and overall expense per month

5.2 Objective Probabilities of Flooding

The probabilities that flood would occur anytime cannot be predicted; there has been no scientific basis to prove how, when, and where the flood would occur. From 1980 to 2011, the peak water level happened with uncertainty. Although the water level at Chaktomuk station had reached only the warning level, it already caused flood disaster at Lvea Aem in 1984, 1991, 1994, 1996, 2000, 2001, 2002, and 2011. The farmers perceived the 2011 flood to be the worst. Based on an analytical scale of 0–10 (with 0 = very bad and 10 = very good), they rated the 2011 flood as 2.35.

Historically, if the peak water level reaches 9.84 m below the flood warning level, then flood can occur. When flood occurs in a given year, it may or may not hold true for the coming years. The farmers' belief in the dragon year, which is considered as the year of water, was also another factor that increases the farmers' belief that flood would occur for that given year. Twelve animals represent 12 years in Cambodian calendar. Within the 12-year period, the worst flood could happen once. As evidence of this belief, the worst flood event (also known as the century flooding disaster) occurred in the 12th year. The probability of flooding is high with the coming of the dragon year, which accordingly places the local community on high alert.

Table 3. Historical data of Chaktomuk gauge station

Year	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**
Peak Level	10.21	10.47	9.94	9.74	10.63	9.89	9.72	9.09
Year	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
Peak Level	8.32	8.82	9.82	10.56	9.01	8.95	10.53	10.14
Year	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Peak Level	10.94	10.05	7.92	9.88	11.20	10.75	10.90	9.43
Year	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Peak Level	9.97	9.95	9.90	9.64	9.32	9.93	8.49	10.86

Source: MRC (2011)
Note: Lowest Water level =7.92 m, highest water level =11.20 m, warning water level =10.70 m

5.3 Economic Consequences from Flooding/Droughts

Secondary data from NCDM of Cambodia showed that flood events affect social activities, agricultural production, and infrastructure (NCDM 2012a). The 2011 flood has been considered as the worst in recent decades that has adversely affected Cambodia's economic growth. Table 4 shows the economic consequences caused by the 2011 flood in Cambodia.

Table 4. Economic consequences from flooding in Cambodia (whole country data)

Impact Sectors	Negative Impact	Scope of Negative Impact
Social	Houses	Flooded 268,631 Destroyed 1,297
	Schools	1,360
	Public Health Center	115
	Pagoda (Buddhist temple)	491
Agricultural production	Rice production	Affected 43,1476 ha Destroyed 26,7184 ha
	Crops	Affected to 219,29 ha Destroyed 17,264 ha
	Livestock	Killed 1,675 (Cattle 121; pigs 1,554)
Infrastructure	National road, provincial road, and city road	Affected 925 km
	Track roads	Damaged 4,469 km
	Bridge	Sank 177 places
	Irrigation systems	Damaged 53.9 km
	Well	Damaged 77,544

Source: NCDM (2012)

The people living in the flood-prone areas have always been worried about the possibility that a flood disaster would occur because of the serious damages such event could bring. Different natural hazards can happen in the community at different impact levels. According to the respondents' perceptions of natural hazards, flood had the most serious impact on their livelihoods. Setting zero (0) as the no impact level and 10 as the worst negative impact level, normal flood got 8.15, early flood at 8.02, and 7.88 for protracted flood, which had negative effect on the socioeconomic stability of the local people.
Another natural hazard that the respondents were worried about was drought. The uncertainty of heavy rainfall had the least impact on farmers' views (Figure 7).

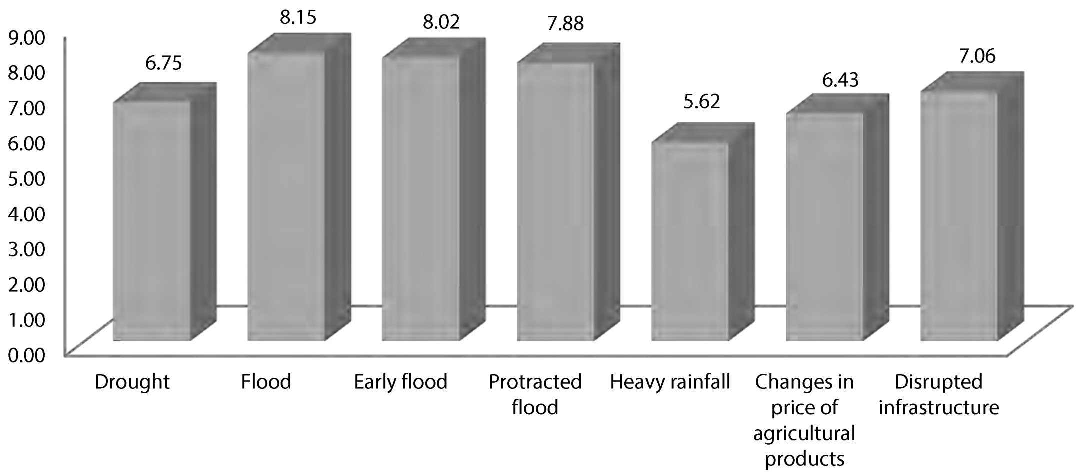

Figure 7. Impact level of flood

Note: 0 level is not affected at all; 10 level is severely affected

At the provincial level, Kandal province has a total of 11 districts, and all have been affected by the 2011 flood. NCDM reported that about 72,047 households had been affected by the flood; about 2,180 of these households had decided to evacuate to safer places. Unfortunately, four people died during the incident. Houses, which were the main property of families in Cambodia, were also damaged with a total of 66,740 houses damaged. A total of 207 schools and the 408,397-meter track road were also damaged during the incident (NCDM 2012b). Fortunately, some of the crops (i.e., rice crop) were not seriously damaged because the farmers had changed their farming pattern. However, the perennial crops (i.e., mango), livestock, and aquaculture were seriously damaged. Trading of agricultural commodities had also been affected by the flood event, which caused the farmers to lose income. Despite losing income due to the flood, farmers still spent much on food, medicine, fuel, gasoline, house maintenance, and animal evacuations. If they didn't have enough money to spend, they borrowed from private money lenders, microfinance, and relatives.

5.4 Flood Knowledge

The respondents had different ways to predict the probability of future floods. They predicted the flood based on their own experiences, beliefs, media information, and through gossip. Table 5 shows the probability assumption of the local farmers that flood would come in the succeeding year.

The household respondents believed that more than 50% of the flood would occur during the dragon year (year of water); when this calendar year comes, they said that the worst of the flood would come with it. This local belief seemed to be right based on the experiences of the elderly. Climate change, which farmers learned through mass media and development agencies, is another probable reason for the occurrence of the worst flood. The dam construction upstream, which the farmer had also heard from mass media and neighbors, was also considered as a factor that raises that possibility of a flood event.

Table 5. Subjective probabilities of flooding forecast for the next year

Description	N	Min	Max	Mean	SD
Probability of the flood come before harvest this year	190	0	100	54.44	35.813
Missing (No respond/No ideas)	10				
Total	200				

Note: SD = standard deviation

5.4.1 Flood determination (Case of the 2011 flood)

Flood impacts the local peoples' lives at different levels. Accordingly, disaster risk can be reduced if the community can learn about the flood characteristics. Figure 8 shows the flood knowledge of the local residents under study.

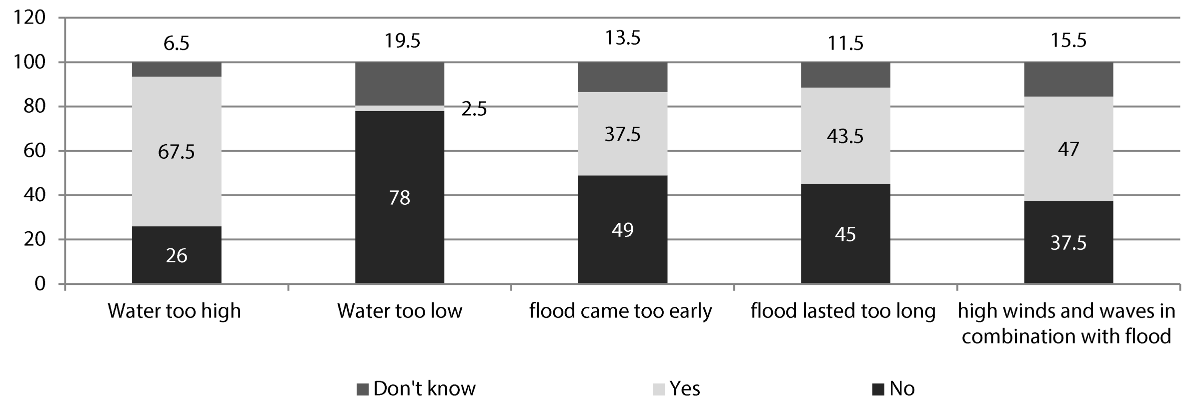

Figure 8. Flood knowledge of local people

The respondents understood very well the impacts of flood on their livelihoods. During the 2011 flood, people claimed that the water level had been too high, which had damaged track roads and mango trees. The flood was accompanied by strong wind and waves that adversely affected the fishermen. Some houses were also damaged by the waves and strong winds. In addition, the flood came too early and lasted for a long period. Some crops like vegetables, banana, papaya, and others were not harvested on time because the flood came earlier than expected. Many agricultural products were lost or of low quality. Because the flood didn't recede quickly, this hindered the farmers from working on their farms, making them unable to recover from their losses. The consequence trapped the farmers in poverty.

5.4.2 Access to information on water level measurements

Having access to information sources about the water level is a kind of early warning system (EWS) that enables people to be prepared for the flood. Accordingly, the local community can access information about the water level during the flood season from two main sources. The first source is the Chaktomuk gauging station, which has a formal public broadcasting station that reaches Lvea Aem district. All formal gauging stations generally broadcast information via television and radio. The local community can also access the information that the gauging station measures from local authorities and neighbors through mobile phone or face-to-face direct information. The second source of EWS is the local measurement being done by the community, in which the people use their own techniques to monitor the water level (Figure 9). Measurement pillars have been built near the river bank or rice field to measure the water level. Accordingly, the information is broadcasted through community posters along the roads or at the village chief's house. However, the local people are more familiar with the Chaktomuk gauging station than with their own local measurement (Table 6). Most of the local residents had mobile phones, radio, and TV, which were more convenient for them to get updated information on the current water level. Also, the Chaktomuk gauging station has been broadcasting information far longer than the local community has been measuring the water level, which was established only after the 2000 flood. Moreover, the local people still need to go to the designated areas to see the information posted by agencies. This was not convenient for them, although the local measurement gave more accurate information than the Chaktomuk station.

Figure 9. Local measurement pillar near river bank (left) and community information board about water level (right)

Table 6. Knowledge on information sources

Knowledge	Chaktomuk Gauging Station	Local Measurements
No	21.50%	66.50%
Yes	78.50%	33.50%
Total	100.00%	100.00%

The farmers could assess whether the flood would positively or negatively affect them based on their knowledge of the water level. Many of them preferred the safe water level; but if the water level is too high, then they could expect to suffer the consequences of a flooding. However, many of local people regularly access information from Chaktomuk gauging station to monitor the increase in the water level.

Table 7 below indicates how the local population assessed the impacts of flood based on the water level. According to the general preference of the local people, if the Chaktomuk gauging station reports a water level of 10 m, then the flood could be disastrous for them. However, at 7.6-meter water level, the farmers can still benefit from the flood because their farmland becomes more fertile after the water recedes. Hence, they can expect better yields from producing rice, reeds, mango, and other crops. Also at this water level, the aquaculture activities (caged along stream connected to Mekong River) are not affected, thus, fishermen can catch more fish.

Table 7. Impact of water levels from gauging station

Water Impact	Mean	SD
Start to have negative impact	10.3810 m	1.40700
Start to have positive impact	7.6032 m	1.94120
Most preferred in support of livelihood	7.7691 m	1.72774

5.4.3 Period of intense flooding

In Lvea Aem district, majority of the farmer respondents said that the flooding season starts in mid-June and lasts until December (Figure 10). However, the peak flooding season is from September to October. Farmers can grow rice only once a year because the floodwater in the floodplain remains for a long period of time. Generally, farmers start planting rice when the water level starts to recede in November or December, so they can harvest before the flood comes again. The farmers also grow vegetables and perennial crops, raise livestock, and catch fish as additional income-generating activities.

Furthermore, the farmers perceived that flood will always happen because they are living in the flood-prone area of the Mekong River. Thus, the farmers developed their own strategies for self-protection against flood. Nevertheless, they were still concerned about the destructive effect of floods due to their experience during the 2000 and 2011. The flood affected their capacity to invest to increase their crop production. Hence, the farmers preferred farm diversification to ensure their security.

Month	Jan	Feb	March	Aprl	May	June	July	Aug	Sept	Oct	Nov	Dec
Flooded												

Figure 10. Flood calendar

Note: Dark gray color shows intensity and peak season of water level

5.5 Risk Management

For generations, the local farmers have adopted traditional adaptation measures to reduce the negative impacts of the flood in their area. Houses have been built 6 m above the ground; higher income households build on concrete pillars, whereas the lower income households build on bamboo stilts.
Safe places to evacuate people and animals have been identified, and properties have been secured.
In addition, most of the households have at least one boat for traveling during the flooding period.
Boats have also been used for fishing not only during the flooding season. The culture of community action in times of flood disasters has also been ingrained at the study sites, such that neighbors, relatives, friends, authorities, monks, and external private donors are well-coordinated in their efforts to help those affected by the flood. Moreover, farmers have shifted to producing dry rice instead of rain-fed rice as the main rice production strategy, and this has served them well. Despite these traditional adaptation practices, however, some people still suffered from the disaster.

Although a number of new adaptation measures have been introduced to the communities at the study sites, the level of acceptance and implementation of the local people have been limited (Figure 11). Among the new strategies that have been introduced to farmers was the production of rice varieties that can be harvested within three months instead of five months. Around 33% of the total respondents implemented this strategy. However, other strategies like building irrigation canals and higher dikes didn't take off due to budgetary constraints. The farmers also opted to raise livestock instead of crops, did off-farm jobs, and leased their farms to others to generate income.

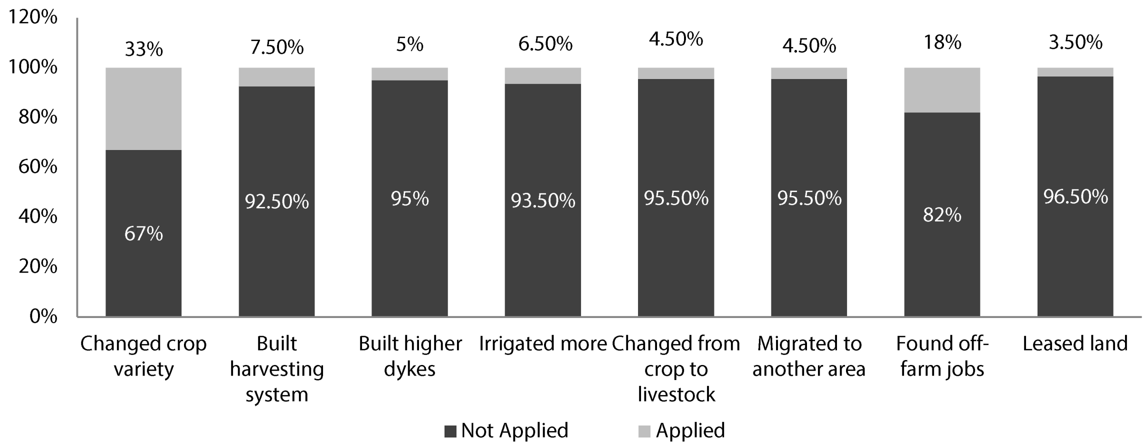

Figure 11. Adaptation practices at households' level to cope with flooding

5.5.1 Community-based structural and nonstructural mitigation of flood

Disaster mitigation refers to those initiatives that lessen or limit the adverse impacts of hazards and related disasters (UNISDR 2009). Disaster mitigation can be divided into two different components, namely, the structural and nonstructural mitigation.

Structural mitigations. According to UNISDR (2009), structural mitigation is the physical construction of structures to reduce the risks and impact of flood.

1. *House design adapted to flooding* (Figure 12). Most of the houses in Lvea Aem district are built on stilts at least 6 m high. Households with higher income build their houses on concrete pillars, whereas the households within the low-income bracket build their houses on bamboo stilts. These house designs have helped the local residents in protecting their properties, stored food, energy, and small animals (chicken or pig) from floods. All family members and their belongings (except cattle) always stay inside the house when the flood comes. Although this kind of houses is rarely affected by the water level, it could be affected by waves and strong wind. Hence, household heads always monitor and check whether their houses can withstand the winds and waves; and if any problem arises, their family members and belongings are sent by boat to Buddhist temples or other high-ground temporary shelters. Cattles are kept in other safe places or in Buddhist temples. The house design helped in mitigating the impacts of flood. Since it is not expensive to build such design, it could lessen the damages due to floods.

Figure 12. Houses built on high stilts (left) and jars on high stilts to keep clean water (right)

2. *Temporary shelter on higher grounds around the Buddhist temple* (Figure 13). Although these structures are small and serve as temporary shelters only, they can be used for several years. Small bridges have also been built for the cattles in the event of flood, and these structures can also be used as a walkway during the dry season. The grounds have also been raised to shelter cattle and other house properties. Such structures have always been built in front of the commune council house, Buddhist temples, or common places familiar to the villagers. The local people also contributed materials, money, and labor to build roads on higher ground in order to mitigate the water level. These roads were built for other purposes as well aside from flood mitigation. The local people also contributed for the maintenance of Buddhist temples (Pagoda) because these temples are important to the community for their religious beliefs and also serve as safe haven. However, these kind of structures are of poor quality and have high maintenance cost. Since the local people, community, or monks had limited funds to build high-quality structures, they made do of what they could afford to reduce the flood damages rather than do nothing.

Figure 13. Preak Kmeng temple (left) in Preak Kmeng commune, and Peam Ta Erk temple (right) in Preak Oknha Ong commune,

Note: Buddhist temples serve as temporary shelter for people during flood

Nonstructural mitigations. Nonstructural mitigation is the use of knowledge, practice, policies/laws, public awareness, and training to mitigate the potential impacts of a particular phenomenon (UNSDR 2009). Some strategies were mentioned by the farmers to mitigate flood risk.

1. *Early warning information management*. Early warning is a timely and effective information dissemination method. It allows individuals exposed to hazards to take preemptive action to reduce their risk exposure and accordingly respond effectively (UNISDR 2003). EWS, on the other hand, generates and disseminates timely and meaningful warning information to enable individuals, communities, and organizations to reduce the possibilities of harm or loss.

   Farmers in Lvea Aem accessed information about flood risks and hazards from multiple sources (Figure 14). About 91% of the respondents accessed information through television and radio, 40% also got warning information from their neighbors/relatives, and around 30% got their information from government sources.

   The farmers considered EWS as a good information source; however, they indicated that such system was not enough. Although the information generated from Chaktomuk gauging station can be accessed through mass media, the farmers still could not determine the impact of water level/flood on their farms and livelihood. Although the Provincial Committee on Disaster Management (PCDM) has worked intensively on EWS through posters and teachings, not all farmers were able to access the information. Instead, information was shared among neighbors.

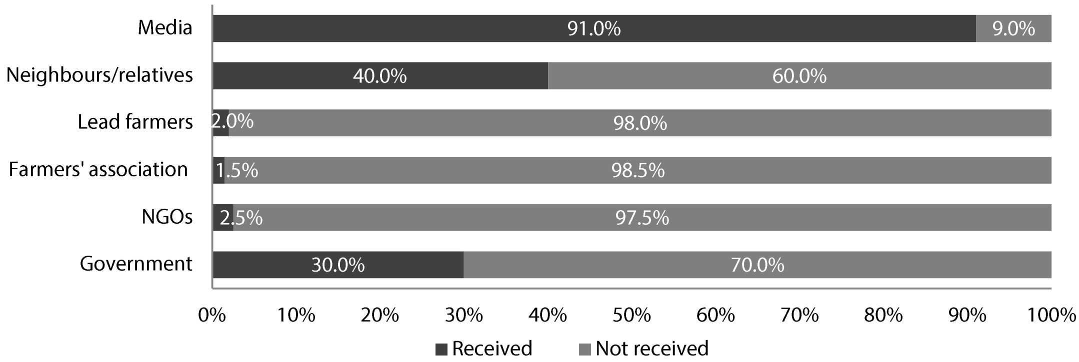

Figure 14. Sources of flood forecast in 2011

2. *Farming adaptive capacity.* Farming adaptive capacity is a knowledge-based nonstructural strategy that reduces the damages due to hazards. Based on the results of the survey, each household had at least two main agricultural activities, namely, dry rice crop farming and fishing. Figure 15 shows the kind of main crops planted and its seasonal growing.

   Farmers have shifted to planting rice varieties that can be harvested within a shorter period of time. Also, farmers grew lotus flower, sesame, and vegetables after growing rice because these crops can be harvested within a short period. Moreover, crop diversification became the new innovative farm strategy to reduce their risk exposure from floods in case one crop gets damaged. For instance, rice was grown together with reeds. In addition, other perennial crops were also planted and harvested before severe flooding.

Farm Activities	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Flood Period												
Rice Crop (dry rice)												
Mango (fruits collecting)												
Papaya (fruits collecting)												
Sesame												
Lotus												
Reed												
Vegetables												
Banana (fruits collection)												
Fishing												
Aquaculture												
Livestock												

Figure 15. Seasonal farming period within the year

Note: Blank column for no activity; dark color (grey and red) for strong and full activities

Figure 16. Rice field diversification with corn and reed (left)
and aquaculture cultivation along stream (right)

3. *Sources of financial relief.* Another nonstructural strategy was availing micro-credit or insurance. However, micro-credit was more popular than insurance among the farmer respondents. Around 60% of the respondents borrowed money either from banks, private money lender or neighbors, friends, and relatives. Although around 23% of the respondents have heard about insurance, they hesitated to acquire because they had not been aware of the procedures involved. Also, they could not afford to pay regularly because most of the farmers belong to poor families. However, access to micro-credit should be done with caution because of the risk involved.

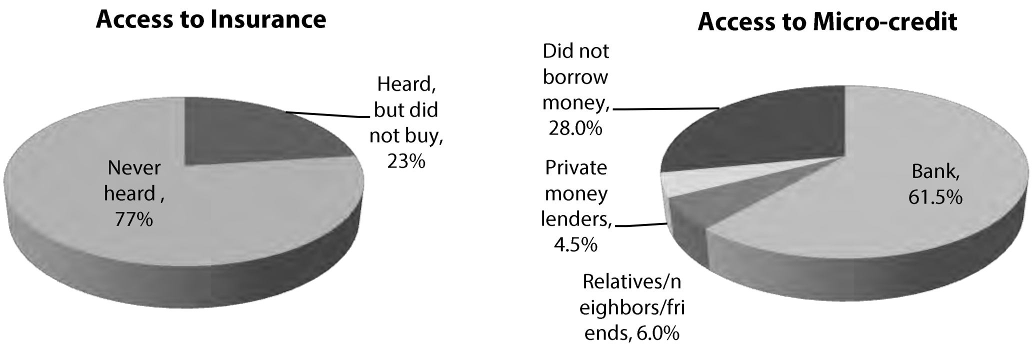

Figure 17. Households' expectation of relief assistance from relevant agencies

5.5.2 Local initiatives

Institution involved. The damages caused by the 2000 flood event prompted numerous government institutions at all levels, NGOs, and the community to act. For one, both NCDM and PCDM were established after the 2000 flood. Accordingly, these two committees aimed to provide and make all the relevant information on hazards accessible to vulnerable communities to help them to protect themselves against flood and drought.

PCDM is a committee composed of authorities from the provincial government; district level; commune level; related ministry departments (i.e., MWRM, Ministry of Agriculture, Ministry of Health, etc.); provincial police; and the army. The committee monitors all water levels, provides the alarm information, evacuates people and animals, and delivers extension services on how to protect the community before the flood, how to respond during floods, and how to recover after the flood. In addition, the Cambodian Red Cross and NGOs (i.e., World Vision, Caritas, AOC, etc.) also play very important roles in helping farmers during the flooding period by providing food and by evacuating people to safe places.

Since many authorities and institutions have initiated a campaign to help farmers protect themselves from the flood, farmers have started to pay more attention to flood information and methodologies. The stakeholders' interventions plus their own experiences have made the farmers better adopters of strategies against flood.

Social capitals/Community initiative. Social or community initiative is a powerful strategy to empower the local community to solve their problems together. Although every household needs to have their own individual adaptation strategies, community resilience through the community's collective effort in developing disaster risk reduction strategies is also important for efficient mitigation, preparedness, and prevention, response, and recovery actions. For instance, building dams/drainages or safe shelters on higher grounds are better risk mitigation strategies for the whole community compared to piling up sand bags around individual houses. However, all stakeholders, especially the vulnerable ones, need to participate in building community resilience to reduce risk exposure.

Before establishing a community for disaster risk reduction, it is important to understand the existing social capitals and the key players in the community. At the study sites, the agencies that provided relief to those in need were composed of the people themselves who lived around or near the community.

Figure 18 indicates the level of engagement that the respondents could expect from different agencies/institutions in relief operations and risk reduction initiatives due to flood. The measurement level is between 0 (low engagement) to 5 (high engagement). Neighbors or the local community reached the highest level (4.47) as shown in Figure 18. Based on the interviews, the local communities worked closely together to reduce the community's risk exposure to floods. They helped each other in building safer temporary shelters or village roads on higher grounds and in constructing houses designed for floods. Moreover, the farmers worked together in evacuating those people at risk and in providing food during flood disasters.

The respondents expected the same level of relief provision from government agencies. The level of engagement from government agencies that the respondents expected to get was 4.68. It indicates that government agencies play an important role in supporting the local people in protecting themselves from floods. Accordingly, NCDM, PCDM, local authorities, Red Cross, and high-ranking government officers have been well-coordinated in terms of flood disaster prevention, preparedness, response, recovery, and adaptive capacity building. The government is usually responsible for building infrastructures such as road and bridges. However, those infrastructures cannot cover the whole area due to limited funds. Road conditions were bad, especially during rainy season. More so that the local people themselves also contributed their own money, labor, and materials to build the needed structures. High-income households contributed more money, whereas those in the low-income bracket contributed less but spent more of their time and labor during the construction phase. The amount of contribution was managed by the commune councils' officers.

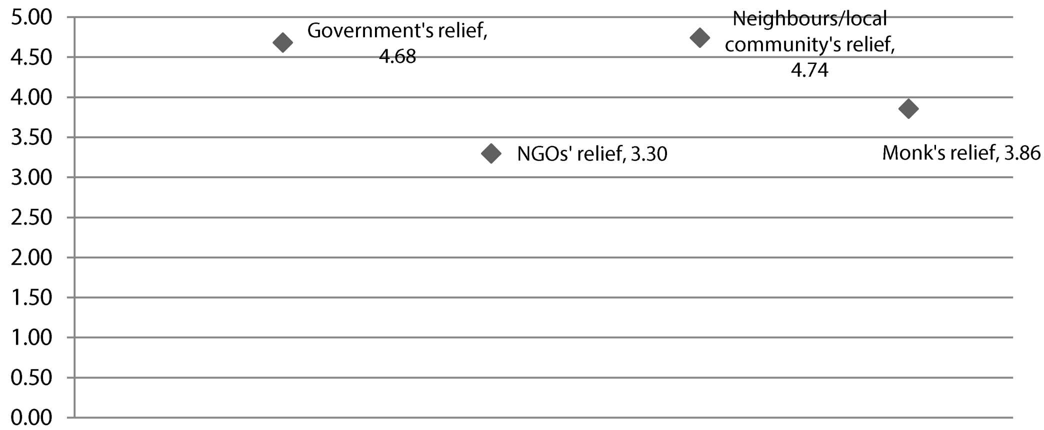

Figure 18. Level of engagement of different institutions in relief operations and disaster risk reduction initiatives

Noted: 0 = low engagement; 10 = high engagement

The monks also worked closely with the community at the moderate level. The Budhist monks were well-known among the local communities. They were always at the forefront of charitable activities, especially during relief operations when people suffered from the flood. However, the size of the Buddhist temple (which served as the venue for relief operations) was small, which also limited the scale of relief operations that they could provide. Specifically, the monks used the Buddhist temples (Pagoda) as temporary shelters to those affected by the floods and as a venue for food distribution and other disaster relief operations. In essence, the temples served not only as a place where the community can worship, but it also served as venue for helping the poor. Likewise, the local people and authorities and the rich people from nearby towns send their donations to the the monks at those temples. However, donations were limited and were not a stable source of fund. The elderly regularly go to the temple every two weeks to assist in the food distribution and to bring food. The huge support, such as provision of food, beverages, and money, comes only during the two biggest festivals in Cambodia. One of the biggest festivals, Khmer New Year, is a three-day celebration, and most of the households go to the temple to offer food and money to the monks so that their wishes can be fulfilled. Another biggest religion festival is the Phchum Ben, which is a 15-day celebration. A lot of the remaining food and money are given to the monks during this festival. From this charitable spirit, the people, especially the poor, are assured of food and shelter during flood events.

Surprisingly, the respondents indicated that NGOs had the least level of engagement in the provision of relief assistance at the study site, as shows in Figure 18. This was surprising because NGOs work hard on disaster risk reduction. This prevailing perception among the respondents was because NGOs could only cover selected population/community, which the local people could not understand. NGOs conduct relief operations directly to the most vulnerable people and those with low adaptive capacity in terms of knowledge and resources against natural disasters. Likewise, NGOs work toward this end indirectly through capacitating the community representatives and local government in the development of risk assessments and risk reduction plans, implementing disaster risk reduction programs, monitoring the processess involved, and evaluating natural disasters. They also provided capacity-building activities to lead farmers in reducing their exposure to the risks of natural hazards, who in turn, can teach other people. They also take crucial actions during flood events by providing food, clean water, medicine, and other utilities.

All agencies were regarded with equal importance by the local people. Hence, all stakeholders must work together to mitigate the risk of natural disasters. The responsibility of each stakeholder must be strengthened to build the communities' resilience and capability.

6.0 CONCLUSION

Flood is a natural hazard that affects people's lives. Communities that live in flood-prone areas are regarded as the vulnerable group facing the highest risk exposure. In Cambodia, flood occurs every year at different intensities. The 2000 and 2011 flood events were considered as the worst floods that hit Cambodia because of the extent of the damage it brought to communities; it took years before the people recovered from the devastation.

Accordingly, Cambodians have learned to protect themselves and their communities from the devastation that floods can bring. Farmers have become more knowledgeable about flood characteristics based on their experiences and on other stakeholders' initiatives. They have tried to mitigate the damages that floods can cause through structural and nonstructural interventions. Both structural and nonstructural interventions have been beneficial to the farmers and their community. The information about water level from the Chaktomuk gauging station has helped the local people to be prepared in cases of floods. Likewise, the local people have become good adopters of new adaptation measures such as diversified farming, planting new rice varieties, and having at least two main farming activities.

Indeed, the collective actions of all stakeholders is essential to increase the community's adaptive capacity and to mitigate flood risk exposure. Natural hazards cannot be prevented, but their impacts on people's lives can be reduced through the cooperation and implementation of sustainable strategies of all stakeholders.

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