AGRICULTURAL LIVELIHOODS AND COPING STRATEGIES TO FLOOD IN FARM HOUSEHOLDS IN KAMBALU TOWNSHIP

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AGRICULTURAL LIVELIHOODS AND COPING STRATEGIES TO FLOOD IN FARM HOUSEHOLDS IN KAMBALU TOWNSHIP

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The thesis attached here to, entitled **"Agricultural Livelihoods and Coping Strategies to Flood in Farm Households in Kambalu Township"** was prepared under the direction of the chairperson of the candidate supervisory committee and has been approved by all members of that committee and board of examiners as a partial fulfillment of requirements for the degree of **Master of Agricultural Science (Agricultural Economics).**

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DECLARATION OF ORIGINALITY

This thesis represents the original work of the author, except where otherwise stated. It has not been submitted previously for a degree at any other University.

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DEDICATED TO MY BELOVED PARENTS,

U BO CHECK AND DAW SEIN SHWE MYINT

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ABSTRACT

This study was carried out to understand a short term impact of flood on agricultural livelihoods conditions, coping strategies adopted by affected farm households and to determine the factors affecting on the revenue of monsoon paddy before and after flood during 2015 which is the devasting flood in Kambalu Township, Sagaing Region. Data were obtained from 135 flood affected farm households selected from six villages by purposive random sampling in the study area which was severely affected area of flood in 2015. The sample farm households were categorized into three groups: seriously affected, moderately affected and less affected farmers according to their damaged crop areas due to flood.

Based on the findings, the average age of household's head was around 50 years with average 6 schooling years among the three groups. There were significantly different in the household and farm assets of mobile phone, cattle, chicken, harrow, plough and boat for all groups before and after flood. The flood extremely reduced yield of monsoon paddy, sugarcane and maize up to 52%, 71% and 64% respectively among three groups. The lower yield of crop production resulted lower farm income in all groups. Each 55% of the sample farm households in seriously and moderately affected groups obtained the aids from government and non-government organizations while almost all of the sample farm households in less affected group received it because their location and transportation access were easier than others. Reducing household expenditure, borrowing money, selling household assets and livestock were found commonly used coping strategies in the study area. Among these coping strategies, engaging in borrowing money with various interest rates will lead to higher debt in farm household groups in the long term.

The regression analysis showed that, flooding in the study area had negative affect on the revenue of monsoon paddy per hectare because of high yield reduction due to flood. However, family labor and non-farm income were significantly influencing factors to get high revenue for monsoon paddy production by engaging and investing more on it before and after flood. Regarding on the findings, the study area which is frequently flood affected region needed the introducing the sustainable farming system through climate resilient varieties and improved agricultural technology, disaster awareness information and improved transportation infrastructure and non-farm income activities should be provided and created as the development program for the rural areas to overcome negative impact of disaster.

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LIST OF ABBREVIATIONS

ADPC	Asian Disaster Preparendness Center
CRED	Center for the Research on the Epidemiology of Disaster
DoA	Department of Agriculture
DMH	Department of Meteorology and Hydrology
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GFDRR	The Global Facility for Disaster Reduction and Recovery
ha	Hectare
HH	Household
IASC	Inter Agency Standing Committee
IFRC	International Federation of Red Cross
IUCN	International Union for Conservation of Nature
KI	Key Informant
MCCA	Myanmar Climate Change Alliance
mm	Millimeter
MMK	Myanmar Kyat
MOALI	Ministry of Agriculture, Livestock and Irrigation
ºC	Degree Celsius
OCHA	Office for the Coordination of Humanitarian Affairs
sq km	Square kilometer
SPSS	Statistical Packages for Social Science
UNDP	United Nations Development Programme
UNEP	United Nations Enviroment Programme
UNICEF	The United Nations Children's Fund
UNISDR	United Nations International Strategy for Disaster Reduction
Yr	Year

LIST OF CONVERSION FACTORS

1 basket of paddy	= 20.9 kilogram
1 basket of maize (seed)	= 24.9 kilogram
1 basket of sesame	= 24.5 kilogram
1 basket of groundnut (pod)	= 11.4 kilogram
1 basket of pigeon pea	= 32.7 kilogram
1 basket of black gram	= 32.7 kilogram
1 basket of niger	= 24.5 kilogram
1 viss	= 1.64 kilogram
1 hectare	= 2.47 acre

CHAPTER I
INTRODUCTION

1.1 Background of the Study

The natural and man-made disasters have adversely affected the world for a long period and it continues to increase. The growth of human societies and their escalating complexity with the changing climate will further increase the risks of natural disasters by losing the life and property and the destruction of the environment. The number of people at risk has been growing each year and the majorities are in developing countries with high poverty levels to be more vulnerable disasters. According to the German Watch Global Climate Risk Index, extreme weather events are mostly faced by Honduras, Myanmar and Haiti between 1996 and 2015 as described in Table 1.1. These rankings were attributed to the aftermath of exceptionally devastating events such as Hurricane Sandy in Haiti and Hurricane Mitch in Honduras. Likewise, Myanmar had also been struck hard, most notably by Cyclone Nargis in 2008 (Kreft et. al., 2016).

As the people and societies are becoming more vulnerable, losses increase more and more from disasters. Impact depends on development practices, environmental protection, human activity, regulated growth of cities, distribution of people and wealth and government structures. In theory, natural hazards such as earthquakes, floods, drought, storms, tropical cyclones and hurricanes, wildfire, tsunami, volcanic eruptions and landslides can threaten everyone. In practice, proportionally, they tend to hurt the poor most of all (ISDR, 2004).

At the local level, disasters could seriously impact household livelihood activities and push already vulnerable groups into poverty. Local and household economies are affected by Cyclones limiting production or market access and the destruction of them. In addition to, various numbers of disasters that have destroyed in many sectors of health and sanitation access, houses and education resulting in underpinning social development have been seen. During the year from 1995 to 2015 in the world, floods have accounted for 42% of all weather related disasters followed by 28% of storm, 8% of earthquake, 6% of extreme temperature, each 5% of landslide and drought, 4% of wildfire and 2% of volcanic occurred in the world as shown in Figure 1.1. According to this figure, flood in the most common disaster events faced around the world. The impact of disasters was different based on the various types

(CRED, 2015). Similarity, livelihoods of the affected people are lost and they have to search alternative ways of livelihoods to adapt and cope with the adverse impact of extreme weather events. One of the coping mechanisms that have long been recognized is the sustainability of diversification in rural livelihood.

Agriculture is most sensitive to disasters as the nature of crop production is heavily dependent on weather conditions in Myanmar. Rural households get livelihoods especially through agriculture; others through off-farm and non-farm labors and self-employment in rural non-farm economy; and others through migrating to towns, cities and other countries. In Myanmar, farmers who practice rain-fed agriculture faced with significant yield reduction and other losses because of irregular rainfall pattern, drought and shifts of the rainy season. Therefore agricultural livelihood in rural households plays a vital role to be altering different activities and their coping strategies to reduce disaster risk at the local level. Coping strategies are for the short-term solutions for unexpected events whereas adaption strategies can provide the long-term solutions.

1.2 Myanmar and Natural Disasters

1.2.1 Overview of Myanmar

Myanmar is located in South East Asia between latitudes 09º 32′ North and 28º 31′ North and longitudes 92º 10′ East and 101º 11′ East. The total area of Myanmar is 676,577 sq km and it is bordered on the north and north-east by China, on the east and south-east by Laos and Thailand, on the south by the Andaman Sea and the Bay of Bengal and on the west by Bangladesh and India. It is an immense and diverse region comprising areas with very different sets of environmental, geographic, economic and social characteristics. The population was about 52.48 million with 78 per square kilometers of population density in 2016. An average of 70% of the population is supported by agriculture that generating 20.1% of GDP, 25.5% of total export earnings and 61.2% of the labor force in Myanmar (MOALI, 2016). Agriculture has remained a prime source of livelihoods in Myanmar. In addition to, it is also still vulnerable to disasters by declining agricultural production.

The country's topography varies from hilly and mountainous regions in the west, north and east, a semi-arid dry zone in the central region, coastal areas in the west and alluvial plains in the southern delta. The major rivers follow the lie of the mountain ranges from the north of the country to the south. There are four main rivers

crossing Myanmar: Ayeyawady, Thanlwin, Chindwin and Sittaung. Besides the main rivers, Myanmar has many small and medium rivers, streams and creeks flowing through every region of the country. Therefore, the topography of Myanmar comprises mountains, highlands, an intricate river system, vast river basins and the delta region. The location and topography of the country generate a diversity of climatic conditions. Seasonal changes in the monsoon wind directions create summer, rainy and winter seasons (Habitat, 2009).

The average annual rainfall in the coastal regions of Rakhine and Tanintharyi ranges from 4,000 to 5,600 mm, while in the Ayeyawady Delta it is approximately 3,300 mm. The extreme north receives between 1,800 mm and 2,400 mm of rain while the hills of the east receive between 1,200 mm and 1,400 mm. The central dry zone has between 600 mm and 1,400 mm of rain. The average temperature in the delta ranges from 22°C to 32°C, while in the central region it is between 20°C and 34°C. The temperature in the hilly regions is between 16°C and 29°C. Therefore, April, May and October are considered to be cyclone months based on the last 100-year record. The direction of winds and depression bring rain and although it is always heavy in the coastal areas during monsoon season. The rivers fill to their capacity, often exceeding maximum levels; this sometimes causes flood disasters in the towns and villages alongside of the rivers (ADPC, 2009).

1.2.2 Natural disasters in Myanmar

Myanmar has encountered a lot of natural disasters such as floods, cyclones earthquakes and landslides have caused severe damage in the recent past. According to the Climate Risk Index for 2015, Myanmar ranks as the 6th most at risk country in the world for natural disasters (Kreft et. al., 2016). The increased frequency of natural disasters and extreme weather events such as erratic rainfall, flooding, drought and landslides seriously threat to livelihood security and aggravates risks and vulnerabilities in the agriculture sector, especially in the regions of Ayeyawady Delta, costal and Central Dry Zone of Myanmar.

In Myanmar, the high incidences of fire cases are concentrated mainly in Yangon, Mandalay, Ayeyawady, Sagaing and Bago. These Regions account for 63 percent of the total fire cases of the country. Forest fire are more common in upland regions, namely, Bago, Chin, Kayah, Kachin, Mandalay, Rakhine and Shan. They cause haze problems and have negative impact on the community. The

landslides of various scales occur in mountainous regions especially in the Western Ranges and some localities in the Eastern Highland of Myanmar. Due to the sparsity of population, landslides in these regions damaged infrastructure rather than human settlements. Additionally, flooding has always been one of the major hazards in Myanmar. It leads to loss of lives and property, damage to critical infrastructure, economic loss and health-related problems such as outbreak of water-borne diseases when the lakes, ponds and reservoirs become contaminated. In Myanmar, the threat of flooding usually occurs in three waves each year: June, August and late September to October with biggest danger arriving in August as peak monsoon rains occur around that time. In cities and towns, localized floods occur from time to time due to a combination of cloudburst, saturated soil, poor infiltration rates and inadequate or poorly built infrastructure (such as blocked drains). In the rural areas, breakage of water resistant structures as dams, dykes and levees destroy valuable farmlands. Flash floods are frequent in the large and medium rivers, caused by the heavy rainfall striking at head water regions for a considerable period of 1-3 days (ADPC, 2009).

The risk of natural hazard is mostly characterized by small- scale and medium-scale but frequent events in Myanmar. During the years from 1990 to 2014, flood represented about 55% of major hazards followed by each 16% of earthquakes and storms and 13% of landslides in Figure 1.2. In recent years, strong cyclones that declared as Cyclone Mala (2006), Nargis (2008) and Giri (2010) and Cyclone Komen (2015) had been occurred in the country (UNICEF, 2015).

Among the various disasters, Nargis was not only the serious natural disaster in the history of Myanmar but also the worst cyclone in striking Asia since 1991. It also had the destruction of the environment of Ayeyawady and Yangon Regions where majority of the population mainly dependent on natural resources for their livelihoods. Cyclone Nargis caused extensive damage and loss of livelihoods, employment and income of the people living in the affected areas of the coastal zone, the agricultural productive zone, and the urban and peri-urban area (Baker et. al., 2008).

In 2015, the floods occured in 12 of Myanmar's 14 states and regions and it had a serious impact on agricultural livelihoods according to a joint Government-United Nations report (UNICEF, 2015). This flood mainly affected on the rural areas of Myanmar where agriculture is the largest business to support the farmers' livelihoods. A flood after, the six most-affected regions/states were Ayeyawady,

Bago, Chin, Magway, Rakhine and Sagaing. Among them, Ayeyawady is the most affected region in terms of damaged crops with more than 100,000 ha due to floods. Sagaing is the second most affected state with over damaged crops 30,000 ha, followed by Bago and Magway shown in Table1.2 (FAO & WFP, 2015). Farmers among rural households are the most vulnerable groups to disasters because they have least access to prevention, preparedness and early warning. In addition their recovery rate from disasters is slow because of lack of support networks, insurance and other ways of livelihood. They also face with difficulties in farming due to disasters. Therefore, it is needed to employ coping mechanisms to reduce various risks in the aftermath of the flood.

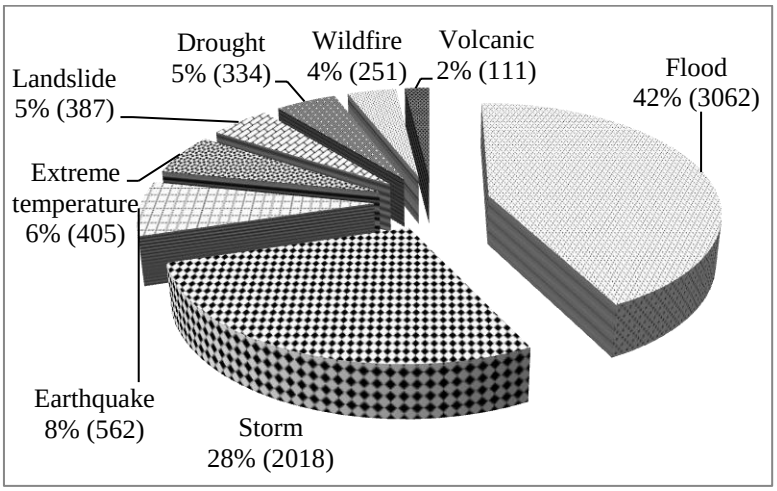


Figure 1.1 Difference types of natural disasters in the world (1995-2015)

Source: Center for the Research on the Epidemiology of Disaster, 2015

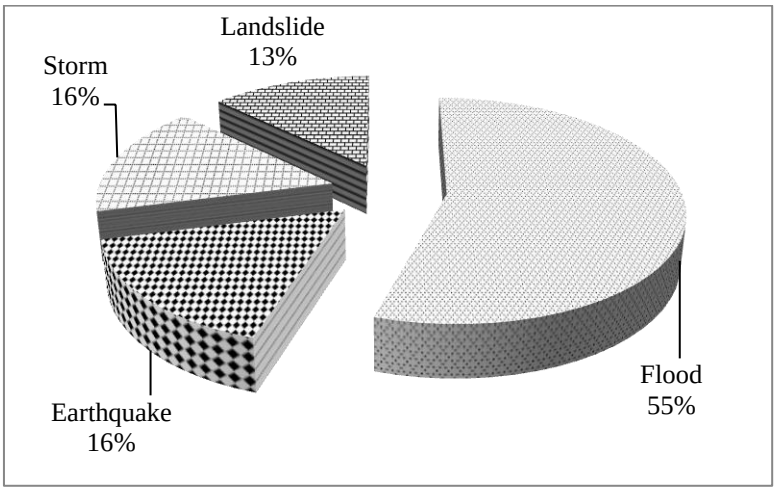


Figure 1.2 Natural disasters in Myanamr (1990-2014)

Source:http://www.preventionweb.net

Table 1.1 The Long-Term Climate Risk Index (CRI): the 10 most affected countries (1996-2015)

CRI 1996–2015 (1995–2014)	Country	CRI score	Death toll	Deaths per 100 000 inhabitants	Total losses in million US$ PPP	Losses per unit GDP %	Number of events (1996-2015)
1 (1)	Honduras	11.33	301.90	4.36	568.04	2.10	61
2 (2)	Myanmar	14.17	7145.85	14.71	1300.74	0.74	41
3 (3)	Haiti	18.17	253.25	2.71	221.92	1.49	63
4 (4)	Nicaraua	19.17	162.90	2.94	234.79	1.20	44
5 (4)	Philippines	21.33	861.55	1.00	2761.53	0.63	283
6 (6)	Bangladesh	25.00	679.05	0.48	2283.38	0.73	185
7 (8)	Pakistan	30.50	504.75	0.32	3823.17	0.65	133
8 (7)	Vietnam	31.33	339.75	0.41	2119.37	0.62	206
9 (10)	Guatemala	33.83	97.25	0.75	401.54	0.47	75
10 (9)	Thailand	34.83	140.00	0.22	7574.62	1.00	136

Source: Kreft et. al., 2016

Table 1.2 Affected area of flood in 2015 in six most affected regions/states in Myanmar, 2015

(Hectare)

States/Regions	Cultivated area	Flooded area	Replanted area	Damaged area	Destroyed area
Ayeyawady	834,409	128,053	12,506	101,814	13,732
Bago	1,811,743	151,331	42,282	21,278	87,771
Chin	118,968	2,332	150	1,158	1,024
Magway	1,026,412	38,932	6,166	20,309	12,457
Rakhine	605,301	117,070	86,748	585	29,737
Sagaing	1,679,423	89,880	25,035	30,219	34,627
total	**6,076,256**	**527,598**	**172,887**	**175,362**	**179,349**

Source: Food and Agriculture Organizaiton and World Food Programme, 2015

1.3 Rationale of the Study

In Myanmar, floods are most common during the mid-monsoon period (June to August) in areas traversed by rivers or large streams by devasting impact on agricultural livelihoods of rural people (Mohamed, 2009). As a country prone to heavy rainfall, the most affected regions and states of Rakhine, Chin, Magway and Sagaing were experienced with the flood in 2015 due to the effect of Cyclone Komen which brought strong winds, heavy rains to Myanmar (IASC, 2015). In all affected areas, this flood had a severe impact on the livelihoods of rural households that rely on agriculture. While the actual impact would vary in intensity according to the geographical location and on the nature of the affected population's main income source, the overall impact of the floods is visible in terms of a significant decrease in income from the partial/total loss of the wet season rice harvest; loss of seeds, lack of agricultural inputs for re-planting; lack of staple rice to eat until the next harvest; loss of small livestock; and damage to some small livelihood-related community infrastructure. Therefore, coping strategies are very important for affected households to maintain their livelihoods with the adverse impact of flood. For these reasons, this study was conducted to understand a short term impact of flood on socioeconomic conditions, crop losses and difficulties in agricultural production facing by affected farm households, aids received and coping strategies etc. before and after flood. In Myanmar, there is limited studies of the impact of climate change and disaster affects on the farm households.

In lower Sagaing region regarded as Central Dry Zone of Myanmar, Kambalu Township was the worst affected Township in terms of destroyed crop's areas on cultivated land. Flood affected on 5,892 hectares would have severe impact on agricultural livelihoods in Kambalu Township (DoA, 2016). Moreover, major economic activities of rural households in Kambalu Township also depend on agricultural production. For these reasons, Kambalu Township was selected as the study area to explore agricultural livelihoods and coping strategies adopted by affected farm households.

1.4 Objectives of the Study

The primary objective of this study is to explore the understanding of agricultural livelihoods and coping strategies to flood in study area. For this purpose, this study was carried out with the following objectives:

1. To compare socioeconomic conditions and agricultural production of flood affected farm households before and after flood in Kambalu Township
2. To estimate crop losses and difficulties in farming faced by flood affected farm households in the study area
3. To identify aids received and coping strategies adopted by flood affected farm households in the study area
4. To determine the factors affecting on the revenue of monsoon paddy before and after flood in the study area

CHAPTER II
LITERATURE REVIEW

2.1 Theoretical and Empirical Review of Disasters

2.1.1 Theoretical background of disasters

Disaster has the same expression with calamity and catastrophe. Disaster is a disastrous event that seriously affects the functions of a community or a society resulting in a large amount of human, economic or environmental losses (UNISDR, 2009). This sudden event brings losses and destruction to life and property. The destruction caused by disasters is difficult to measure based on the geographical location, the earth surface type, degree of vulnerability and climate. In simple term, disaster can be defined as a hazard that makes heavy loss to life, property and livelihood. According to the Center for Research on the Epidemiology of Disasters (2015), the term hazard refers to a severe or extreme event such as a flood, storm, cold spell or heatwave etc. which occurs naturally anywhere in the world. Hazards only become disasters when human lives are lost and livelihoods damaged or destroyed. Rises in the global population increase the risk of disasters because more people live in harm's way. Disasters are unexpected shocks to the socioeconomic and environmental system, involving loss of life and property.

Generally, disasters are distinguished into two types. These are natural and manmade disasters. Natural disasters include flood, cyclone, drought, earthquake, thunderstorms and cold wave. In order to be recorded as a natural disaster in Emergency Events Database, an event must meet at least one of the following criteria:

- Ten or more people reported killed
- 100 or more people reported affected
- Declaration of a state of emergency
- Call for international assistance (CRED, 2015).

2.1.2 Natural disaster and extreme weather

Any disastrous event caused by the natural processes of the earth and the nature is called the natural disaster. It can occur suddenly due to environmental factors that can injure people and damage property. The severity of a disaster is measured based on the facts that how many lives lost and how much economic situation destroyed. Events that happen in unpopulated areas such as an uninhabited island are not considered as disasters. However a flood in a populated area is a kind of

natural disasters. Depending on the severity, all natural disasters cause some losses to a certain extent (www.basicplanet.com/natural-disasters).

In all disasters, flood occurs at irregular intervals; vary in size, duration and the affected area (www.disastermgmt.org/type/flood.html). Floods are caused by both weather and human related factors. Heavy or prolonged rainfall, snowmelt, thunderstorms, storm surge or debris jams were major weather factors to cause flood. On the other hand, structural failures of dams and levees, altered drainage, and land-cover alterations were human factors.

Briones (2014) analyzed that there is an interaction between household poverty and natural disasters and he also discussed the remedial measures used by households to respond to natural disasters in the Philippines. In Philippines, the damages are always very high as compared to any other country facing the same disaster with the same magnitude due to its weak infrastructure and extreme lack of awareness to manage a disaster situation. In Pasay City, Metro Manila, typhoons and/or floods gave significant negative effects on capita income. From this example, it could be concluded that natural disasters affected dramatically the household income resulting in household poverty.

Harvey & Raktobe (2014) stated that some extreme weather and climate events have increased in recent decades, and it was evident that some of these increases are related to human activities. As the effects of climate change, people have to experience the extreme weather and climate events, for example, heat waves, droughts and floods. The increasing frequency of the events of extreme weather makes to improve the capacity of communities, institutions and households to adapt to such events and increase their resilience to the risk of damage. Farmers also have to frequently face with the extreme weather causing remarkable crop and income losses and hit on food insecurity.

2.1.3 Impact and incidence of disaster

The world has faced a large number of natural and man-made disasters with social and economic impacts to households, communities and institutions, especially for low income countries. Disaster impacts have generally classified into direct and indirect impacts. National Research Council (1999) stated that direct impacts was measured as the physical destruction from a disaster, and indirect impacts are considered the consequences of that destruction. Direct impacts refer to the

destruction of structures, contents, and infrastructure and the direct impacts such as mortality and injury are also involved. Indirect damages include decline in economic activity, for example, decreasing potential production, increased costs of production, loss in expected income, and other welfare losses occur as a result of the initial damage. In theory, the total economic costs of a disaster include all direct and indirect losses (Kousky, 2012). Therefore, natural disasters vary in impact depending on their type as well as with the population and economic characteristics of the affected country. Moreover, the worst disasters can have permanent economic consequences such as decrease in GDP and damage to the public infrastructure, road and bridge. In developed countries with better institution and education, those economic impacts are less severe. But negative impacts are more severe for developing countries and smaller geographic areas. Damages also increase with the severity of the event (Datar & Liu, 2011).

Leoni (2010) mentioned that damage in the past two decades was significantly greater than in earlier decades. This could reflect greater exposure, or better reporting, or both. Rich countries' damage due to a disaster was greater because of their high-value infrastructure that can generate millions of jobs and provide in long-term productivity benefits. In a highly developed nation, the average cost is US$636 million, US$209 million in a medium-developed nation and US$79 million in low-income nation based on severity Small disaster can also affect people as large ones causing damage and death, undermining livelihoods and leading to chronic poverty.

Noy & Pont (2016) described that losses can be examined for households, firms and businesses at the microeconomic level. The disaster losses during the reconstruction and recovery process can also be further divided between the short-run from a few months up to several years and the long run typically considered at least three to five years or sometimes measured for decades. Low-income countries face much bigger direct impacts because of their higher degrees of vulnerability and exposure and it is very likely that these bigger direct impacts will lead to larger losses in the short-term, and possibly also in the longer-term.

Natural disasters such as tropical cyclone, windstorms, floods and landslides had a large impact on most people. Leoni (2010) reported that the deaths of 226,000 were caused by 373 disasters in the world that also affected 207,000 people in 2010. During a decade between 2000 and 2010, a total of 1,077,683 people died and 2.4 billion were affected by disasters and in terms of annual basis, 400 disasters

caused 98,000 deaths and destroyed the livelihoods of 226,000 million people. Poor people are also the ones who suffer the greatest long-term consequences of disasters as they have no insurance and no means to recover quickly; they often lose their homes, jobs and livelihoods which making them more vulnerable to the next disaster. According to IUCN report, women and children died 14 times more than men during a disaster. Even in industrialized countries, more women died than man during the year 2003 from European heat wave. In addition during Hurrican Katrina 2005, women were suffered than man. In many countries, women have subordinate positions, restricted mobility, less educational opportunity, less voice in decision-making and poorer employment, all of which increases vulnerability. Francisco (2015) also stated that extreme flood events among these increased disasters can cause significant damage to affected communities and to its most vulnerable members.

UNDP (2012) analyzed that the impact of the floods on the livelihoods of the affected population in Cambodia. The methodology used a secondary data review of assessments of other organizations, complimented by key informant interviews and qualitative focus group discussions (FGD) with local community leaders and affected residents in the provinces of Prey Veng, Kratie and Siem Reap. Key findings and results of the assessment indicate that agriculture is the main source of income for 80 percent of the flood-affected population, with rice farming being the key economic activity. The assessment surveys of World Food Programme indicate a 60 to 66 percent decrease in the incomes of affected households. The loss of the rice (and vegetable) harvest affected livelihood activities which depend on crop production, especially agricultural wage labor. With no harvest, agricultural wage laborers, who make up the poorest households, lost a major source of their seasonal employment and income. In addition, the loss of the wet season harvest not only means the loss of income, but translates to certain food shortages for many households until the next harvest. Based on the review of secondary data, interviews with key informants and discussions with groups of local leaders and villagers, the general livelihood recovery needs of the flood-affected communities are identified as: short- or long-term income and employment opportunities to offset decrease/loss of income; support for resuming agriculture and crop production activities; replacement of lost small livestock; access to affordable credit sources for restarting/rehabilitation of small and micro businesses.

2.1.4 Impact of natural disaster in Myanmar

Myanmar is vulnerable to multiple natural hazards including fire, forest fire, earthquake, cyclone, storm surge, tsunami, landslide, floods and drought. In June 2001, the Wundwin Township in central Myanmar suffered from a severe flood which swept away a large number of villages. In June 2010, the excessive sedimentation resulted from intense rains was severe affected to the paddy fields in Rakhine State. From July to October 2011, losses of about 1.7 million tons of rice were resulted by flooding in the Ayeyawady, Bago, Rakhine and Mon Regions/States (MCCA, 2016). A part of the monsoon, heavy rain, made many parts of Myanmar encounter flooding in the beginning of August 2012. In late July 2013, the flash floods resulted from heavy monsoon rains and overflowing local rivers affected Kayin, Mon, Rakhine and Taninthayi States and Ayeyawaddy Regions (OCHA, 2013).

In the last four decades, five major cyclones hit Myanmar: in 1968 (Sittwe cyclone), 1975 (Pathein cyclone), 1982 (Gwa cyclone), 1994 (Maundaw cyclone), 2006 (cyclone Mala) and 2008 (cyclone Nargis). The Sittwe cyclone led to the loss of 1037 lives, Pathein cylone claimed 304 lives and Nargis, the most devastating in the living memory of Myanmar, led to the loss of 138,373 lives, while affected 2.4 million populations while the damage and destruction to properties to the tune of USD 4.1 billion were sustained (ADPC, 2009).

Moreover, Myanmar was hit by devastating floods and landslides in 2015, according to Government figures affecting over 9 million people across the country, and temporarily displacing 1.7 million people. As a result of flood, 525,330 ha of farmland were inundated with an extreme impact on crop production, especially rice which is the staple food in the country. Subsistence farmers and casual workers in most of the affected areas generally reduce the quantity of food because staple food becomes less available and more expensive in local markets. Most villages in the six regions/states; Ayeyawady, Bago, Chin, Magway, Rakhine and Sagaing reported that large parts of their agricultural land was affected by the floods, particularly in Ayeyawady, Bago and Rakhine, where almost 400,000 ha of land were flooded, resulting in severe damage to cultivated crops, particularly rice. In fact, of the overall proportion of crops damaged by the floods, 89% consisted of monsoon paddy rice, which is likely to experience losses of production of at least 30% compared to the same time last year. Seeds, fertilizers and tools were also lost in the disaster. The

livestock sector was also severely impacted with the loss of more than 250,000 animals particularly poultry, cows, buffalo and pigs. Sagaing and Rakhine reported the highest number of losses. Therefore, the key findings of the assessment show that the flood had a severe impact on the livelihoods of families that rely on agriculture (FAO & WFP, 2015).

GFDRR (2013) described the effects of Nargis and subsequent natural hazards on the key farmers, fishermen and casual laborers. It examined how Nargis affected the social capital, the capacity for collective action, intra-and inter-village relations, and relations between villagers and their leaders. The cyclone caused erosion and destroyed embankments, which made the fields more prone to flooding; the duration of daily and monthly tides became longer in the post-Nargis period, making the fields more saline and more prone to pest infestation. In fact, the average frequency of negative external events was almost twice as high in highly affected villages compared to moderately and lightly affected villages. Nargis had affected livelihoods to such a degree that many villages appeared to have lost their ability to self-recover. In 2013, farming had recovered in only about one-quarter of the villages, and none of the highly affected villages showed good farming conditions. Therefore, on average, yields still remained below pre-Nargis levels even in lightly affected villages. It was also found that social relations of about three-quarters of villages were considered good or fair, including in two-thirds of the highly affected villages. Where social relations were good, the community was organized and villagers undertook collective activities, mostly socio-religious tasks and regular community works such as road renovation and pond cleaning.

Khin Oo & Theingi Myint (2010) discussed that the impact of Nargis on the monocropping system of paddy farmers in Bogalay Township, Ayeyawady Region of Myanmar. It was observed that seriously affected farmers cultivated paddy only in the monsoon season using a monocropping system. Nargis reduced the cultivated areas for monsoon paddy production. Paddy yield was also significantly reduced to half of the current yield (from 2.2 to 1.1 tons/ha). Moreover, the paddy farmers therefore faced declining paddy price from USD211.60 to USD130.20 per ton. Thus, farm income from monocropped paddy was reduced about sixfold (from USD3, 924.30 to USD669.40).

2.1.5 Agricultural Livelihoods and Impact of flood in agriculture

Agriculture is the mainstay of farmer livelihoods, serving both as the primary source of household food and principal means of income generation. Most of developing countries, the risks arise mostly because most of the population dependent on climate sensitive factors, especially agriculture, for their livelihoods. In developing countries, the poor are more vulnerable to these disasters due to less favorable economic, social and institutional conditions.

Israel et al., (2012) analyzed the impacts of natural disasters, particularly floods, droughts and typhoons on agriculture, food security, the natural resources and environment in the Philippines. It aimed to propose recommendations to respond to the impacts of natural disasters. The agriculture and natural resources sectors are more likely to be affected by the natural disasters and their undesirable consequences. The agricultural sector which has to rely on natural rainfall employs most of the population in a developing country. The disasters caused the significant problem for the people from developing countries who are already struggling to tackle the poverty and economic inequalities (Patnaik & Narayanan, 2010).

Nang Ei Mon The (2012) observed that drought, extreme heat and flood were the main climate shocks realized by the people over the last four years of 2008, 2009, 2010 and 2011 in Pakokku Township, Magway Region, Myanmar. In 2011, floods were the major climatic effect due to heavy rainfall in the study area. According to the results, agriculture sector was influenced by the impact of climate. Therefore, more improved technology, suitable varieties and trainings for farmers are recommended to combat with the risk associated due to climate change.

Mya Yadanar Tun (2015) studied that impact of flood on livelihood and agricultural production by interviewing 120 respondents from 10 villages in Seikphyu Township, Magway Region. The study was described that livelihoods of the majority of the respondents were mainly relied on upland farming and alluvial land farming before and after flood. As a result of flood, the most common problem faced by the sample respondents was the lack of seeds for the next crops cultivations, almost all of the farmers reduced their profit and income and money problem of farmers to invest their farming. Therefore, the farmers needed the rehabilitation programs related to credit, construsitng well for water supply, distribution of high yielding varieties, and improve technology, farm machineries and implements and all-weather road to recover livelihood.

FAO & WFP (2015) worked on the assessment study based on secondary data as well as the collection by analyzing field data from 6 to 21 September 2015 in six most affected regions/states, Sagaing, Chin, Magway, Rakhine, Ayeyawady and Bago. Among the villages assessed, 45% and 43% of sample farmers reported crop production and subsistence farming as their main livelihoods. Casual labor and crop production are the second most important livelihoods according to 30% and 28% respectively of visited villages. Livestock breeding represents the third most important livelihood for around 30% and 27% of sample villages respectively. Fisheries and livestock breeding are particularly important in Rakhine state where a high percentage of households rely on these sectors as their main livelihoods. Of the overall area fully destroyed by the floods, about 79% was monsoon paddy, resulting in total loss of production in these fields. Most of the assessed villages reported that agricultural land was covered by water as well as mud, sand and debris. This situation might hamper winter and summer crops production. The assessment concluded that the disaster had a severe impact on the livelihoods of families that rely on agriculture.

2.2 Disaster Risk Management and Rehabilitation

Disaster risk management are really essential to improve the understanding of designing, implementing and evaluation strategies, policies and measures and to improve preparedness and recovery practices for the purpose of peoples' security, well-being and sustainable development (Christopher & Barros, 2012). In particular, the cumulative effects of disasters at local adaptation and disaster risk management approaches to reduce and manage disaster risk in a changing climate. This approach can substantially affect the capacity of communities and societies livelihood options and resources to prepare for and respond to future disasters. Disaster risk management becomes a vital component of any climate change adaptation program when climate change contributes to an increase in disaster risk. Climate change through higher temperature, changing precipitation and extreme weather may lead to incidences of weather-induced disasters such as floods, droughts, wild fires, strong winds, and heat and cold waves in many countries of the region,. Therefore the efforts of disaster risk management should build on and expand for decrease in present and future vulnerabilities to climate change risk (Pollner.et. al., 2010).

Rehabilitation and reconstruction after disasters is predominately undertaken by governments, civil society, international and/or non-governmental organizations

(NGOs) that have the necessary expertise in the area. Rehabilitation and reconstruction of infrastructure aims to restore the functioning of the existing structures and services or upgrade them to meet current needs. These programmes should be designed and implemented with the involvement of relevant line ministries/local authorities, through local consultants and contractors, by making use of locally available expertise. However, in post-disaster situations, depending on the magnitude of the resulting damage, aid agencies, civil society and other organizations, private and public, may collaborate with the government to facilitate the rehabilitation and/or reconstruction of the infrastructure, based on damage and needs assessments. Reconstruction is a complex process which may take up to several years. It is also important to link up the programmes with any long-term strategies the government may have developed previously. Post-disaster there is a need to provide the affected population not only with adequate sheltering options but also to ensure that they have access to water supply, basic sanitation facilities, healthcare and services as well as education. Addressing shelter needs and community infrastructure are parallel processes and need to be planned and implemented simultaneously (IFRC, 2012).

Kousky (2012) analyzed that disasters associated with climate extremes influence population mobility and relocation, affecting host and origin communities. The rich societies gave a lot of help for the affected ones in the time of disasters in form of cash, clothes, tents and first aid equipment that can be gathered. People abroad have also been witnessed participating actively to help the cause. Extreme and non-extreme weather or climate events affect vulnerability to future extreme events by modifying resilience, coping capacity, and adaptive capacity.

Vathana et.al. (2013) presented that impact of disasters on household welfare and the linking of social protection interventions to address the entitlement failure of poor and vulnerable people suffering from the impacts of flood and drought in Cambodia. It was found that the pattern of risks faced by the poor and vulnerable in rural areas of Cambodia, as a consequence of natural disaster was posing an increasing threat to their livelihoods. This study provided evidence for policy decisions on linking the mechanism of disaster management to social risk management and social protection instruments that best fit the context of the series of flood and drought disasters in Cambodia. Households perceive social risk management instruments differently. Preventive strategies to reduce the probability of the risk occurring were not well understood by poor households. There is a strong

need at policy level to design social protection interventions to emphasize ex-ante instruments rather than focus the response to natural disasters as ex-post actions, concentrating on emergency measures and relief. Ex-ante cash transfer programs could play a crucial role in encouraging poor households to invest in business rather than spending on food. Microfinance schemes can also help ex-ante income diversification to help households cope with a wide range of natural disasters.

2.3 Coping Strategies to Disasters

Coping capacity means the beneficial manner in which existing resources are effectively used by the people and organizations during adverse condition s of a disaster event (OECD, 2006). Households develop a number of ex-ante and ex-post risk coping strategies to combat negative impacts related with natural disasters like floods. The ex-post coping strategies try to overcome the shortfall in consumption of households after the post disaster event. Various ex-ante and ex-post risk coping mechanisms are developed to prevent from negative impacts due to natural disasters like floods. The ex-post coping mechanism is to reduce the extent of deficiency in consumption of households after the disaster. For instance, farmers use crop diversification, intercropping, use of contracts and use of low risk technologies as a form of managing agricultural production risks. The ex-post risk coping strategies are to stabilize the households' consumption level. Examples are (1) reducing household expenditure (2) use of loan (3) selling of some assets after disasters and so on.

The ex-ante risk coping strategies are to protect themselves against shocks before the negative impacts actually happen. These strategies include adopting conservative production choices and a wide range of economic activities. Three main categories are included in the income smoothing strategies. They are risk avoidance, risk transfer and risk reduction.

An example of risk avoidance is moving to a less disaster prone area. The formal forms of risk transfer that can be readily employed by the agricultural households are risk-sharing and self-insurance. While risk-sharing is a cross-sectional transfer of risk to a group in a social network, self-insurance is a risk transfer to oneself across time via saving. The third method, risk reduction has three main methods; (1) diversification, self-sufficiency and specialization. Diversification can minimize the income risk by spreading risk exposure over a wide range of income generating activities. Self-sufficiency is to reduce risk associated with expenditure.

Specialization is to reduce risk by focusing low risk income generating activity that will give a low return (Lekprichakul, 2007).

Francisco (2015) showed that household coping choice is influenced by income, lesson from past experience, suggestion from the media and people's perceptions towards natural disasters. It also found that household income, access to credit (borrowing), the use of a flood alarm system, access to safe shelter, membership in a community organization, adoption of specific measures, and general preventive measures significantly reduce the time taken to recover from property damage. Evacuation, relief aid, type of housing, education, household size, and frequency of flooding in the area did not have significant effects on the choice of coping strategy.

Harvey & Rakotobe (2014) described that there are also limitations to be employed successfully in different coping strategies. For instance, in the planting time, off-farm employment opportunities were often limited. Farmers also sold household assets (particularly chickens) to purchase rice from market or sent household members to get outside employment as an agricultural laborer on another farm to obtain income for consumption.

Kamal (2013) stated that coping and recovery strategies based on indigenous strategies have been far more significant than external assistance. Following many generations of experience, people of the study village have learned to cope with disasters in their own ways. Although they have limited options, people are increasingly searching for alternative livelihood strategies to adapt to the reality of severe disruption of their livelihoods. Due to lack of financial and physical capital, households increasingly rely on natural, human, social capitals, but these capitals are not enough for making them resilient. Risk reduction strategies therefore need to capitalize on the inherent social and cultural capacities of the communities.

UNDP (2012) reported that 40 percent of the affected households in the provinces of Prey Veng, Kratie and Siem Reap in Cambodia said they took on new loans which were mainly spent on agricultural inputs for re-planting, although a portion of the loans were spent on food consumption. Using loans for non-income generating purposes or to pay off existing debt will have negative consequences on the household's future ability to repay the debts. Many people, particularly in Prey Veng and Siem Reap, have resorted to labour migration. Other coping measures reported include the sale of livestock, and reduced food consumption.

CHAPTER III
RESEARCH METHODOLOGY

3.1 Description of the Study Area

3.1.1 Study area

Kambalu Township in Sagaing region was selected as the study area which is one of the Dry Zone areas. Sagaing region is made up of the districts of Sagaing, Monywa, Shwebo, Katha, Kalay, Mawlaik, Tamu and Hkamti, comprising 34 Townships. Kambalu Township is situated between latitudes 20º 50′ North and 23º 43′ North and longitudes 20º 50′ East and 20º 50′ East. Total area is 1,599.35 sq miles (414,240 hectares) and it is long 43 miles long from east to west and 64.5 miles from south to north. It is bordered by Kawlin and Kyunhla Townships on the North, Khin U on the South, Tasei Township on the West and Thabeikkyin Township on the East. On the other hand, it was also bounded by Muu river on the West and Ayeyawady on the East. There are 5 wards, 86 village tracts comprising 275 villages in Kambalu Township and has about 265,884 hectares of total arable land with the total population was over 291,702 in 2015 (DoA, 2016). Major economic activites of Kambalu Township are agriculture, trading and livestock production. In agricultural production, the common crops grown by farmers are monsoon paddy, groundnut, pigeon pea, maize and sugarcane which mainly supported to the livelihoods of rural people. They mostly reared chicken as the livestock production. In Kambalu Township, there are many development areas such as sugar industry, oil and rice milling enterprise, hospital, rail station, primary schools, high schools and Government Technical College of Kambalu.

3.1.2 Climatic statistics

In Kambalu Township, like the other part of Myanmar, there are three seasons: the rainy season (mid-May to mid-October), winter (mid-October to mid-February) and summer (mid-February to mid-May). The rainy seasons are defined May-June as early monsoon season, July-August, mid monsoon season and September-December, late monsoon season. Monthly average rainfall and temperature are shown in Figure 3.1 and 3.2. Based on normal rainfall data, the average annual rainfall in Kambalu Township is 1,048 mm. The average monthly temperature ranges from minimum of 13 ºC to maximum 36 ºC throughout a year. In terms of rainfall, based on the data from the Kambalu meteorological satation, the average rainfall from 2011 to 2015

was 994 mm/year. From 2011 to 2015, the highest total rainfall was 1629 mm in 2015 and the total lowest rainfall was 578 mm in 2011. Rainfall was the highest in rainy season from mid-May to mid-October while the lowest was found in January to April and December. As a result, flood from heavy rainfall due to Cyclone Komen happened in the study area on July 2015. According to the temperature recorded from 2011 to 2015 in Kambalu Township, the average maximum temperature and average minimum temperature were 33ºC and 21ºC, respectively. The hottest months were March and April and the coldest ones concentrated on December and January (Figure 3.2).

3.1.3 Land utilization

The Township total area was 414,240 hectares and forest occupies the largest share as 43% of the total area as shown in Figure 3.3. About 42% of the total area was agricultural land, 1% was fallowed land and 14% was the other. Upland or Ya land occupies nearly 66% of the agricultural land while lowland or Le land, Kaing/Kyune and orchard land comprise 33%, 0.60% and 0.40% respectively in Figure 3.4. In Kambalu Township, upland occupies the highest portion and farmers grow various crops such as rice, pulses, oil seeds, cotton, pigeon pea, groundnut, sugarcane and maize in lowland and upland (DoA, 2016).

3.1.4 Flooded, destroyed and damaged areas of different crops in Kambalu Township

Kambalu Township was faced with the flood due to heavy rainfall from Minn Myin and Tha Pan Zeik dams with about 471 mm in three rainy days from 16 to 19 July in 2015. It mainly affected to the villages located near these dams, transportation and public infrastructure, crop cultivated areas and households. Table 3.1 presents flooded, destroyed and damaged areas under different cultivated crops in Kambalu Township were shown. The flood affected crops were monsoon paddy including seedling bed, groundnut, green gram, pigeon pea, maize and sugarcane according to the data from Department of Agriculture, Kambalu Township. The total damaged area of all affected crops was about 5,064 ha where monsoon rice was the most affected crop occupying about 1,926 ha of damaged area and followed by maize with 1,420 ha (DoA, 2016).

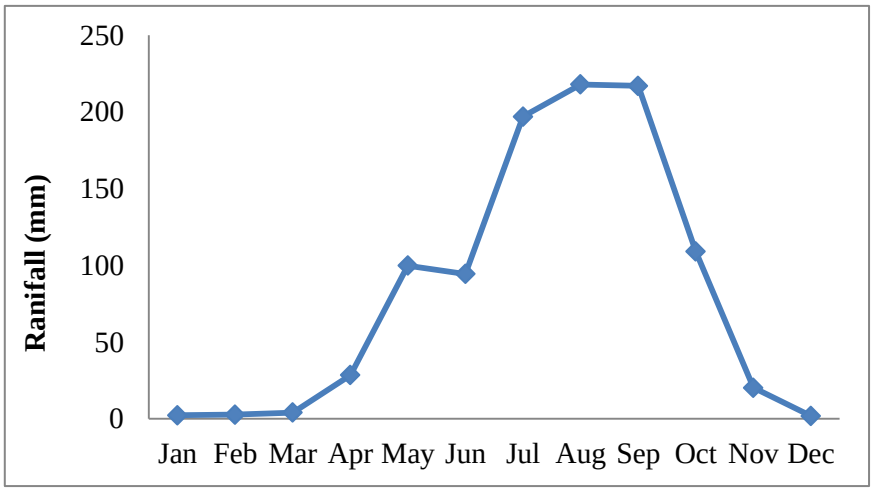


Figure 3.1 Monthly Average Rainfalls of Kambalu Township (2011-2015)

Source: Deparment of meteorological and hydrology, 2016

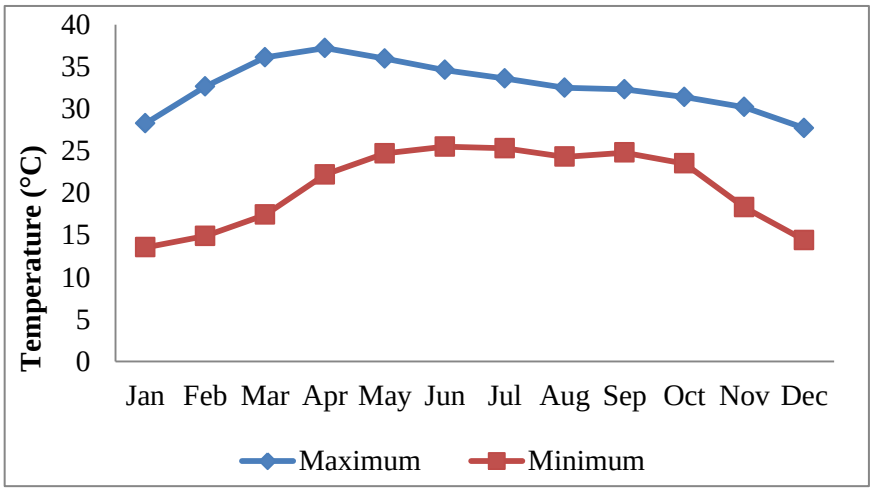


Figure 3.2 Monthly Average Temperature of Kambalu Township (2011-2015)

Source: Deparment of meteorological and hydrology, 2016

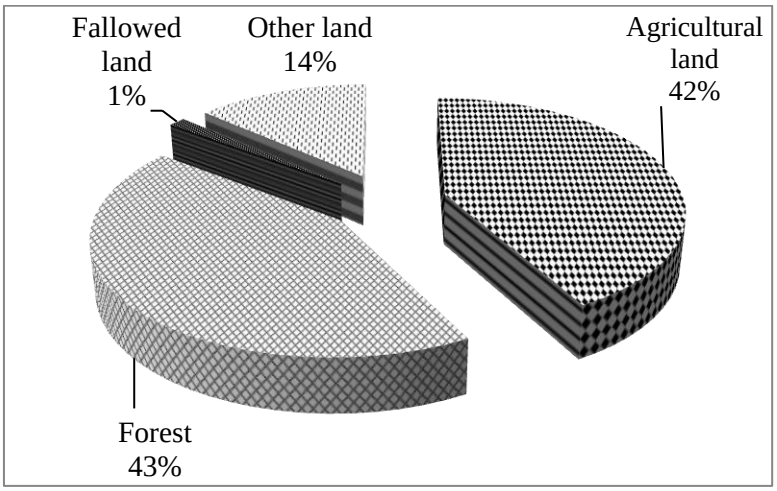


Figure 3.3 Land Utilization in Kambalu Township (2014-2015)

Source: Department of Agriculture, 2016

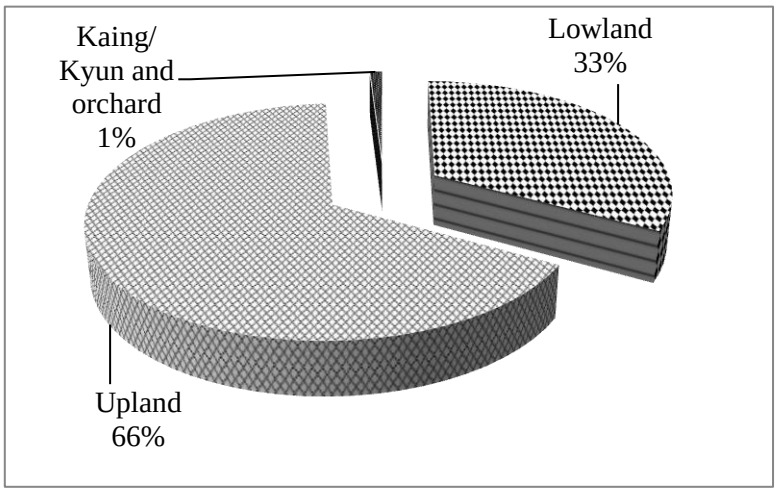


Figure 3.4 Agricultural Land Utilization in Kambalu Township (2014-2015)

Source: Department of Agriculture, 2016

Table 3.1 Flooded, destroyed and damaged crop's areas in Kambalu Township in 2015

Crop	Flooded area (ha)	Damaged area (ha)	Destroyed area (ha)
Monsoon rice	2,113.31	1,925.94	1,468.64
Rice seedling bed	778.23	560.50	539.86
Groundnut	510.72	353.70	329.42
Green gram	323.76	295.83	281.26
Pigeon pea	437.88	437.88	373.53
Maize	1,554.84	1,420.48	1,298.26
Sugarcane	70.01	70.01	70.01
Total	5,788.75	5,064.34	4,360.99

Source: Department of Agriculture, 2016

3.2 Data Collection and Sampling Procedure

Both secondary and primary sources of data were used in this study. Secondary data were gathered from various sources such as several books, public journals, thesis, government and non-government organizations and other related publications. The data on land utilization, studied village profile and information on Kambalu Township were collected from Department of Agriculture (DoA), Kambalu Township while the data on temperature and rainfall were taken from Department of Meteorology and Hydrology.

Field survey was carried out in October 2016, one year period after flood in 2015. The primary data were gathered by household interview, focus group discussions and key informant interview by using purposive random sampling method. A total of 135 flood affected farm households were interviewed by using structured questionnaire. Number of selected sample farm household's covers 22.54% of the total flood affected farm households in the six sample villages from five village tracts. As shown in Appendix 1, the sample villages were Pay Kone (South), Pauk Sein Kone, Zee Ka Nar, Shaw Phyu Kone, Koe Taung Boet and Kya Khat Aingh. Pay Kone (South) village tract is located about 11 miles from Kambalu Township while Kan Gyi is also situated about 24 miles from it. Moreover, Zee Ka Nar, Koe Taung Boet and Kya Khat Aingh are located between 30 to 32 miles from Kambalu.

The survey collected information from 135 sample farm households before and after flood to identify socioeconomic and agricultural conditions and coping strategies used by affected farm households.

Four focus group discussions were conducted in Pay Kone (South), Koe Taung Boet, Kya Khat Aingh and Shaw Phyu Kone villages with 8 to 10 participants in each group. All participants from each focus group discussion were farmers who discussed the effects of flood experienced by affected farm households, local perspectives of agricultural livelihoods and what coping strategies they used to overcome the impact. Five key informant interviews were also conducted to obtain detail information related to this study from a clerk from general administrative office, two village administrative officers, one ten-headed household leader and a key farmer. Each key informant was collected from five sample village tracts to capture the qualitative data by enriching the data from personal interview. This interview provided the information about socioeconomic and agricultural conditions before and after flood, coping mechanisms employed by affected households and aids received from governmental organizations and non-governmental organizations (NGOs).

3.3 Method of Analysis

The study was analyed on both quantitative and qualitative data. Some qualitative data were given numerical codes to continue data processing. These coding and responses were compiled into Microsoft excel program. Sets of primary data from the household survey were processed by using the Statistical Packages for Social Science (SPSS version 17) software. Descriptive statistics such as the mean, frequency counts, and percentage distributions were used to describe socioeconomic and agricultural conditions of sample farm households. In order to compare the socioeconomic characteristics and agricultural production activities before and after flood, losses and difficulties in farming, aids received and coping strategies used by sample farm households among different flood affected levels, Pearson Chi- square test, Paired sample t-test and F-test were used. Moreover, regression analysis was carried to determine the factors affecting on crop income changes by comparing the revenue obtained from monsoon paddy production before and after flood.

3.3.1 Descriptive analysis

Descriptive statistics such as frequency, percentage, mean, minimum and maximum were used to explore socioeconomic conditions of sample farm households before and after flood, crop production activities, annual household income and losses due to flood. Also it was used to describe aids such as farm inputs, clothes, foods, financial support, purified water and general property received by farm households and to list difficulties like low yield, lack of farm investments, seeds, farm implements and pest or disease problems etc faced by sample farm households. Furthermore, coping strategies such as reducing expenditure, borrowing money, selling livestock and asset were identified by descriptive methods.

3.3.2 Paired sample t-test

A paired sample t-test is used to compare two population means where there were two samples in which observations in one sample can be paired with observations in the other sample. As an example, before-and-after observations on the same subjects such as students' diagnostic test results before and after a particular module or course were mostly analyzed by this test. Therefore, Paired sample t-test was applied to analyze and compare the statistical significance of the mean differences between before and after flood conditions of household and land assets, crop production activities and annual household income including non-farm and farm incomes.

3.3.3 Pearson Chi-square test

The Chi-square statistic is a non-parametric tool to analyze group difference when the dependent variable is measured at a nominal level. It provide considerable information about how each of the groups performed in the study. Thus, Pearson Chi-square test was used to analyze the losses of agricultural inputs and activities, receiving aids and coping strategies to flood among different affected groups.

3.3.4 Regression analysis

To determine the factors affecting on the total revenue function of monsoon paddy in affected farm households, Cobb-Douglas functional form was used. The dependent variables was applied total revenue of monsoon paddy by sample farm households and independent variables that are important factors for revenue of monsoon paddy were age and schooling years of household's head, family size and total family labor, total number of cattle in the household and cultivated area of monsoon paddy and non-farm income. The Log linear form of Cobb-Douglas function for total revnue of monsoon paddy before and after flood was as follow:

$$\text{Ln } Y = \beta_0 + \text{Ln } \beta_1 X_{1i} + \text{Ln } \beta_2 X_{2i} + \text{Ln } \beta_3 X_{3i} + \text{Ln } \beta_4 X_{4i} + \text{Ln } \beta_5 X_{5i} + \text{Ln } \beta_6 X_{6i} + \text{Ln } \beta_7 X_{7i} + \beta_1 D_{1i} + \mu_i$$

Where,

Y = Total revenue of monsoon paddy per hectare before and after flood (MMK/ha)

X_{1i} = Household head's age (Year)

X_{2i} = Household head's schooling year (Year)

X_{3i} = Total family member (Number/HH)

X_{4i} = Total family labor (Number/HH)

X_{5i} = Total number of cattle ((Number/HH)

X_{6i} = Cultivated area of monsoon paddy (ha)

X_{7i} = Non-farm income (MMK/Year)

D_{1i} = Before and after flood in the study area (after flood=1, before flood=0)

μ_i = Disturbance term

CHAPTER IV
RESULTS AND DISCUSSION

4.1 Background Information of Sample Farm Households

Kambalu Township in Sagaing region was included one of the seriously affected areas in 2015 due to the heavy rains in Myanmar from the effect of Cyclone Komen. One hundred and thirty five sample farm households which is about 23% of the affected total households were collected from six sample villages of Pauk Sein Kone, Zee Ka Nar, Shaw Phu Kone, Kya Khat Aingh, Koe Taung Boet and Pay Kone (South) in Kambalu Township, Sagaing Region as described in Table 4.1.

Among the sample villages, Pauk Sein Kone village is located about one mile far from Zaw stream while Zee Kan Nar, Shaw Phyu Kone, Kya Kyat Aingh and Koe Taung Boet villages are situated along the Daung Myuu stream. Moreover, Pay Kone (South) is also located near the Minn Myin stream. Therefore, participants from focus group discussions and key informants reported that these villages usually experience with minor flood once in every three years but the flood in 2015 was the most serious in the study area. The map of the study area is presented in Appendix 1.

The selected sample farm households were categorized based on their damaged cultivated crop area due to flood into three groups: seriously affected farm households which damaged cultivated crop area of above 1.0 ha (groupI) , moderately affected farm households which damaged cultivated crop area of 0.4 ha to 1.0 ha (group II) and less affected farm households which damaged cultivated crop area of less than 0.4 ha (group III). In Table 4.2, there were each 55 sample farm households in seriously and moderately affected group and 25 sample farm households in less affected group.

4.2 Socioeconomic Characteristics of Sample Farm Household Groups

4.2.1 Demographic characteristics and gender status of household's head

Demographic characteristics and gender status of household's head are presented in Table 4.3 and 4.4. The average age of household's head for three different groups were around 50, 52 and 46 years within a range of 24 to 83 years. Farming experience of household's head was about 26 years in group I and II and 22 years in group III with the minimum 3 years to maximum 50 years. It was observed that group I and II household's head had more farming experience than group III. In the study area, majority of the household's head completed primary and

middle education level with around 6 schooling years in all sample household's head, such as 5 years in group I and 6 years in group II and III, respectively. The maximum schooling years of sample household's head for different three groups was about 15, 14 and 9 years while the minimum was around 5 years in group I and III and illterate in group II. The number of family members in average were around 5 members with the range of 2 to 13 in group I, 3 to 10 in group II and 2 to 7 in group III respectively. According to the F-test result, there was signinificant different at 10% level in family size among different farm household groups. Among the family members, about 3 members in three groups were family labors and approximately 1 member was the student. Results of the average dependency ratio among the three groups was 58% while each of group I, II and III were about 60%, 53% and 63% respectively can be found in the study area.

In the study area, each of 87% of group I and II and 88% of group III household's head were males. On the other hand, about 13% of group I and II and 12% of group III household's head were females. About 87% of sample farm households were headed by males while 13% of household's head were females.

4.2.2 Occupation status of sample farm household's head and family members

In the study area, all of sample farm household heads were farmers engaged in agriculture for their main income of the household. Results of the secondary occupation showed there was no secondary occupation in most the sample affected households among the three groups. About 11% and 8% of farm household's head in group II and III worked as casual labors. Among three groups, 7% in group II had handicraft making while 2% of farm household's head were brokers to get secondary income. In group I and II, 2% of farm household heads had livestock production as secondary occupation. In regarding to all farm households of three groups, majority of the household heads were farmers with 87% and followed by government staff with 2% and dependent with 11%. Around 89% of all of farm household's head had no secondary occupation as most of the farm household's head in the study area were working only on their own farm. Therefore a few farm household's head had secondary income from 6% of casual labor, 3% of handicraft, each 1% from livestock production and broker.

In the study area, sample farm household groups heavily relied on agriculture for their main income. Therefore, majority of family members in all groups did only

farm work as their primary occupation. Therefore, about 84% of total family members were engaged on farm as primary occupation and followed by 5% of casual labors, 4% of livestock production, 2% of handicraft, 1% of government staff, and 2% of company staff respectively for total farm households. Among three groups, group III relatively worked more on livestock production with 10% of family members than 5% in group I but it had no livestock production in group II as the primary occupation. As group II farm households have domestic business of flat grinding stones (called making Kyauk Pyin), 5% of family members worked handicraft making while it had 2% in group III. It can be found that the family members do not have secondary job. Only very few percent of family labors were engaged on casual labor, livestock production and handcraft for their secondary income.

Table 4.1 Number of sample farm households in the selected villages of Kambalu Township

Village tract	Village	Total flood affected farm households	Sample farm households
Kan Gyi	Pauk Sein Kone	95	8
Zee Ka Nar	Zee Ka Nar	100	16
	Shaw Phyu Kone	143	31
Kya Khat Aingh	Kya Khat Aingh	42	25
Koe Taung Boet	Koe Taung Boet	41	30
Pay Kone (South)	Pay Kone (South)	178	25
Total		**599**	**135**

Source: Department of Agriculture, 2016

Table 4.2 Groups of the sample farm households according to different flood affected level

Category	Farm households	
Group I (seriously affected - above 1.0 ha)	55	(40.74%)
Group II (moderately affected - 0.4 ha to 1.0 ha)	55	(40.74%)
Group III (less affected - less than 0.4 ha)	25	(18.52%)
Total	**135**	**(100.00%)**

Note: Figures in parentheses represent percent of sample farm households groups.

Table 4.3 Demographic characteristics of sample farm household groups in the study area

Item	Unit	Group I		Group II		Group III		Total		F-test
		Mean	Range	Mean	Range	Mean	Range	Mean	Range	
Age of household's head	Yr	49.51	25-73	51.51	25-83	46.28	24-76	49.73	24-83	1.620^{ns}
Farming experience of household's head	Yr	26.53	3-46	26.31	3-50	22.00	3-50	25.60	3-50	1.535^{ns}
Schooling years of household's head	Yr	5.40	5-15	5.62	0-14	5.64	5-9	5.53	0-15	0.186^{ns}
Family members	No.	6.02	2-13	5.36	3-10	5.12	2-7	5.59	2-13	2.618^{*}
Family labors in sample farm households	No.	2.76	1-8	2.60	1-6	2.56	1-6	2.66	1-8	1.522^{ns}
No. of students in sample farm households	No.	1.44	0-4	1.25	0-4	0.95	0-3	1.16	0-4	1.964^{ns}
Dependency ratio	%	60.00	-	53.00	-	63.00	-	58.00	-	0.950^{ns}

Note: * is significant at 10% level and ns is not significant.

Table 4.4 Gender of sample farm household heads in different flood affected groups

Item	Group I		Group II		Group III		Total		Pearson Chi-square
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent	
Male	48	87.27	48	87.27	22	88.00	118	87.41	0.010^{ns}
Female	7	12.73	7	12.73	3	12.00	17	12.59	
Total	55	100.00	55	100.00	25	100.00	135	100.00	

Note: ns means not significant.

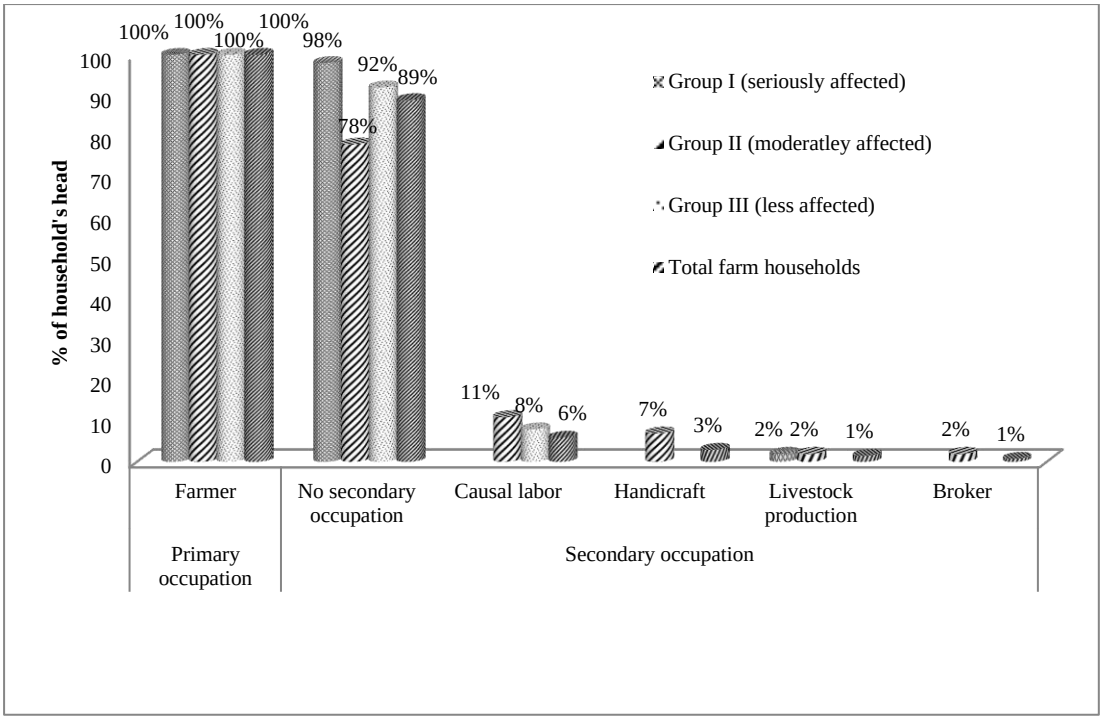


Figure 4.1 Primary and secondary occupation status of household's head

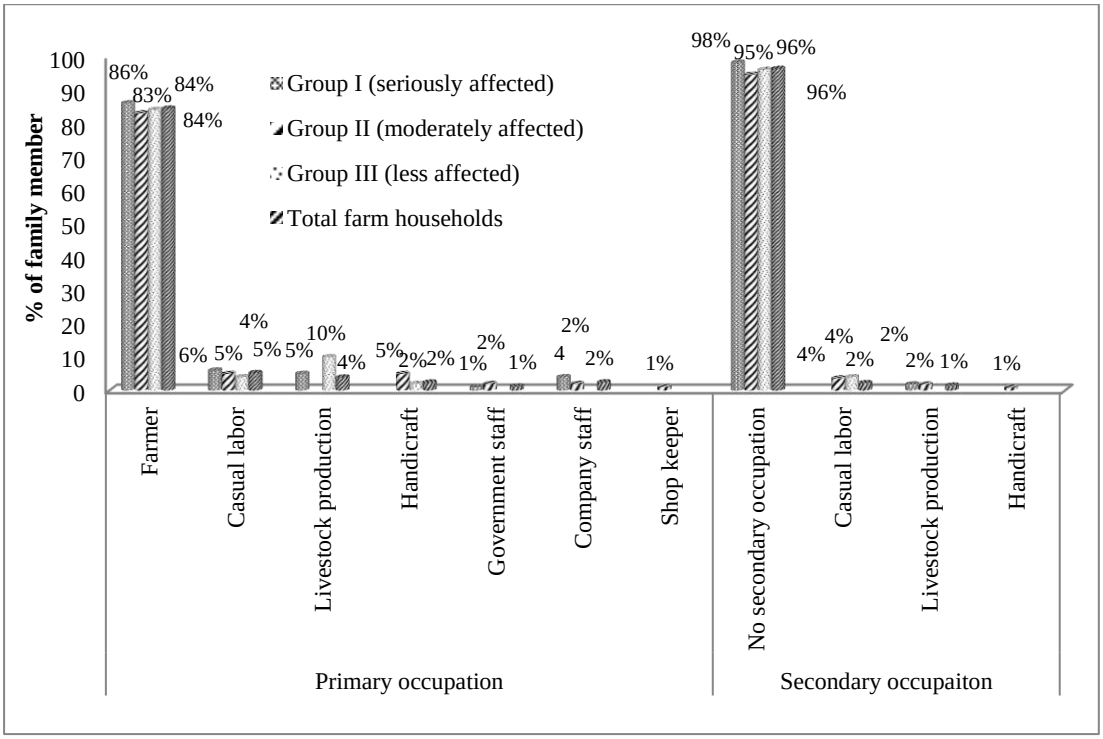


Figure 4.2 Primary and secondary occupation status of family members

4.3 Comparison of Household and Productive Assets of Sample Farm Household Groups

4.3.1 Household assets before and after flood

Lists household assets of sample farm household groups before and after flood were shown in Table 4.5. In this table, all selected farm households possessed near the same number of their household assets except mobile phone before and after flood. The paired sample t-test described that there was significant difference in phone possession in all farm households by increasing mean value from 1.46 before flood to 1.50 after flood. They bought more mobile phone than before flood. The reason was that they wanted to be access the information especially disaster as quickly as possible through internet or SMS. The average numbers of motor cycle and bicycle for all affected farm households reduced more than before flood because of the losses during flood. Among three groups, group I and group III farm households owned more mobile phone after flood than before flood. The paired sample t-test demonstrated that there was a significant difference in mobile phone assets at 10% level in farm household for group I and III before and after flood but it was not significantly different in group II. It was also observed that there were no significant difference in the average number of TV, radio, sky net, car, motor cycle, bicycle and sewing machine before and after flood among the three groups.

4.3.2 Farm assets before and after flood

The comparison of farming tools, equipment and machineries farm assets of sample farm households before and after flood were presented in Table 4.6. In seriously affected farm households, the farm assets such as harrow, plough and boat reduced from 1.82, 1.76 and 0.53 before flood to 1.44, 1.40 and 0.47 after flood. As a result, significant difference was found in harrow and plough at 1% level and boat at 10% level before and after flood. Also the average reducing numbers of bullock cart and well of group I sample farm households can be found. On the other hand, the average numbers of sprayer and tractor used by farm households in group I increased after flood. Therefore, paired sample t-test showed that there was a significant difference at 1% level for the average farm assets (harrow and plough) and at 10% level for the average possession of boat in group I farm households.

In the moderately affected farm households, harrow and plough also drastically decreased from about 1.29 and 1.27 before flood to around 1.15 and 1.13 after flood.

Significant difference of t-test results was found in the average possession of harrow and plough of group II farm households at 5% level. Moreover, the average number of farm assets such as sprayer, water pump and storehouse owned by group II decreased as they lost with flood while some sample farm households used more tractor in their farming activities than after flood instead of draft animals with harrow and plough. However the mean number of sprayer, water pump, storehouse and tractor were not significantly different before and after flood. The same number of farm assets such as bullock cart, well, thresher and rice mill were possessed before and after flood.

In less affected farm households, the average possession of their farm assets was the same before and after flood. However, it was found that the average possession of well decreased slightly from about 0.44 before flood to about 0.40 after flood as it was covered by sand due to flood.

The average numbers of farm assets such as harrow, plough and boat of all sample farm households decreased from about 1.58, 1.54 and 0.26 to approximately 1.36, 1.33 and 0.24 because some of their farm implements floated along the stream during flood. Therefore, the paired sample t-test showed that there was a significant difference at 1% level for possessing of harrow and plough and 10% level for possessing of boat before and after flood.

Nearly all farm households possessed harrows and ploughs which were primary farm implements for crop production in the study area. However, only farm households in group I used tractors and threshers for their farming. The use of sprayer and thresher were relatively high in group III among farm households. Among three affected groups, only a few farm households of group I owned harvester while group II farm households owned rice-mill as compared to group I and III farm households.

4.3.3 Livestock assets before and after flood

The results of livestock assets of farm household comparison among groups before and after flood were presented in Table 4.7. The farm households in the study area used cattle and buffalo for crop production activities while chicken, pig, duck and sheet also were raised for their extra family income. After flood, the average number of cattle and chicken was significantly reduced from approximately 7 and 18 to 6 and 11 in group I farm households. Therefore, paired sample t-test showed that there was a significant difference at 5% level for cattle and at 1% level for chicken before and after flood. As for group II, the average number of chicken reduced

drastically from 24 to 5 before and after flood. Therefore, the paired sample t-test showed that there was a significant difference at 10% level for chicken of group II farm households.

The paired sample t-test showed that there was no significant difference in any livestock of group III farm households before and after flood as it had not seriously affected by flood. Therefore, it was observed that the average number of cattle, chicken and pig were slightly decreased from about 3.48, 20.88 and 1.64 before flood into 3.20, 14.88 and 0.80 after flood but the average number of sheet was the same before and after flood in group III. Among all sample farm households, the average number of cattle significantly decreased from about 5 to 4 before and after flood because they were sold to cope their immediate basic needs due to flood. On the other hand, the average number of chickens was also extremely reduced from around 21 to 9 after flood as it had been killed by flooding.

4.3.4 Land holding size before and after flood

In the study area, there were mainly two types of cultivated land: lowland and upland. The total number of land owned by all sample farm households didn't significantly differ before and after flood shown in Table 4.8. In different affected groups, the average farm size of group I farmers was the largest with about 7.44 ha before flood and 7.42 ha after flood and followed by group II with 3.78 ha and 3.75 ha and group III with 4.18 ha the same before and after flood. The minimum and maximum of land holding size were about 0.81 ha and 40.47 ha in group I, 0.40 ha and 10.93 ha in group II and 0.40 ha and 15.38 ha in group III respectively. Also, the results of paired sample t-test showed that the average land holding size of farm household among the groups did not significantly differ before and after flood. As a result, it was investigated that flood in the study area did not much affect on the land holding size of sample farm household groups.

Table 4.5 Household assets of three groups of sample farm households before and after flood in the study area

Item (Number)	Group I			Group II			Group III			Total		
	Before	After	t-test	Before	After	t-test	Before	After	t-test	Before	After	t-test
Mobile phone	1.71	1.76	-1.765*	1.25	1.25	0.000ns	1.36	1.48	-1.809*	1.46	1.50	-1.745*
TV	0.67	0.67	0.000ns	0.64	0.64	0.000ns	0.60	0.60	-	0.644	0.644	0.000ns
Radio	0.38	0.35	1.427ns	0.31	0.31	0.000ns	0.28	0.32	-1.000ns	0.33	0.33	0.446ns
Sky net	0.11	0.11	-	0.11	0.11	-	0.04	0.04	-	0.10	0.10	-
Car	0.02	0.02	-	-	-	-	-	-	-	0.00	0.00	-
Motor cycle	0.65	0.62	1.427ns	0.75	0.75	-	0.76	0.80	-1.000ns	0.71	0.70	0.576ns
Bicycle	0.27	0.27	-	0.47	0.42	1.352ns	0.40	0.40	-	0.38	0.36	1.346ns
Sewing machine	0.22	0.22	-	0.16	0.16	-	0.08	0.08	-	0.17	0.17	-

Note: * is significant at 10% and ns is not significant.

Table 4.6 Farm assets of three groups of sample farm households before and after flood in the study area

Item (Number)	Group I			Group II			Group III			Total		
	Before	After	t-test	Before	After	t-test	Before	After	t-test	Before	After	t-test
Harrow	1.82	1.44	3.518***	1.29	1.15	2.213**	1.68	1.68	-	1.58	1.36	4.055***
Plough	1.76	1.40	3.833***	1.27	1.13	2.213**	1.64	1.64	-	1.54	1.33	4.295***
Boat	0.53	0.47	1.765*	0.11	0.11	-	-	-	-	0.26	0.24	1.745*
Bullock cart	1.33	1.29	1.427ns	1.00	1.00	-	1.12	1.12	-	1.16	1.14	1.420ns
Sprayer	0.40	0.44	-1.427ns	0.42	0.38	1.000ns	0.52	0.52	-	0.43	0.43	0.000ns
Water pump	0.51	0.51	-	0.24	0.22	0.375ns	0.08	0.08	-	0.32	0.31	0.377ns
Harvester	0.02	0.02	-	-	-	-	-	-	-	0.01	0.01	-
Tractor	0.20	0.22	-1.000ns	0.05	0.07	1.000ns	0.04	0.04	-	0.11	0.13	-1.420ns
Well	0.64	0.62	1.000ns	0.33	0.33	-	0.44	0.40	0.043ns	0.47	0.46	1.420ns
Thresher	0.04	0.04	-	0.02	0.02	-	0.08	0.08	-	0.04	0.04	0.815ns
Storehouse	0.62	0.62	-	0.56	0.53	0.814ns	0.68	0.68	-	0.61	0.59	-
Rice-mill	-	-	-	0.02	0.02	-	-	-	-	0.01	0.01	

Note: ***, ** and * are significant at 1%, 5% and 10% level respectively and ns is not significant.

Table 4.7 Livestock assets of three groups of sample farm households before and after flood in the study area

Item (Number)	Group I			Group II			Group III			Total		
	Before	After	t-test	Before	After	t-test	Before	After	t-test	Before	After	t-test
Cattle	7.40	6.24	2.107**	3.71	3.22	1.773*	3.48	3.20	0.838ns	5.17	4.44	2.797***
Chicken	18.15	11.07	2.906***	23.69	5.40	1.897*	20.88	14.80	1.474ns	20.91	9.45	2.777***
Duck	0.20	0.47	-1.070ns	-	-	-	-	-	-	0.08	0.19	1.069ns
Pig	2.29	1.89	0.546ns	2.20	1.44	1.262ns	1.64	0.80	1.359ns	2.13	1.50	1.568ns
Sheep/goat	-	-	-	-	-	-	2.50	2.50	-	0.45	0.45	-

Note: *** and ** are significant at 1% and 5% level respectively and ns is not significant.

Table 4.8 Land owned by sample farm households before and after flood

Land asset and cultivated area	Before	After	t-test
Group I			
Farm size (ha)			
Mean	7.44	7.42	1.000^{ns}
Maximum	40.47	40.47	
Minimum	0.81	0.81	
Total area owned by farmers in group I (ha)	**409.19**	**407.97**	
Group II			
Farm size (ha)			
Mean	3.78	3.75	1.000^{ns}
Maximum	10.93	10.93	
Minimum	0.40	0.40	
Total area owned by farmers in group II (ha)	**207.84**	**206.22**	
Group III			
Farm size (ha)			
Mean	4.18	4.18	-
Maximum	15.38	15.38	
Minimum	0.40	0.40	
Total area owned by farmers in group III (ha)	**104.61**	**104.61**	
Total			
Farm size (ha)			
Mean	5.35	5.32	1.405^{ns}
Maximum	40.47	40.47	
Minimum	0.40	0.40	
Total area owned by all farmers (ha)	**721.64**	**718.81**	

Note: ns means not significant.

4.3.5 Housing conditions before and after flood

The study area have a large area of forest that produced woods. Therefore, most of farm households used wood in building their houses. According to Table 4.9 results, the sample farm household groups constructed various types of houses. In group I, the housing conditions of most of the farm households were the same before and after flood. Only a few number of farm households in group I lived with Corrugated iron sheet + Brick wall + Brick floor. About 15% of farm households with the buildings of Thatch roof+ Bamboo wall+ Bamboo floor were changed into about 13% of it after flood while the owners of Thatch roof +Bamboo wall was increased from about 4% to 6% of group I farm households. Therefore, it described that the living condition of a few group I farm households was slightly low after flood by changing housing conditions.

As for group II, the housing conditions of the Thatch roof+ Bamboo wall+ Bamboo floor were changed by increasing from about 2% to 4% and Thatch roof + Bamboo wall of farm households by decreasing from 24% to 22% before and after flood. As a result, only a few number of farm households could built the higher housing conditions than before flood to be resistant to the disaster like flood. Therefore, it was observed that it did not significantly differ in living condition of moderately affected farm households before and after flood.

As the flood in group III destroyed to the wood floor, farm households changed from Corrugated iron sheet+ Bamboo wall + Wood floor to Corrugated iron sheet+ Bamboo wall. Thus Corrugated iron sheet+ Bamboo wall + Wood floor decreased from about 16% to 12% while Corrugated iron sheet+ Bamboo wall increased from 44% to 48% in group III before and after flood. Therefore, the housing conditions of group III did not very differ before and after flood.

In all sample farm households, about 42% possessed the housing conditions of Corrugated iron sheet+ Wood wall+ Wood floor and only about 3% of farm households had the same housing conditions of Corrugated iron sheet+ Brick wall+ Brick floor before and after flood. The other housing types were Corrugated iron sheet+ Wood wall approximately that owned by about 7% of all sample farm households before and after flood, Corrugated iron sheet+ Bamboo wall about 18% before flood and 19% after flood, Corrugated iron sheet+ Bamboo wall+ Wood wall with over 8 % before flood and 7% after flood, Thatch roof+ Bamboo wall+ Bamboo floor with 1.48% before and after flood, Thatch roof+ Bamboo wall with over 13%

before and after flood and Thatch roof Bamboo wall+ Bamboo wall+ Bamboo floor with about 7% before and after flood. Based on all sample farm households, there was not much difference in housing conditions in the study area before and after flood. Therefore, the flood had no impact on the housing condtions of sample farm household groups.

4.4 Comparison of Crop Production and Income Composition of Sample Farm Household Groups before and after Flood

4.4.1 Different cropping pattern by sample farm household groups before and after flood

In the study area, most of the farmers practiced mono-cropping system in both lowland and upland because this area only relied on rain for agriculture. The most common cropping patterns of the study area are shown in Table 4.10. In lowland, about 98% of group I and II farmers and 96% of group III farmers cultivated only monsoon paddy while 1.8% of sample farmers in specific group used the double crop of Monsoon paddy - Sesame, Monsoon paddy - Chilli and Monsoon paddy - Pulses before and after flood. In upland, group I farmers commonly cultivated sugarcane and groundnut as the mono crop while group II farmers mostly planted sugarcane and sesame as the mono crop before and after flood. Moreover, group III farmers mainly cultivated maize followed by groundnut as the double crop and pigeon pea + maize + groundnut as the mix crop before and after flood. Thus, about 71% of group I farmers cultivated sugarcane before and after flood, but it was grown by only 16% of group II farmers before flood and 15% after flood. Double cropping system of Maize - Groundnut was practiced by 3.6% and 20% of group I and II farmers and Maize - Sesame by 3.6% of group II farmers before and after flood. About 1.8% of group I farmers practiced mix cropping system of Maize + Groundnut before and after flood. In group III, Pigeon pea + Maize + Groundnut cropping system was used by about 40% of farmers before flood and 36% after flood while the mix crop of Pigeon pea + Maize was cultivated by 12% of farmers before and after flood.

About 99% in total farm households mainly cultivated monsoon paddy as mono crop in lowland before and after flood. Only each 0.74% of all sample farmers used the double cropping patterns of Monsoon paddy-Sesame, Monsoon paddy-Chilli and Monsoon paddy-Pulses before and after flood. It can be seen that the cropping pattern of sample farm household groups did not significantly differ before and after flood.

Table 4.9 Housing conditions of sample farm household groups before and after flood

Item	Group I		Group II		Group III		Total	
	Before	After	Before	After	Before	After	Before	After
CIS+BW +BF	4 (7.27)	4 (7.27)	-	-	-	-	4 (2.96)	4 (2.96)
CIS+WW +WF	26 (47.27)	26 (47.2)	26 (47.27)	26 (47.2)	5 (20.00)	5 (20.0)	57 (42.22)	57 (42.22)
CIS+WW	1 (1.82)	1 (1.82)	7 (12.73)	7 (12.7)	1 (4.00)	1 (4.00)	9 (6.67)	9 (6.67)
CIS+BW	11 (20.00)	11 (20.0)	2 (3.64)	2 (3.64)	11 (44.00)	12 (48.0)	24 (17.78)	25 (18.52)
CIS+BW +WF	1 (1.82)	1 (1.82)	6 (10.91)	6 (10.9)	4 (16.00)	3 (12.0)	11 (8.15)	10 (7.41)
TR+BW+ BF	2 (3.64)	2 (3.64)	-	-	-	-	2 (1.48)	2 (1.48)
TR+BW	2 (3.64)	3 (5.55)	13 (23.64)	12 (21.8)	3 (12.00)	3 (12.0)	18 (13.33)	18 (13.33)
TR+BW+ WF	8 (14.55)	7 (12.7)	1 (1.82)	2 (3.64)	1 (4.00)	1 (4.00)	10 (7.41)	10 (7.41)
Total	55 (100)	55 (100)	55 (100)	55 (100)	25 (100)	25 (100)	135 (100)	135 (100)

Note: Figures in parentheses represent percentage. CIS+BW+BF = Corrugated iron sheet+ Brick wall + Brick floor, CIS+WW+WF = Corrugated iron sheet+ Wood wall+ Wood floor, CIS+WW = Corrugated iron sheet+ Wood wall, CIS+BW = Corrugated iron sheet+ Bamboo wall, CIS+BW+WF = Corrugated iron sheet+ Bamboo wall + Wood floor, TR+BW+BF = Thatch roof+ Bamboo wall+ Bamboo floor, TR+BW = Thatch roof+ Bamboo wall, TR+BW+WF = Thatch roof+ Bamboo wall+ Wood floor

Table 4.10 Different cropping pattern by sample farm household groups before and after flood

Cropping pattern	% of farm households							
	Group I		Group II		Group III		Total	
	Before	After	Before	After	Before	After	Before	after
Lowland								
Monsoon paddy	98.18	98.18	98.18	98.18	96.00	96.00	98.52	98.52
Monsoon paddy - Sesame	-	-	1.82	1.82	-	-	0.74	0.74
Monsoon paddy- Chili	1.82	1.82	-	-	-	-	0.74	0.74
Monsoon paddy - Pulses	-	-	1.82	1.82	-	-	0.74	0.74
Upland								
Sugarcane	70.91	70.91	16.4	14.55	-	-	35.56	34.81
Groundnut	25.45	23.64	1.8	1.82	12.00	12.00	13.33	12.59
Sesame	9.09	9.09	12.7	14.55	4.00	4.0 0	9.63	10.37
Black gram	12.73	14.55	-	-	-	-	7.41	8.15
Pigeon Pea	-	-	-	-	4.00	8.00	2.22	4.44
Niger	-	-	9.09	9.09	-	-	3.70	3.70
Garden pea	-	-	1.82	1.82	-	-	0.74	0.74
Maize - Groundnut	3.64	3.64	-	-	20.00	20.00	5.18	5.18
Maize + Groundnut	1.82	1.82	-	-	-	-	0.74	0.74
Maize - Sesame	-	-	3.64	3.64	-	-	1.48	1.48
Pigeon pea - Maize	-	-	-	-	8.00	8.00	1.48	1.48
Pigeon pea + Maize + Groundnut	-	-	-	-	40.00	36.00	7.41	6.67
Pigeon pea + Maize	-	-	-	-	12.00	12.00	2.22	2.22

Note: Crop - Crop means double cropping system.

Crop + Crop means mix cropping system.

4.4.2 Crop yield of sample farm household groups

Most of the farmers in the study area mainly cultivated monsoon paddy in lowland as shown in Table 4.11. In upland, the main cultivated crops were sugarcane and groundnut in group I, sugarcane and sesame in group II and maize and groundnut in group III farmers before and after flood.

According to the different categories of flood affected level, the average yield of monsoon paddy was highly decreased from over 2,600 kg/ha to about 1,139 kg/ha occupying 56% of yield reduction due to flood in group I farm households. Therefore, paired sample t-test showed that there were significant different at 1% level for the average yield of monsoon paddy before and after flood. Additionally, the average yield of brown slab-sugar was extraordinarily declined from 2,362 kg/ha to 598 kg/ha because the sugarcane fields were deteriorated due to overflow for a long time. As a result, the sample farmers faced with about 75% yield reduction of brown slab-sugar as compared to the normal year. Paired sample t-test showed that there was a significant difference at 1% level for average yield of brown slab-sugar. After flood, the yield reduction of groundnut accounted only 30% for seriously affected farmers. Paired sample t-tes showed that there was no significantly different at in average yield of groundnut before and after flood.

As for group II, monsoon paddy cultivated farmers faced with 62% yield reduction by decreasing the yield from about 3,114 kg/ha to 1,197 kg/ha after flood. Although the monsoon paddy cultivated farmers in group II was moderately affected by flood, the yield reduction was more than sample farmers in group I because they did not make strong decisions on their farm with the older group of household's head. Paired sample t-test showed that highly significant differences at 1% level were found in average yield of monsoon paddy before and after flood. In regard to upland crop, average yield of brown slab-sugar was decreased from 2,209 kg/ha before flood to 642 kg/ha after flood. In moderately affected group, the yield reduction of brown slab-sugar was 71% due to flood. Therefore, paired sample t-test showed that there was significantly different at 5% level for average yield of brown slab-sugar before and after flood. However, the paired sample t-test showed that the average yield for sesame did not significantly differ before and after flood. Therefore, the yield of sesame only reduced to 11% of before flood.

Group III monsoon paddy cultivated farmers also experienced with 28% yield reduction with the average yield of 2,703 kg/ha before flood and 1,295 kg/ha after flood. Therefore, the paired sample t-test revealed that there were significantly different in the average yield of group III farmers before and after flood at 1% level. In upland, group III farmers typically cultivated maize and groundnut. The yield of maize was significantly reduced from 2,319 kg/ha to 1,355.89 kg/ha occupying 42% yield reduction due to flood. For groundnut, paired sample t-test showed that there was no significantly different in the average yield of group III farmers before and after flood because they experienced only 20% yield reduction.

In study area, all sample farmers experienced with 52% yield reduction of monsoon paddy because they received the yield of over 2,700 kg/ha before flood and 1,200 kg/ha after flood among the three groups. The paired sample t-test showed that there were significantly different for average yield of monsoon paddy at 1% level before and after flood. As for upland crop, the average yield of brown slab-sugar was extremely decreased from approximately 2,166 kg/ha to 625 kg/ha before and after flood. As a result, they encountered 71% yield reduction due to flood. Therefore, paired sample t-test showed that highly significant differences were found in the average yield of brown slab-sugar before and after flood. According to the results, the average yield of groundnut and maize extremely decreased from 977 kg/ha and 2,599 kg/ha before flood to 684 kg/ha and 939 kg/ha after flood. Therefore, they faced with yield reduction by 30% and 64% for groundnut and maize due to flood. Paired sample t-test showed that there were significantly different at 1% level for the average yield of groundnut before and after flood among the three groups. However, the average yield of sesame with 30% reduction did not significantly different before and after flood.

Table 4.11 Crop yield of sample farm household groups before and after flood

Item		Before (kg/ha)	After (kg/ha)	Yield reduction (%)	t-test
Group I	Monsoon paddy	2,605.00	1,138.59	56.29	11.176***
	Brown slab-sugar	2,362.00	598.00	74.68	6.804***
	Groundnut	1109.76	775.89	30.08	0.304ns
Group II	Monsoon paddy	3,114.00	1,197.00	61.56	10.454***
	Brown slab-sugar	2,209.00	642.00	70.94	2.627**
	Sesame	214.79	191.46	10.86	1.400ns
Group III	Monsoon paddy	2,346.99	1,681.06	28.37	3.495***
	Maize	2319.50	1355.89	41.54	3.074***
	Groundnut	890.62	721.14	19.03	1.701ns
Total	Monsoon paddy	2,702.51	1294.62	52.10	12.072***
	Brown slab-sugar	2,165.98	624.98	71.15	6.396***
	Groundnut	977.02	684.26	29.96	2.975***
	Maize	2,599.95	938.69	63.90	3.187***
	Sesame	229.02	161.37	29.54	1.579ns

Note: ***, ** and * are significant at 1%, 5% level and 10% level respectively and ns is not significant.

4.4.3 Income compositions of sample farm household groups before and after flood

All sample farm households in the study area were mainly relied on agriculture for their main household income and followed by livestock production, handicraft making and working as casual labor etc.. After flood, farm income was significantly reduced due to yield reduction. In Appendix 7, the average annual farm income of all sample farm households was highly declined from 3,137,930 MMK/Yr to 1,421,796 MMK/Yr after flood whild nonfarm income was decreased from 503,452 MMK/Yr before flood to 408,072 MMK/Yr after flood. Simultaneously, the average annual household income of all sample farm households was also decreased from 3,641,382 MMK/Yr to 1,829,860 MMK/Yr after flood. Here, figures 4.3, 4.4, 4.5 and 4.6 present the contribution percentage of the household income from various sources of income before and after flood. In group I, the income of paddy and other crops drastically decreased from round about 57% and 34% before flood to 54% and 23% after flood. As crop income was lower than before flood, farm households engaged more in non-farm activities. Therefore, the income composition of livestock production, casual labor, government staff and company staff increased from 4%, 1%, 1%, and 2% before flood to 9%, 5%, 4% and 4% respectively after flood.

Also in group II, the portion of crop income including paddy and other crops in total income was decreased from 83% (71% and 12%) respectively, before flood to 68% (52% and 16%) after flood. On the other hand, the income composition of livestock, casual labor and government staff was significantly increased from 6%, 3% and 2% before flood to 9%, 12% and 5% respectively after flood. The income of carrier/driver slightly increased from 1% to 2% before and after flood. However, the composition of handicraft and company staff was the same (3% and 1%) before and after flood.

In group III, the contribution percentage of crop income was decreased from 58% and 30% to 50% and 26% for monsoon paddy and other crops before and after flood. Therefore, income composition of livestock production, casual labor, government staff and company staff was increased from 5%, 3%, 1% and 1% before flood to 8%, 8%, 3% and 2%, respectively after flood. The income handicraft was the same contribution with 2% before and after flood. After flood, 1% of carrier/driver occupied to the income composition to compensate low crop income.

In this area, the main income was crop income accounted from paddy and other crops. Therefore, crop income was the highest portion for all farm households shared about 80% of total household income. The income composition of those was occupied by about 58% of paddy and 30% of other crops before flood and 50% of paddy and 26% of other crops after flood. Before flood, about 5%, 3% and 2% of household income were the income from livestock production, casual labor and handicraft while each 1% from government and company staffs. After flood, each 8% of income accounted from livestock production and casual labor while each 2% of income composition was from handicraft and company staff. Moreover, 3% and 1% of household income were obtained from government staff and carrier/driver.

Discussions of farmers and key informants on socioeconomic and agricultural conditions after flood

Key Informants and participants of focus group discussions from seriously, moderately and less affected groups mentioned that all flood affected farm households mainly relied on crop production for their primary income and some affected households received secondary income from off-farm and non-farm activities such as handicraft, casual and company or government staffs. Among them, socioeconomic conditions of seriously and moderately affected groups of flood affected farm households decreased to the half due to the result of lower farm income as compare to before flood. Therefore, most of farm households were more relied on non-farm activities for their livelihoods. According to the focus group discussions of group I and II, participants mentioned that monsoon paddy was the most seriously damaged crop and followed by sugarcane. Key informant and participants from less affected group also expressed that crop yield reduced to two third of last year where maize and pigeon pea were the most affected crops and consequently crop income was significantly reduced.

(Age range 28-60 years old, two males, six females, FGD, Shaw Phu Kone Village _ group I)

(46 and 42 years old, two males, KI interviews, Zee Ka Nar and Pauk Sein Kone Villages _ group I)

(Age range 49-77 years old, eight males and one female, FGD, Koe Taung Boet Village _ group II)

(43 years old, male, KI interview, Kya Kya Aingh Village _ group II)

(Age range 35-60 years old , all males, FGD & 57 years old, female, KI interview Pay Kone

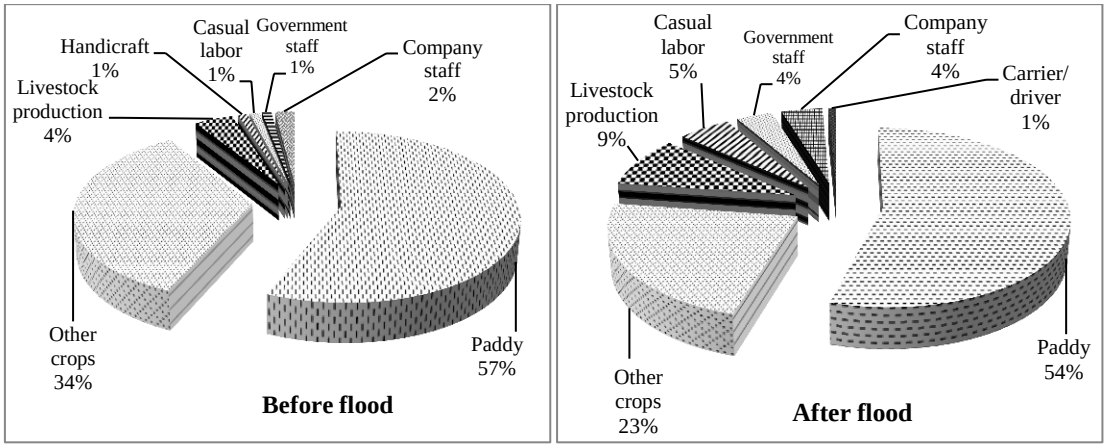


Figure 4.3 Income compositions of group I farm households before and after flood

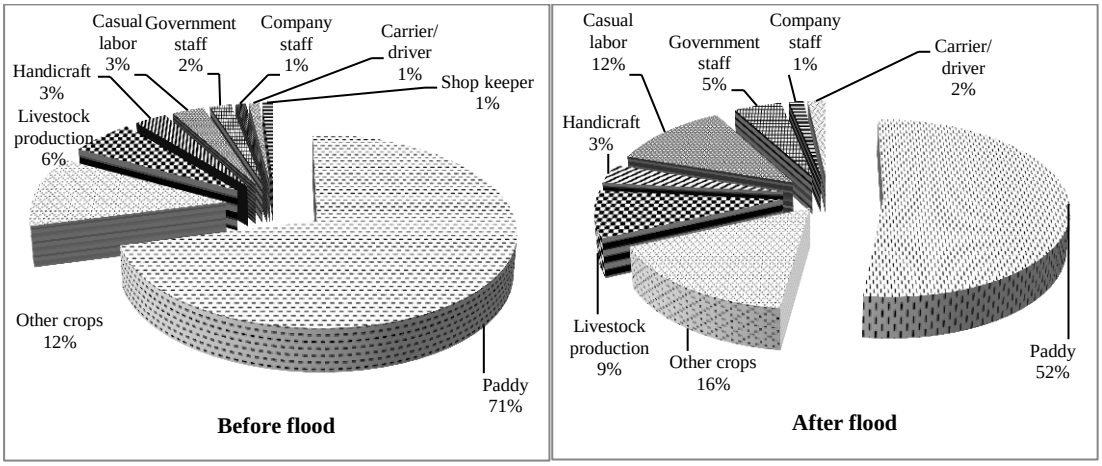


Figure 4.4 Income compositions of group II farm households before and after flood

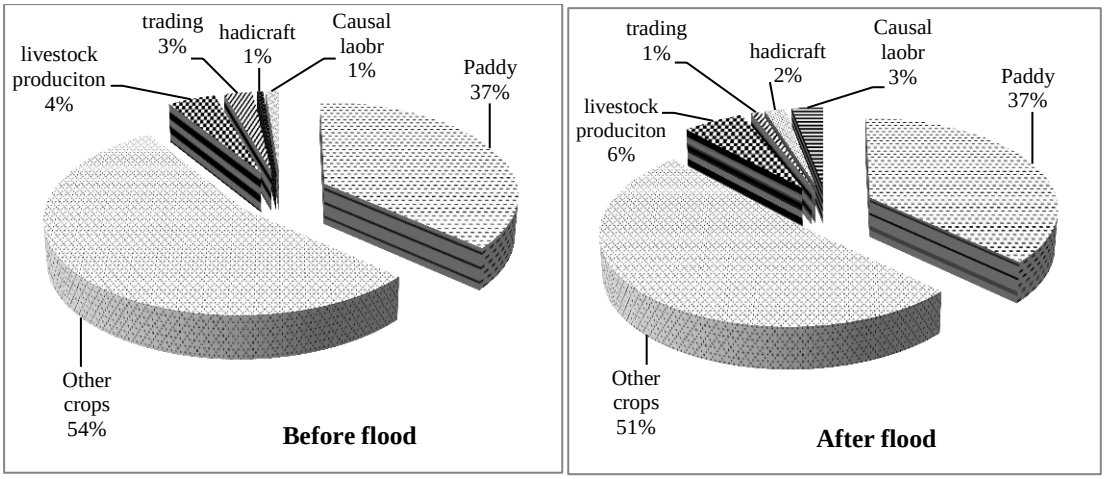


Figure 4.5 Income compositions of group III farm households before and after flood

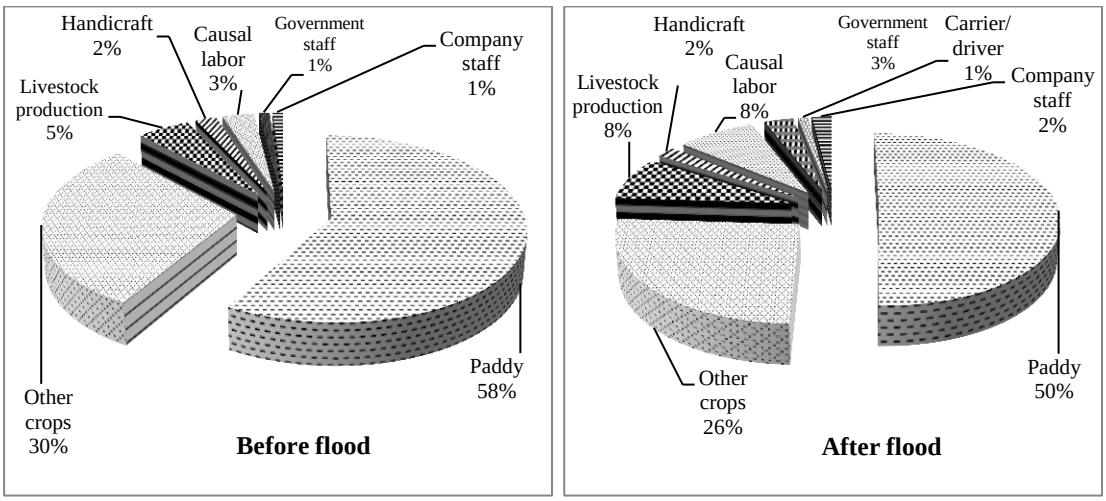


Figure 4.6 Income compositions of all sample farm households before and after flood

4.5 Comparison of Crop Losses and Difficulties after Flood

4.5.1 Crop loss of sample farm household groups after flood

The crop losses of the common crops grown by three different groups were presented in Table 4.12. The flood experienced by the sample farm household groups seriously destroyed the common cultivated crop fields in the study area. As a result, most of the cultivated crops such as monsoon paddy, groundnut, sugarcane and sesame etc. were damaged due to flood. Among three groups, group I farmers grew commonly monsoon paddy, groundnut, black gram and sugarcane before flood. After flood, about 20% of monsoon paddy cultivated farmers faced with 100% yield losses due to flood while about 42% of farmers also encountered 75% yield losses on it. Continuously, about 44% and 18% of farmers estimated that they experienced 100% and 75% yield losses of sugarcane in terms of brown slab-sugar. Moreover, approximately 9% and 4% of seriously affected farmers had 75% yield losses in groundnut and black gram after flood.

Group II farmers mainly planted monsoon paddy, sesame, sugarcane and niger. About 18% and 53% of sample farm households stated that they faced 100% and 75% yield losses in monsoon paddy while over 5% of farm households experienced 100% yield losses in sugarcane and sesame and so on.

As for group III, about 20% and 16% of farm households estimated 75% yield losses in monsoon paddy while only 12% of farm households encountered 100% yield losses in pigeon pea. At the same time, about 12% of farm households expressed that they had 50% yield losses in maize which is one of the main upland crops for group III farmers.

In total, about 42% of total farm households experienced with 75% yield losses in rice while about 18% of total had 100% yield losses in sugarcane in terms of brown slab-sugar. About 2% and 3% of all sample faced no yield in pigeon pea and maize production while about 4% encountered 75% yield losses for groundnut. Only 3%, 2% and 1% of all sample faced 100% yield losses of sesame, 75% of black gram and 25% of niger respectively. In the study area, the flood destructed mostly monsoon cultivated crops as it happened at monsoon season due to heavy rain.

Table 4.12 Crop loss of sample farm household groups after flood

Item	% of farm households				
	Estimated yield losses				
	0%	25%	50%	75%	100%
Group I					
Monsoon paddy	9.09	9.09	20.00	41.82	20.00
Sugarcane	36.36	-	1.82	18.18	43.64
Groundnut	85.45	1.82	1.82	9.09	1.82
Black gram	94.54	-	1.82	3.64	-
Group II					
Monsoon paddy	7.28	5.45	16.36	52.73	18.18
Sugarcane	83.64	3.64	-	7.27	5.45
Sesame	90.93	1.82	-	1.8	5.45
Niger	96.36	-	-	-	3.64
Group III					
Monsoon paddy	52.00	8.00	16.00	20.00	4.00
Maize	76.00	4.00	4.00	4.00	12.00
Pigeon pea	64.00	8.00	12.00	8.00	8.00
Groundnut	96.00	-	-	-	4.00
Total					
Monsoon paddy	16.19	7.41	17.88	42.22	16.30
Sugarcane	68.89	-	3.70	9.63	17.78
Groundnut	92.60	0.74	1.48	3.70	1.48
Pigeon pea	94.82	1.48	0.74	0.74	2.22
Maize	91.12	1.48	2.96	1.48	2.96
Sesame	94.82	0.74	-	1.5	2.96
Black gram	97.78	-	0.74	2.22	-
Niger	97.78	1.48	-	-	0.74

4.5.2 Difficulties in farming faced by sample farm household groups

After flood, difficulties in farming faced by sample farm household groups are shown in Table 4.13. The impact of flood highly reduced yields of the main cultivated crops in the study area. Therefore, about 91%, 89% and 72% of group I, II and III farm households reported that they faced low yield as the most serious difficulty due to flood. Insufficient of farm investment and infestation of disease or pests were second and third the most serious problems for all groups. Moreover, the difficulties such as labor scarcity, inadequate use of fertilizer and inadequate of quality seeds in farming were also encountered by about 64% to 46% of farm households in group I, 64% to 53% in group II and 40% to 10% in group III respectively.

Moreover, soil problems, low crop price, limited access of improved technology for crop production and difficulty in land preparation for affected field were experienced by around 42%, 38%, 30% and 29% of group I farmers, 40%, 33%, 31% and 36% of group II farmers and 24%, 48%, 16% and 40% of group III farmers. Around 20% of farmers in group I and III and 40% in group II expressed that they faced with difficulties in transportation while about 23% of farmers in group I and II and 4% in group III experienced the loss of farm implements after flood. Only about 12%, 18% and 4% of farmers in specific group encountered the difficulty for draft animals to use in crop cultivation after flood.

In summing the three groups, low yield in the agricultural production was also the main difficulties for about 87% of all sample farm households due to flood in the study area. As a result, about 76% and 73% of all sample farmers faced insufficient farm capital investment and pest or disease infestation due to flood. Simutenously, about 59% of sample farmers had to face labor scarcity for farm in the study area. Approximately 49% and 50% sample farmers had inadequate amount of fertilizer and inadequate of quality seeds as the main difficulties in their farming too. Pearson Chi-square test showed that there were significant differences at 1% level for loss of farm investment and failure to adequate amount of fertilizer, 5% level for infestation of disease or pests, scarcity of farm labor, lack of quality seeds and 10% level for low yield and lack of farm implements. It also showed that there were no significant differences in soil problems, low crop price, limited access of improved technology, difficulty in land preparation, transportation problems and loss of draft animals.

Discussions of farmers and key informants on the impact of flood

Participants from focus group discussion of seriously and moderately affected groups described that they encountered with many losses of household assets, damaging to the house and crop fields, pest and disease problems, lack of farm investment and farm implements. Participants and key informant of seriously affected group discussed that the flood mainly damaged monsoon paddy and sugarcane fields and seedling beds and some cultivated areas was covered by sand. Therefore, they faced many difficulties; low yield, pest or disease infestation and seed scarcity. Participants and key informant of moderately affected group reported that monsoon paddy and sugarcane fields were damaged and therefore, yield reduced up to 50% as compared to before flood. Some affected farmers left the yield of monsoon paddy for home consumption. According to the discussions of focus group discussion and key informant interviews, monsoon paddy, maize and pigeon pea were the most serious crops for less affected farmers.

(Age range 28-60 years old, two males, six females, FGD, Shaw Phu Kone Village _ group I)

(46 and 42 years old, two males, KI interviews, Zee Ka Nar and Pauk Sein Kone Villages _ group I)

(Age range 49-77 years old, eight males and one female, FGD, Koe Taung Boet Village _ group II)

Table 4.13 Difficulties in farming faced by sample farm household groups

No.	Item	% of farm households				
		Group I	Group II	Group III	Total	Pearson Chi-square
1	Low yield	90.91	89.09	72.00	86.67	0.055*
2	Insufficient farm investment	89.09	76.36	44.00	75.56	0.000***
3	Infestation of diseases or pests	78.18	78.18	52.00	73.33	0.028**
4	Scarcity of farm labor	63.64	63.64	40.00	59.26	0.095**
5	Use of inadequate fertilizer amount	58.18	52.73	20.00	48.89	0.005***
6	Inadeuate of quality seeds	45.45	63.64	10.00	50.37	0.020**
7	Soil problems	41.82	40.00	24.00	37.78	0.284ns
8	Low crop price	38.18	32.73	48.00	37.78	0.425 ns
9	Limited access of improved technology	30.09	30.91	16.00	28.15	0.326 ns
10	Difficulty in land preparation	29.09	36.36	40.00	34.07	0.569 ns
11	Transportation problems	25.45	40.00	20.00	30.37	0.116 ns
12	Loss of farm implements	23.64	23.64	4.00	20.00	0.086*
13	Loss of draft animals	12.73	18.18	4.00	13.33	0.221 ns

4.6 Comparison of Aids, Coping Strategies of Farm Household Groups after Flood in the Study Area

4.6.1 Aids received by sample farm household groups

In the study area, farm households affected by the flood reported that they received various aids from government and non-government donor organizations including UNICEF, Charity organizations and donors throughout the country. Government mainly provided farm inputs, foods and clothes while non-government organizations and private sectors mostly supported financial aids, general property, food and purified water for affected farm households. In different affected groups, less affected group lived near the Kambalu Township and accessed easily transportation. However, seriously and moderately affected groups lived very far from Kambalu and faced with difficulties in transportation.

Table 4.14 presents aids received by sample farm household groups after flood. Although about 67% and 55% of groups I and II farm households received 6000 MMK as the farm input for damaging one acre of paddy field, all households in group III did not accepted it. Around 62%, 42% and 96% of group I, II and III of sample households obtained clothes after flood. In group I, about 55% of sample farm households received food stuffs including rice, noodle, oil and canned fish. Receipt of food stuffs was limited, receiving about 44% of sample farm households in group II while all households in group III obtained the food aids for their basic needs after flood. Although approximately 51% and 44% of farm households in group I and II received financial aid, about 96% of group III farm households received it. Assistance for purified water was limited, being received by around 32% in group I, 20% in group II and 28% in group III of sample farm households. Among them, group II was the lowest receipt of 20%. About 16% of group I farm households obtained the general property such as corrugated sheet, wood, cooking pans and plates etc.. In group II, about 44% of farm households received it from the Government, however group III farm households did not received the general property. As a result, Pearson Chi-square test showed that there was a significant difference at 1% level for the aids of farm input, clothes, food stuffs, financial aid, purified water and general property among three groups.

Regarding all of farm households, about 49% received farm inputs from the Government while 60% and 58% obtained clothes and food stuffs form the

Government and other organizations. In addition, financial aids for about 56% of sample were donated by the Government, non-government organizations and private sectors and about 27% and 24% of farm households received purified water and general property from the Government and others.

Discussions of farmers and key informants on aids after flood

Key informant of group I reported that the affected farm households received food and purified water from Kawlin Township and some donors within the country. They also accessed to service for sanitation and health after flood from the government and obtained 45 corrugated sheets, 1.5 ton of wood, 450,000 MMK and foods for each affected household through the government organization. Participants of group II mentioned that they received food, clothes and financial aid with 100,000 MMK from UNICEF and one toilet building for each affected household from the government. Some affected households got farming equipment and other household assets from Daw Khin Kyi foundation. Participants of group III stated that they received as the financial aid where 900 MMK/person who aged over 18 years old and 450 MMK/person who aged less than 18 years old from the government and also obtained Food and clothes through the government organization. In group III, most of affected households received the aids because their village is located near the Kambalu Township with easily transportation.

(42 years old, male, KI interview, Pauk Sein Kone Village – group I)

(Age range 43-54 years old, all males, FGD, Kya Kyat Aingh Village _ group II)

(Age range 35-60 years old , all males, FGD, Pay Kone Village _ groupIII)

4.6.2 Coping strategies used by sample farm household groups after flood

In response to property damage including crop, livestock and agricultural inputs, farm households applied various number of coping strategies: (1) reducing household expenditure, (2) borrowing money and (3) selling household assets and livestock etc.. The results from Table 4.15 shows the most common coping strategies adopted by sample farm households in the study area. Majority of the sample farm households in each group used reducing household expenditures as their most common coping strategy and the second most for all groups was borrowing money from relatives/neighbors with various interest rates. Moreover, around 56% of the

sample farm households in group I, about 35% in group II and 20% in group III adopted selling livestock to cope their immediate basic needs due to flood while selling household assets were also applied by about 40% of group I, 35% of group II and 24% of group III farm households as their coping strategies after flood. Moreover, around 18% of farm households in all groups used their saved money to cope their immediate basic needs after flood. About 2% to 9% of farm households in group I and II adopted taking children out of school, migration and selling land as their coping strategies after flood. Pearson Chi-square test revealed that there were significant differences at 1% and 5% level for reducing household expenditure, borrowing money and selling livestock of sample farm households among three groups. However, there was no significant difference in selling households assets, using own saving, take children out of school, selling land or home and migration for sample households of three groups.

As identified in the above, engaging in borrowing money with various interest rates will lead to higher debt in farm household groups in the long term.

Discussions of farmers and key informants on coping strategies after flood

Participants from focus group discussion of seriously affected group reported that they coped the difficulties by selling households assets and livestock and borrowing money with various interest rate from the broker of brown slab-sugar to solve their basic needs after flood. Participants and key informant of moderately affected group mentioned that the affected farm households sold household assets and livestock and taking money with 7 to 8% interest rate from neighbor or money lender. In addition, participants from less affected group stated that farm income reduced more than before flood due to low crop yield and therefore they used reducing expenditure and borrowing money as the coping strategies.

(Age range 28-60 years old, two males, six females, FGD _ Shaw Phu Kone Village & 46 and 42 years old, two males, KI interviews, Zee Ka Nar and Pauk Sein Kone Villages _ group I)

(Age range 49-77 years old, eight males and one female, FGD, Koe Taung Boet Village & 43 years old, male, KI interview, Kya Kyat Aingh Village _ group II)

(Age range 35-60 years old, all males, FGD & 57 years old, female, KI interview Pay Kone Village _ group III)

Table 4.14 Aids received by sample farm household groups after flood

No.	Aid	% of farm households				Pearson Chi- square
		Group I	Group II	Group III	Total	
1	Farm inputs	67.45	54.55	-	48.89	0.000***
2	Clothes	61.82	41.82	96.00	60.00	0.000***
3	Food stuffs	54.55	43.64	100.00	58.52	0.000***
4	Financial aid	50.91	43.64	92.00	55.56	0.000***
5	Purified water	32.73	20.00	28.00	26.67	0.000***
6	General property	16.36	43.64	-	24.44	0.000***

Note: *** is significant at 1% level.

Table 4.15 Coping strategies used by sample farm household groups after flood

No.	Coping strategy	% of farm households				Pearson Chi-square
		Group I	Group II	Group III	Total	
1	Reducing expenditures	74.55	76.36	48.00	70.37	0.025***
2	Borrowing money	69.09	49.09	32.00	54.07	0.005***
3	Selling of livestock	58.18	34.54	20.00	41.48	0.002***
4	Selling household assets	40.00	34.54	24.00	34.81	0.379ns
5	Using own saving	21.82	16.36	16.00	18.52	0.715ns
6	Taking children out of school	9.09	7.27	-	6.67	0.311ns
7	Migration	3.63	7.27	-	4.44	0.319ns
8	Selling Land or home	1.82	1.82	-	1.48	0.794ns

Note: ***, ** and * are significant at 1%, 5% level and 10% level respectively and ns is not significant.

4.7 Factors Affecting Revenue of Monsoon Paddy before and after Flood

To determine the factors affecting on the revenue function of monsoon paddy after flood, Cobb-Douglas functional form was employed. The specific revenue function of monsoon paddy was estimated by using these variables: age and schooling years of household's head, family size, family labor, number of cattle owned by sample farm households, cultivated area of monsoon paddy and non-farm income.

The descriptive statistics of dependent and independent variables of revenue function of monsoon paddy were shown in Table 4.16. In the results of descriptive statistics, average revenue of monsoon paddy by all sample farm households was 531,572 MMK/ha while the highest revenue was 1,853,250 MMK/ha and the lowest was zero. Average age of household's head was about 49 years with a range of 20 to 83 years and their average schooling year was 6 years. Average family size of all farm households was about 6 persons with about 3 family labors on average. The average number of cattle owned by affected farm households was 4. The average cultivated area of monsoon paddy was 3.04 hectares. On the other hand, the average non-farm income of all sample farm households was 460,059 MMK/Yr with the mximum 6,840,000 MMK/Yr and minimum zero non-income. In this case, dummy variable was used as before and after flood in the study area where before flood takes 0 occupying 50% of the total and after flood represented 1 by 50%.

The factors affecting revenue of monsoon paddy in affected farm households are described in Table 4.17. Before and after flood, total revenue of monsoon paddy was positively and significantly influenced by family labor and non-farm income at 1% level respectively. It means that each 1% increases in family labor and non-farm income will increase by 1.424% and 0.127% of the total revenue of monsoon paddy increased. Additionally, the dummy variable was negatively correlated with revenue of monsoon paddy at 1% level showing that revenue of monsoon paddy in affected farm households reduced 2.770% after flood than before flood. Revenue of monsoon paddy was also positively but not significantly related to age and schooling year of household's head and number of cattle while it was negatively correlated to the cultivated area of monsoon paddy.

The F values showed that the selected model was significant at 1% level. The R^2 values 0.220 means that it can explain the variation in the revenue of monsoon paddy per hectare by 22% before and after flood.

According to the regression results, the revenue can be significantly increased if the family labor and non-farm income invested more on it before and after flood. The revenue of monsoon paddy per hectare significantly decreased after flood because high yield reduction due to flood in the study area.

4.8 Sources of Disaster Information in the Study Area

Provision of disaster information is needed to prevent various numbers of risks. Therefore, the sources of disaster information provided the sample farm households with the information including about the flood disaster in 2015 year were collected as described in Table 4.18. About 18% and 11% of sample farm households in group I and II received the information from both of Television and Radio while about 10%, 13% and 16% in specific group obtained it from only Television and about 11%, 6% and 4% in each group accessed information from only Radio. Only 6%, 15% and 44% of groups I and II received the information from Department of irrigation and water management in Kambalu Township. By distributing the information from farmers to farmers, about 6% in group I, 18% in group II and 12% from group III accessed the disaster information. However, 49%, 38% and 24% of groups I, II and III had no access the disaster information.

In all farm households, about 12%, 13%, 7%, 16% and 12% received the disaster information from both of Television and Radio, Television only, Radio only, Department of irrigation and water management in Kambalu Township and farmer to farmer respectively. Unfortunately, 40% of all sample households did not access information related to the flood.

Table 4.16 Descriptive statistics of dependent and independent variables in revenue function of monsoon paddy

Variable	Unit	Mean	Maximum	Minimum
Total revenue of monsoon paddy	MMK/ha	531,572	1,853,250	0
Age	Year	49.16	83	19
Schooling year	Year	5.53	15	0
Family labor	Number	2.63	8	1
Number of cattle	Number	3.51	25	0
Cultivated area of monsoon paddy	Hectare	2.99	20.23	0
Non-farm income	MMK/Yr	460,059	6,840,000	0
Before and after flood in the study area (dummy)	After flood = 1 (50%)		Before flood = 0 (50%)	

Table 4.17 Factors affecting revenue of monsoon paddy before and after flood

Independent variable	Unstandardized Coefficients (B)	Standardized Coefficients (β)	T-value	Sig.
Constant	10.506***		2.931	0.004
Age	0.042ns	0.003	0.049	0.961
Schooling year	0.305ns	0.031	0.547	0.585
Family labor	1.424***	0.188	3.276	0.001
Number of cattle	0.291ns	0.059	0.982	0.327
Cultivated area of monsoon paddy	-0.527ns	-0.091	-1.542	0.124
Non-farm income	0.127***	0.203	3.606	0.000
Before and after flood in the study area	-2.770***	-0.348	-6.357	0.000

Note: Dependent variable: revenue of monsoon paddy per hectare before and after flood

R^2=0.220, Adjusted R^2= 0.199, F=10.537***

***, **, * are significant level at 1%, 5% and 10% and ns is not significant.

Table 4.18 Sources of disaster information of the sample farm households

No.	Source	% of farm households			
		Group I	Group II	Group III	Total
1	Television + Radio	18.18	10.91	-	11.85
2	Television	10.91	12.73	16.00	12.59
3	Radio	10.91	5.55	4.00	7.41
4	Department of irrigation and water management in Kambalu Township	5.55	14.55	44.00	16.30
5	Farmer to farmer	5.55	18.2	12.00	11.85
6	None	49.09	38.18	24.00	40.00

CHAPTER V
SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary and Conclusion of the Study

In Myanmar, floods are the most frequent and devastating natural disasters that affect the livelihood of the people. Previously, flood was brought by Cyclone Komen mainly affected the rural areas of Myanmar where people rely heavily on agriculture to support their livelihoods. Consequently, it is needed to know the impact of this Cyclone to improve the ability of affected people to live under the impacts of vunerability to natural disasters. Therefore, this study was an attempt to know a short term impact of flood by comparing socioeconomic and agricultural production of flood affected sample farmers before and after flood and coping strategies adopted by flood affected sample farm households in the study area of Kambalu Township, Sagaing Region. It was also aimed to analyze factors affecting on the revenue of monsoon paddy per hectare before and after flood. Primary data were obtained from 135 flood affected farm households selected from six sample villages by using purposive random sampling method. Focus group discussions and key informant interviews were also carried out to support the information from household survey. The selected sample farm households were categorized into three groups: seriously affected (group I), moderately affected (group II) and less affected (group III) groups according to the damaged cultivated crop area due to flood.

The study was observed that average age and farming experience of the total sample household's head were around 50 and 26 years indicating that their age and years of farming expeicence is enough to make better decision on farming. However, they attained lower level of education background with average 6 schooling years indicating less knowledge to prevent and aware disaster impact. The average family size was about 6 members including 3 family labors and 1 student with 58% of family members were dependent showing a little high dependent family member. Majority of the household's head and family labors engaged actively in farming for their primary income to complete their livelihoods. It can be found that most of the household assets did not very differ in comparing before and after flood. However, there were significant differences in the household assets of mobile phone among the three groups before and after flood because they used more mobile phone to access disaster information quickly and easily from internet or SMS. The highest significantly losses

of farm assets such harrows, ploughs and boats was found in seriously affected group and only harrows and ploughs were lost in moderately affected groups because some of their farm implements were floated along the stream when it was flooding in the study area. For less affected group, no significantly losses can be found due to slighter flooding area. The number of chicken and cattle were drastically reduced after flood especially in seriously affected group while loss of chicken in moderately affected group was the most serious. In the sum of three groups, significant losses of cattle and chicken observed based on the survey results. The reason was that the chicken was wasted with flood and the cattle were sold to cope their immediate basic needs after flood. The losses of farm equipment and small livestock were the severe losses in sample farm household groups because they was floated during flood in the study area. After flood, a few farm households in each group changed their housing conditions because it was collapsed and damaged due to flood. It also concluded that it did not highly impact on the houses in the study area.

The average farm size was slightly decreased after flood in seriously and moderately affected groups because their land was sold to solve their urgent needs. It can be summarized that the flood did not significantly affected on the land ownership of sample farmers. In the study area, the cropping pattern of sample farm household groups did not significantly differ before and after flood. However, the average yield of main cultivated crops of monsoon paddy, brown slab-sugar, groundnut and maize significantly reduced after flood accounting 52%, 71%, 30% and 63% yield reduction among the three groups. Reducing yield for crop production resulted lower farm income and consequently insufficient in farm investment immediately after flood. Thus, sample farm households engaged more in non-farm activities after flood because farm income was lower than before flood. It was summarized that the flood had a severe impact on the livelihoods of the families that rely on crop production. Each 55% of seriously and moderately affected groups received the aids from government and non-government organizations as their villages were located very far from Kambalu Township with difficult transportation while almost all of the sample farm households in less affected group received it due to easily transportation access. In the study area, reducing household expenditure, borrowing money, selling household assets and livestock were commonly used as coping strategies. Farmers used coping strategy like borrowing money with high interest rate could lead to higher

debt for them in the future. The other utilized coping strategies included: using own saving, taking children out of school, migration and selling land or home.

According to FGD and KI interview, all affected farm households faced with livelihood difficulties due to the lower farm income on the high yield reduction of main cultivated crops as compare to before flood. As a consequence, they was coped by selling households assets and livestock and borrowing money with 5% to 8% interest rate to overcome their difficulties due to flood. Due to easily transportation access, each less affected farm household obtained the aids. However, only each 50% affected farm households in seriously and moderately groups received the aids because of transportation difficulties. By these discussions, FGD and KI interview supported to enrich the results and discussion of data from household survey.

In the study area, the monsoon paddy occupied not only the highest portion of income composition including crop and non-farm incomes but also one of the most serious crop loss due to flood. As a consequence, it was interested to know the impact of flood by comparing the factors influencing the revenue of monsoon paddy before and after flood. According to the regression results, family labor and non-farm income showed as significant factors to get high revenue for monsoon paddy production by engaging and investing more on it before and after flood. After flood, the revenue of monsoon paddy exactly reduced because of high yield reduction due to flood.

5.2 Recommendation of the Study

In the study area, the adverse impact of flood was mainly on crop production by reducing high yield, farm implements, livestock and a little change in housing conditions and land ownership. Among these losses, yield reduction of the common crops grown in this area can be seen as the worst short term impact. In the study area, almost all of the sample farmers in less affected groups received the aids from government and non-government organization due to its convenient transportation situation. On the otherhand, only half of the sample farmers in seriously and moderately affected groups received the aids due to difficult transportation access. It indicated that transportation infrastructure is the important role in facing the disasters. Therefore, the government would provide improved transportation infrastructure especially as one of the development program for rural areas. To cope the impact of flood, sample farmers commonly used coping strategies based on their resources and knowledge. As a result, more disaster impact and adaption's education programs for

farm households are necessary to enhance the ability to implement strategies for flood and to apply the resources effectively. It also needed to provide the training program to prevent the risk and aware the disaster impact.

The development of sustainable farming system through climate resilient varieties, improved technology and soil conservation practices etc. should be introduced in order to sustain crop production. Family labor shoud be encouraged to be actively participate on farming activies because human capital is one of the important fator to produce high revenue from monsoon paddy production before and after flood. On the other hand, there is needed to create non-farm income activities to be able to get high revenue of crop production including monsoon paddy by investing more farm inputs. After flood, the government should provide credit to overcome the impact of flood on significant decrease in revenue of monsoon paddy production.

Based on the research findings, a major source of disaster information was radio and television, therefore, dissemination of disaster information by radio should be promoted with more attractive and effective programs. Moreover, it should be quickly disseminated by mobile phone application because the farmers used more mobile phone after flood. Provision of the local weather forecast would help to reduce the adverse impacts of disaster on agriculture. Therefore, the disaster information should be disseminated by timely and regularly to be able to prevent future risks.

REFERENCES

ADPC (Asian Disaster Preparendness Center). 2009. Institutional Arrangements for Disaster Management in Myanmar.

Basicplanet. 2013. Natural Disasters. http:// www.basicplanet.com/natural-disasters. (n.d.).

Berz, G., and M. Re 2004. Living with Risk:A global review of disaster reduction initiatives. New York and Geneva: International Strategy for Disaster Reduction.

Briones, M., and D. Israel. 2014. Disasters, Poverty, and Coping Strategies: Disasters, Poverty, and Coping Strategies: from Micro/Household Data - Philippine Case. Philippine Institute for Development Studies.

Christopher, B. F., and V. Barros. 2012. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. Special Report of the Intergovernmental Panel on Climate Change.

CRED (Center for the Research on the Epidemiology of Disasters). 2015. The Human Cost of Weather Related Disasters: A Global Perspecitve.

Datar, A., and J.,Liu. 2011. The Impact of Natural on Child Health and Investment on Rural India. Labor and Population.

DMH (Department of Meteorology and Hydrology). 2009. Hazard Profile of Myanmar. Department of International Development (DFID), United Kingdom.

DMH. 2016. Official Report, Department of Meteorology and Hydrology. Kambalu Township, Sagaion Region, Myanmar.

DoA. 2016. Official Report, Department of Agriculture. Kambalu Township, Sagaing Region, Myanmar.

Eschooltoday. 2017. Natural Disasters: http:// www.disastermgmt.org /type /flood. html.

FAO (Food and Agriculture Organization). 2015. Agriculture and Livelihood Flood Impact Assessment in Myanmar. 1-59.

FAO (Food and Agriculture Organization) and WFP (World Food Programme). 2015. Agriculture and Livelihood Flood Impact Assessemetn in Myanmar. Jointly led by the Ministry of Agriculture and Irrigation; Ministry of Livestock, Fisheries & Rural Development; FAO and WFP under the framework of the Food Security Sector in partnership with UN Women, World Vision, CESVI, CARE, JICA and LIFT.

Francisco, J. S. 2015. Property Damage Recovery and Coping Behavior of Households Affected Metro Manila, Philippines. Philippine Institute for Development Studies.

Field, B., C. Barros and Stocker. 2012. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. Special Report of the Intergovernmental Panel on Climate Change.

GFDRR (The Global Facility for Disaster Reduction and Recovery). 2013. Another Naris Strikes Every Day: Post Nargis Social Impacts Monitering Five Years. Development / International Development Association or the World Bank.

Habitat, U. 2009. Manual on Flood: Causes, Effects & Preparedness. United Naitons Human Settlements Programme.

Harvey, C. A., and Z. L. Rakotobe, 2014. Extreme vulnerability of smallholder farmers to agricultural risks and climate change in Madagascar. Rural Society.

IASC (Inter Agency Standing Committee). 2015. Myanmar Flood., 1-8.

IFRC (Internaitonal Federation of Red Cross). 2012. Post-disaster Community Infrastructure Rehabilitation and reconstruction Guidelines. Internaitonal Federation of Red Cross and Red Crescent Societies.

ISDR (Internatonal Strategy for Disaster Reduciton). 2004. Living With Risk: A global review of disaster reduction intiatives. New York and Geneva, United Nations:

Israel, C., D. Briones, and M. Roehlano. 2012. Impacts of Natural Disasters on Agriculture,Food Security, and Natural Resources and Environment in the Philippines. Philippine Institute for Development Studies, Discussion Paper Series.

Kamal, M., 2013. Livelihood Coping and Recovery from Disaster: The Case of Coastal Bangladesh. Current Research Journal of Social Sciences 5(1): 35-44, 2013.

Khin Oo, & Theingi Myint. 2010. Impacts of Cyclone Nargis on Livelihood, Food Security and the Agricultural Sector in Myanmar. Science and education for agriculture and development. Southeast Asian Reginal Center for Graduate (SEARCA).

Kousky, C. 2012. Informing Climate Adaptation: A Review of the Economic Costs Informing Climate Adaptation: Informing C. Washigton.DC: Resources for the future.

Kreft, S., and D. Eckstein. 2015. Global Climate Risk Index 2015. (B. K. Devarti, Ed.) Germanwatch, 1-32.

Lekprichakul, T. 2007. Ex Ante and Ex Post Risk Coping Strategies: How Do Subsistence Farmers in Southern and Eastern Province of Zambia Cope? Zambia: Research Institute for Humanity and Nature, Kyoto, Japan.

Leoni, B. 2010. Disaster Through A Different Lens: Behind every effect, there is a cause. International Strategy for Disaster Reduction.

MCCA (Myanmar Climate Change Alliance). 2016. Retrieved September 1, 2016, from myanmarccalliance.org.

MOALI (Ministry of Agriculture, Livestock and Irrigation). 2016. Myanmar Agriculture Sector in Brief. Nay Pyi Taw, Myanmar

Mohamed, N. 2009. Investing in the environment for livelihoods and disaster risk reduction. United Nations Enviroment Programme.

Mya Yadanar Tun. 2015. Impact of Flood on Livelihood And Agriucltural Production in Seikphyu Township, Magway Region. Nay Pyi Taw: Department of Agronomy, Yezin Agricultural University.

Nang Ei Mon The. 2012. Impact of Climate Change on Rural Livelihoods in Pakokku Township, Magway Region, Myanmar. Nay Pyi Taw: Department of Agricultural Economics, Yezin Agricultural University.

Nang Hsen Hom, Nyo Mar Htwe, Shwe Mar Than, and Yazar Hein. 2015. Myanmar Climate-Smart Agriculture Strategy. Nay Pyi Taw.

Noy, I., and W. duPont IV. 2016. The long-term consequences of natural disasters-A summary of the literature. School of Economics and Finance | Victoria Business School | www.victoria.ac.nz/sef.

OCHA (Office for the Coordination of Humanitarian Affairs). 2013. Myanmar:Humanitarian Bulletin, Issue 06. Retrieved Sep 1, 2016, from reliefweb.int/report/myanmar.

Patnaik, U., and K., Narayanan. 2010. Vulnerability and Coping to Disasters: A Study of Household Behaviour in Flood Prone Region of India. Munich Personal RePEc Archive,1-20.

Pollner, J., J. Kryspin-Watson, and S. Nieuwejaar, 2010. Disaster Risk Management and Climate Change Adaptatiion in Europe and Central Asia. The world Bank.

Ponja. 2009. Post Nargis Recovery. Food and Agriculture Orginzation of teh United Nations.

SelnnSelnn, and Ahmad. 2015. Farmers' Adaptation to Rainfall Variability and Salinity through Agronomic Practices in Lower Ayeyarwady Delta, Myanmar. Earth Science & Climatic Change.

Shahzad, U. 2014. Impact Assessment of Natural Disasters upon Economic Growth in Pakistan. Lahore School of Economics.

Tongruksawattana, S., and H., Waibel, 2010. Shocks and Coping Actions of Rural Households: Empirical Evidence from Northeast Thailand. Institute of Development and Agricultural Economics, Leibniz University of Hannover, Germany.

UNDP (United Nations Development Programme). 2012. Livelihood Recovery: Needs Assessment and Action Plan by the 2011 Combadia Flood.

UNEP (United Nations Environment Programme). 2009. Learning from Cyclone Nargis: Investing in the environment for llivelihoods and disasters risk reduction.

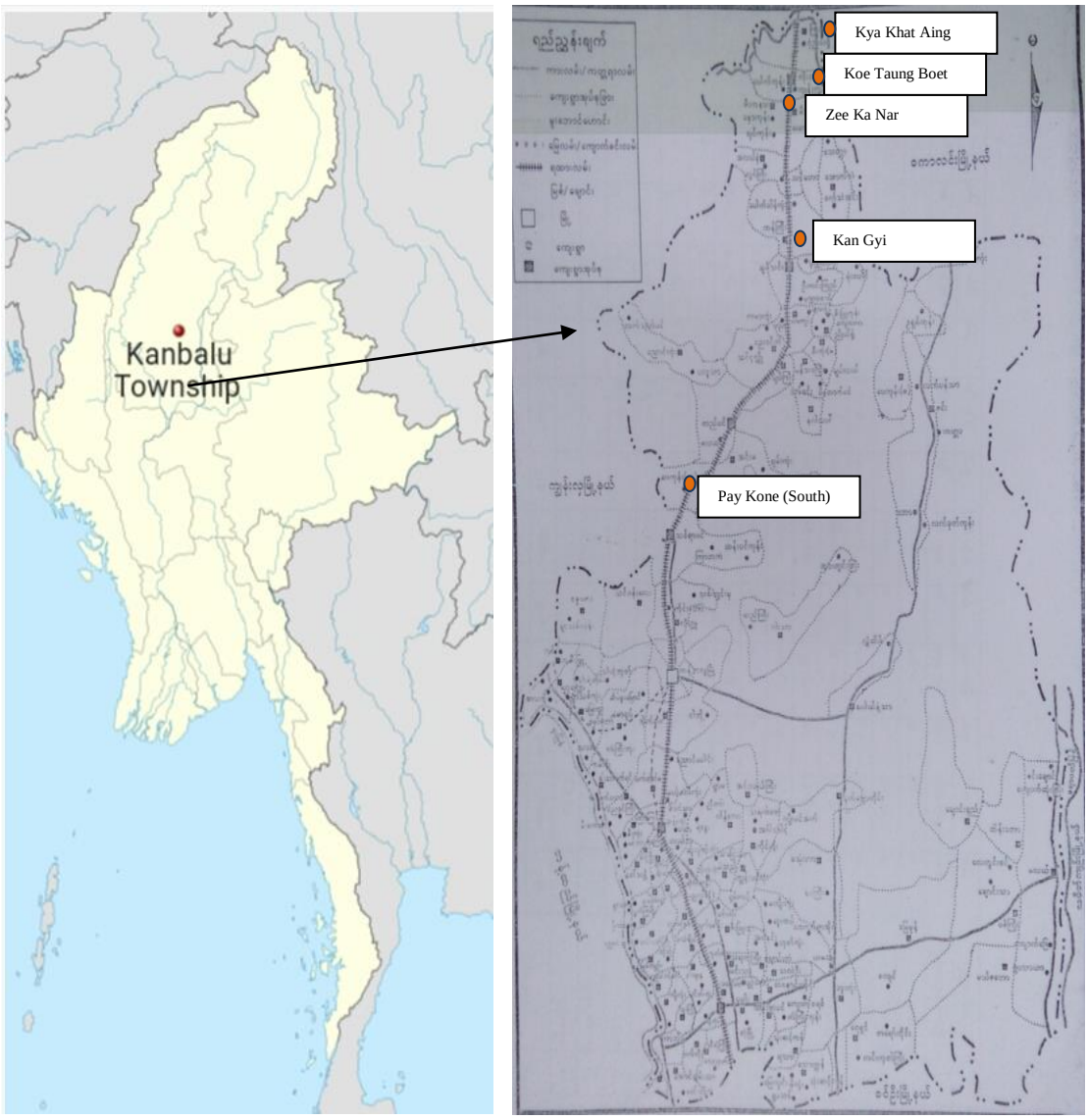
UNICEF (The United Nations Children's Fund). 2015. Enhancing National and Sub-National Capacity to Prevent, Prepare for and Mitigate Negative Impacts of Disasters, Climate Change and Conflict on Children in Myanmar. Disaster Risk Reduction.

UNICEF (The United Nations Children's Fund). 2015. Myanmar CO Humanitarian Situation Report 2. The United Nations Children's Fund, 1-4.

UNISDR (United Nations International Strategy for Disaster Reduction). 2009. UNISDR Terminology on Disaster Risk Reduction. Geneva.

Vathana, S., S. Oum, P. Kan and C. Chervier. 2013. Impact of Disasters and Role of Social Protection in Natural Disaster Risk Management in Cambodia.

APPENDICES



Appendix 1 Survey areas in Kambalu Township with selected sample villages in 2016

Appendix 2 Characteristics of participants of focus group discussion (group I, Shaw Phyu Kone Village)

No.	Name	Gender	Age	Schooling year	Family size
1	Daw Tin Moe Khaing	Female	28	5	4
2	U Kyaw Sein	Male	45	5	10
3	U Kan Kaung	Male	60	5	4
4	Daw Khin Thein	Female	48	5	9
5	Daw Winn Mar	Female	43	5	6
6	Daw Tin	Female	54	5	4
7	Daw Khin Mar	Female	53	5	4
8	Daw Winn Cho	Female	39	5	5

Appendix 3 Characteristics of participants of focus group discussion (group II, Koe Taung Boet Village)

No.	Name	Gender	Age	Schooling year	Family size
1	U Ohm Maung	Male	64	5	9
2	U Kyaw Myint	Male	49	6	4
3	U Htun Sein	Male	77	5	4
4	U Soe Myint	Male	60	5	4
5	U Thar Htoo	Male	50	5	26
6	U Kyaw Winn	Male	63	9	6
7	U Winn Maung	Male	58	5	5
8	Daw Khin Myint	Female	61	3	5
9	U Kyi Maung	Male	62	5	16

Appendix 4 Characteristics of participants of focus group discussion (group II, Kya Kyat Aingh Village)

No.	Name	Gender	Age	Schooling year	Family size
1	U Aung Soe	Male	49	7	5
2	U Htun Maung	Male	47	5	7
3	U Htun Aung	Male	54	5	2
4	U Aye Htun	Male	53	10	4
5	U Soe Naing	Male	43	7	5
6	U Soe Maung	Male	45	4	5
7	U Than Myint	Male	52	4	4
8	U Than Hla	Male	52	5	4
9	U Than Winn	Male	46	5	8
10	U Soe Naing	Male	53	6	6

Appendix 5 Characteristics of participants of focus group discussion (group III, Pay Kone Village)

No.	Name	Gender	Age	Schooling year	Family size
1	U Aung Naing Winn	Male	45	6	4
2	U Than Hlaing	Male	57	5	5
3	U Thein Tan	Male	37	5	4
4	U Aung Winn	Male	47	5	3
5	U Chit Thein	Male	60	4	4
6	U Kyauk Khae	Male	55	5	6
7	U Khin Maung Su	Male	45	5	5
8	U Than Nyunt	Male	52	5	6
9	U Maung Kyaw	Male	35	5	3

Appendix 6 Characteristics of key informants of three groups

Name of group	Name of Village	Name of key informant	Gender	Age	Schooling year	Position
Seriously affected group	Zee Ka Nar	U Cho Win	Male	46	6	Village administrative officer
	Pauk Sein Kone	U Sein Win	Male	42	6	Ten-headed household leader
Moderately affected group	Koe Taung Boet	U Khin Maung Htoo	Male	49	6	Key farmer
	Kya Kyat Aingh	U Soe Naing	Male	43	7	Village administrative officer
Less affected group	Pay Kone (South)	Daw Aye Aye Myint	Female	57	9	Clerk from general administrative office

Appendix 7 Average annual income of sample farm household groups before and after flood

Annual income/Year	Before (MMK)	% of total HH income	After (MMK)	% of total HH income	t-test
Group I (n=55)					
Farm income	4,092,670	90.88	1,712,544	77.19	9.246***
Non-farm income	526,546	9.12	541,582	22.81	-0.102ns
Total HH income	4,619,215	100.00	2,254,126	100.00	7.846***
Group II (n=55)					
Farm income	2,376,130	83.08	981,811	68.19	8.575***
Non-farm income	569,836	16.92	383,182	31.81	1.841*
Total HH income	2,945,967	100.00	1,364,993	100.00	7.427***
Group III (n=25)					
Farm income	2,713,464	91.68	1,750,120	87.49	3.789***
Non-farm income	190,600	8.32	169,112	12.51	0.968ns
Total HH income	2,904064	100.00	1,919,232	100.00	3.973***
Total (n=135)					
Farm income	3,137,930	88.00	1,421,796	75.44	11.159***
Non-farm income	503,452	12.00	408,072	24.56	1.269ns
Total HH income	3,641,382	100.00	1,829,860	100.00	12.261***

Note: *** and * are significant at 1% and 10% level. Here, total HH income is the annual income of all household members including farm income.