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"Strengthening Institutional Capacity, Extension Services and Rural Livelihoods in the Central Dry Zone and Ayeyarwaddy Delta Region of Myanmar"
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AGRICULTURAL LIVELIHOODS AND COPING STRATEGIES TO FLOOD IN FARM HOUSEHOLDS IN KAMBALU TOWNSHIP

SAN SAN MYINT AND YU YU TUN

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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 sample farm households and to analyze the factors affecting the revenue of monsoon paddy before and after 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 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. 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 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 commonly used coping strategies in the study area. According to the regression analysis, family labor, non-farm income and cultivated area of monsoon paddy were significant factors to get high revenue for monsoon paddy production by engaging and investing more on it before and after flood. Before flood, age and education level of household's head is also important in managing and decision making on the farming activities to receive high revenue on the monsoon paddy production, however this demographic characters seem not significantly influence the paddy revenue immediately after flood. As a result, there is needed to create non-farm job opportunities and providing credit in farming activities to cope the impact of flood. Moreover, sustainable farming system through climate resilient varieties and improved agricultural technology, disaster awareness information and improved transportation infrastructure should be provided as the development program for the rural areas to overcome disaster impact.

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LIST OF ABBREVIATIONS

EM-DAT	Emergency Events Database
FGD	Focus Group Discussion
GDP	Gross Domestic Product
ha	Hectare
HH	Household
IUCN	International Union for Conservation of Nature
KI	Key Informant
mm	Millimeter
MMK	Myanmar Kyat
ºC	degrees Celsius
sq km	Square kilometer
SPSS	Statistical Packages for Social Science
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 are attributed to the aftermath of exceptionally devastating events such as Hurricane Sandy in Haiti and Hurricane Mitch in Honduras. Likewise, Myanmar has 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, 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 in Figure 1.1.

The impact of disasters was different based on the various types. In the period 1995-2015, flooding impacted more on people than any other type of disaster, accounting for 56% of the total people affected (nearly 2.3 billion people) in Figure 1.2 (CRED, 2015). Therefore, 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.

In Myanmar, agriculture is most sensitive to disasters as the nature of crop production is heavily dependent on weather conditions. 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. Naturally, farmers are trying to cope with in their traditional way based on the resources they have, experience and exposure to immediate basic needs under increasing climate change like disaster. However, some local coping strategies to reduce disaster impact are not sustainable for future risks. The choice of coping mechanisms depends on socioeconomic characteristics of farm households, access to extension services, credit supply and the existing resources. 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. 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 Natural Disasters and Myanmar

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 51.4 million and about 70% of total population was living in rural areas in 2014. The population growth rate was 0.89% with 76.1 per square kilometers of population density in 2014 (DoP, 2015).

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 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 this region damage 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. Throughout the rainy season, riverine floods are common in the river deltas while flash floods and landslides frequent in the upper reaches of the river systems, which are normally the mountainous areas, whereas the coastal areas experience intermittent flooding from cyclones. 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).

An average of 70% of the population is supported by agriculture that generating 22.1% of GDP, 20% of total export earnings and 61.2% of the labor force in Myanmar (MOAI, 2015). Agriculture has remained a prime source of livelihoods in Myanmar. In addition to, it is also still vulnerable to disasters by declining agricultural production. Therefore, Disaster coping mechanisms are crucial for vulnerable groups to avoid consumption shortfalls and to meet their immediate basic needs just aftermath of a disaster.

The risk of natural hazard is mostly characterized by small- 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 1.3. 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 remain 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 agriculturally productive zone, and the urban and peri-urban area (Baker et. al., 2008).

In 2015, the floods nearly in all over spreading across 12 of Myanmar's 14 states and regions 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. 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 destroyed crops with more than 100,000 ha of cultivated land washed away due to floods and a total loss of crops. Sagaing is the second most affected state with over 30,000 ha of cultivated land washed away, followed by Bago and Magway 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.

Floods in Myanmar are most common during the rainy season because it usually receives rainfall between mid-May and October. The threat of flooding usually occurs in June, July, August and late September to October with the highest risk in August around the period of peak monsoon rains. In Ayeyawady and Chindwin rivers, flood occurs when intense rain persists for at least three days over the headwaters of the rivers in northern Myanmar.

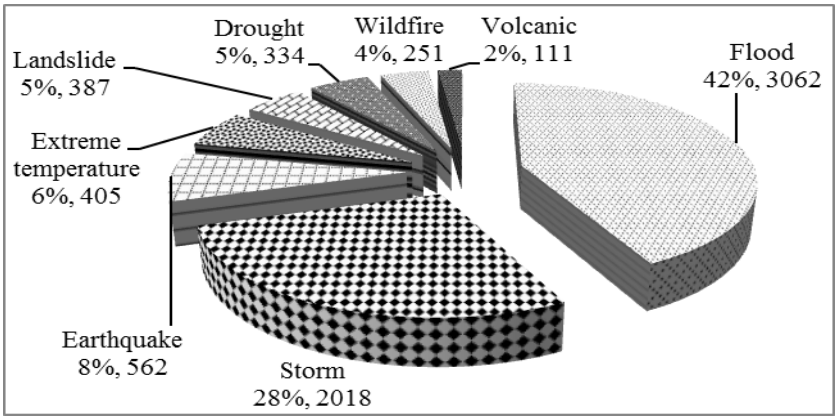


Figure 1.1 Occurrences of natural disasters by disaster type in the world (1995-2015)

Source: (CRED, 2015)

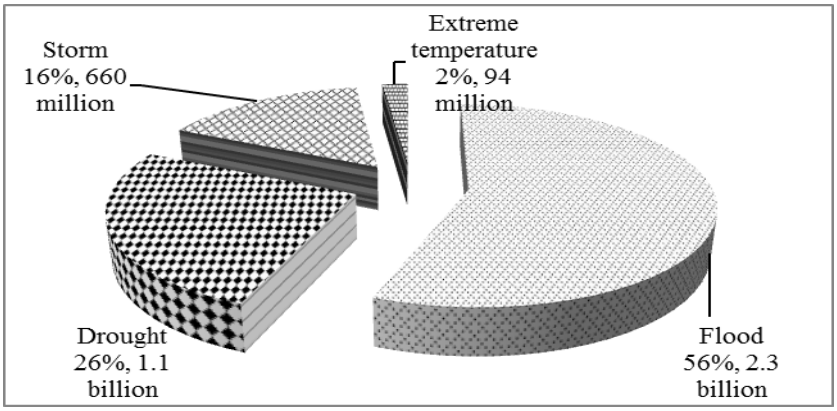


Figure 1.2 Number of people affected by disaster type in the world (1995-2015)

Source: (CRED, 2015)

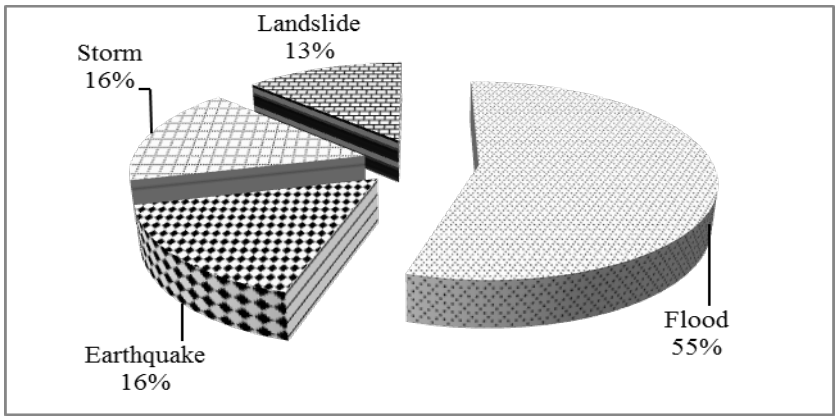


Figure 1.3 Natural disasters in Myanamr betweewn 1990 and 2014

Source:http://www.preventionweb.net

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

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 Flooded, replanted, destroyed and damaged crop's areas in six most affected regions/states in Myanmar, 2015

(Hectare)

States/Regions	Cultivated area	Flooded area	Replanted area	Destroyed area	Damaged 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
Grand total	**6,076,256**	**527,598**	**172,887**	**175,362**	**179,349**

Source: (FAO & WFP, 2015).

1.3 Rationale of the Study

Disasters cause a huge impact on agricultural livelihoods, loss of lives and damage to properties etc. which pose significant implications on economic growth. 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 socioeconomic conditions, losses and difficulties in agricultural

production facing by affected farm households before and after flood. It was to describe aids received and coping strategies used by flood affected farm households. It was also to highlight the factors affecting on crop income changes by comparing the revenue obtained from monsoon paddy production before and after flood as this crop was the most serious crop due to flood.

In lower Sagaing region regarded as Central Dry Zone of Myanmar, Kambalu and 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 affected sample farm households before and after flood in Kambalu Township
2. To estimate losses and difficulties in farming faced by affected sample farm households in the study area
3. To identify aids received and coping strategies adopted by sample farm households in the study area
4. To analyze the factors affecting 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.

A disaster and a crisis are different, but they are related events where the crisis is more comprehensive than the disaster. A disaster is not a crisis in the traditional meaning decisions involving threat and opportunity have to be made in a particular short time. The industrial disaster is known as a crisis-related phenomenon and may develop to a crisis, then called industrial crisis. Crisis may develop from political, economic issues as well as from disasters (Shaluf et. al., 2015).

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 EM-DAT, 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) .

Sena (2006) stated that manmade disasters are fire, deforestation, epidemic, accidents, industrial crisis, food poisoning and environmental pollution. Among various kinds of natural disasters, flood is extremely dangerous and has the potential to wipe away an entire city, coastline or area, and cause extensive damage to life and property.

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. Among them, heavy or prolonged rainfall, snowmelt, thunderstorms, storm surge or debris jams were major weather factors. On the other hand, structural failures of dams and levees, altered drainage, and land-cover alterations were human factors.

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).

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 can be concluded that natural disasters affected dramatically the household income resulting in household poverty.

Extreme weather refers to weather phenomena that are the extremes of the historical distribution especially serve or unseasonal weather. It includes severe thunderstorms, hurricanes, flooding and heavy winds and heat waves. When they can cause destruction of buildings, vehicles, roads and homes, it has many costs to recover. People's lives are also at risk from some unexpected weather events (www.globalchange.gov/highlights/extreme-weather, 2014).

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. Direct impacts have been described as the physical destruction from a disaster, and indirect impacts are considered the consequences of that destruction (National Research Council 1999). 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. 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 is significantly greater than in earlier decades. This could reflect greater exposure, or better reporting, or both. Rich countries' damage due to a disaster is greater because of their high-value infrastructure. 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.

Disasters have diverse impacts on society; they are often categorized into economic, social and environmental impacts. Economic impacts include, for example, loss of assets and business interruptions. Social impacts include death, injury and changes to the functioning of communities, to name a few. Some impacts are both economic and social. For example, increased poverty and unemployment would be interpreted from both perspectives. Environmental impacts are for example, loss of habitats for animals and deforestation due to natural fire. When these are all combined, disaster can have a macro-economic impact, for example, the reduction of GDP and trade balances. Economic analysis only focuses on the economic impacts of disaster. In analyzing macro-economic impact, it is very important to analyze the impact from supply and demand sides and short and long-term perspective. From supply side, decrease of production due to capital loss can be observed as a negative impact in the short term. However, in the long term, replaced new and more productive factories can improve efficiency and produce positive impact. From the demand side, decline of income, asset value, and population can be all observed as negative impacts in the short term. However, reconstruction demand can have a positive impact, especially for depressed economies that lack effective demand. The total impacts can be evaluated as the balance of supply and demand side impacts. A macroeconomic model is constructed based on many assumptions reflecting causal relationships that impact both the demand and supply sides (UNISDR, 2015).

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 are 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 WFP 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 had to suffer 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 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. 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 cause 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. As the impact of flood, almost all of the farmers reduced their profit of income. Another consequence of the flood was money problem of farmers to invest their farming. Therefore, the farmers needed the rehabilitation programs related to credit, 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) reported that the assessment was based on the review of secondary data as well as the collection and analysis of field data from 6 to 21 September 2015 in six most affected regions/states of Sagaing, Chin, Magway, Rakhine, Ayeyawady and Bago. Among the villages assessed, 45% and 43% reported crop production and subsistence farming respectively 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 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 is covered by water as well as mud, sand and debris. This situation might hamper winter and summer crops production. The reason why is the key findings of 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 give a lot of help for the affected ones in the times 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. 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, is 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 are 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 can 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. Risk sharing can be commonly found within household. 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. It is for achieving food security by minimizing market risks. Specialization is to reduce risk by focusing low risk income generating activity that will give a low return (Lekprichakul, 2007).

The Global Facility for Disaster Reduction and Recovery (2013) stated those two kinds of coping strategies for affected households; (1) increasing income and (2) reducing expenditure to cope economic crisis due to disaster. The affected households are employed the strategies to increase income through different important ways including working longer hours, migration, changing agricultural practices, selling assets, and changing livelihoods. On

the other hand, the strategies to reducing expenditure means those households at risk diminish the number of meals, social expenditure, and investment in farming input. Education and health expenditure had never been a high priority for villagers, and there were no official fees for primary education in Myanmar.

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.

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 are often limited. Farmers also sell household assets (particularly chickens) to purchase rice from market or send 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 reported to have been 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 of Sagaing region was selected as the study area which was 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 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 economics of Kambalu Township are agriculture, trading and livestock production. In agricultural production, the common crops grown by farmers in study area 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 were three seasons: the 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. 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 term of rainfall, based on the data from the Kambalu Meteorological Satation indicated that the average rainfall from 2011 to 2015 was 994 mm/year. From 2011

to 2015, the highest total precipitation was 1629 mm in 2015 and the total lowest precipitation was 578 mm in 2011. Monthly average rainfall and temperature are shown in Figure 3.1 and 3.2. 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 was happened in the study area on July 2015. According to the temperature recorded from 2011 to 2015 in Kambalu Township showed that the average maximum temperature and average minimum temperature were 33 ºC and 21 ºC, respectively. The hottest months were March and April and the coldest ones concentrated on December and January in Figure 3.2.

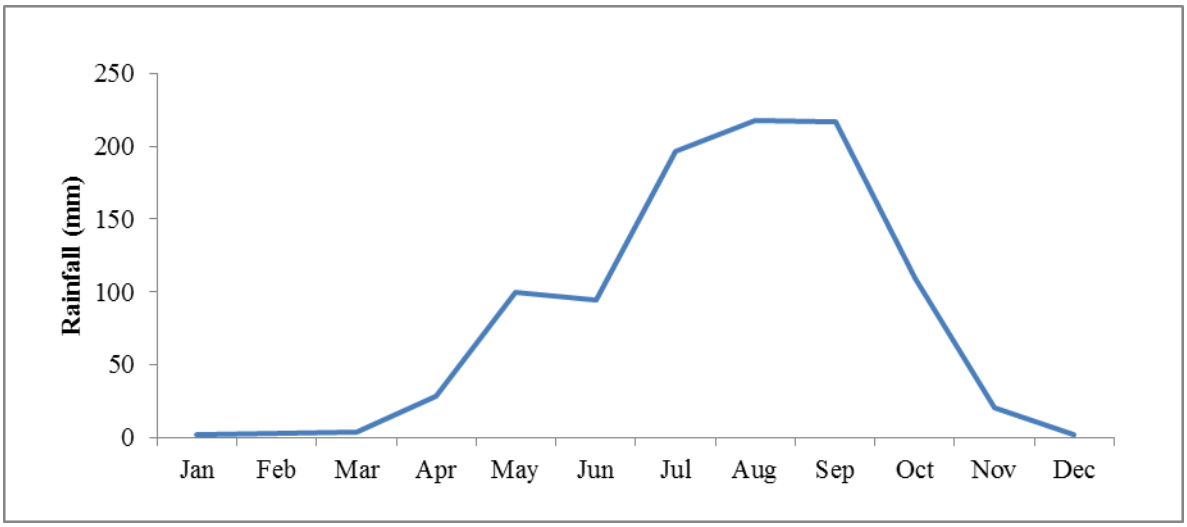


Figure 3.1 Monthly Average Rainfalls of Kambalu Township form 2011 to 2015
Source: (DMH, 2016)

3.1.3 Land use pattern

The Township total area was 414,240 hectares and forest occupies the largest share as 43% of the total area. 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 Kambalu Township, upland occupies the highest portion as shown in Figure 3.3 and farmers grow various crops such as rice, pulses, oil seeds, cotton, pigeon pea, groundnut, sugarcane and maize in lowland and upland.(DoA, 2016).

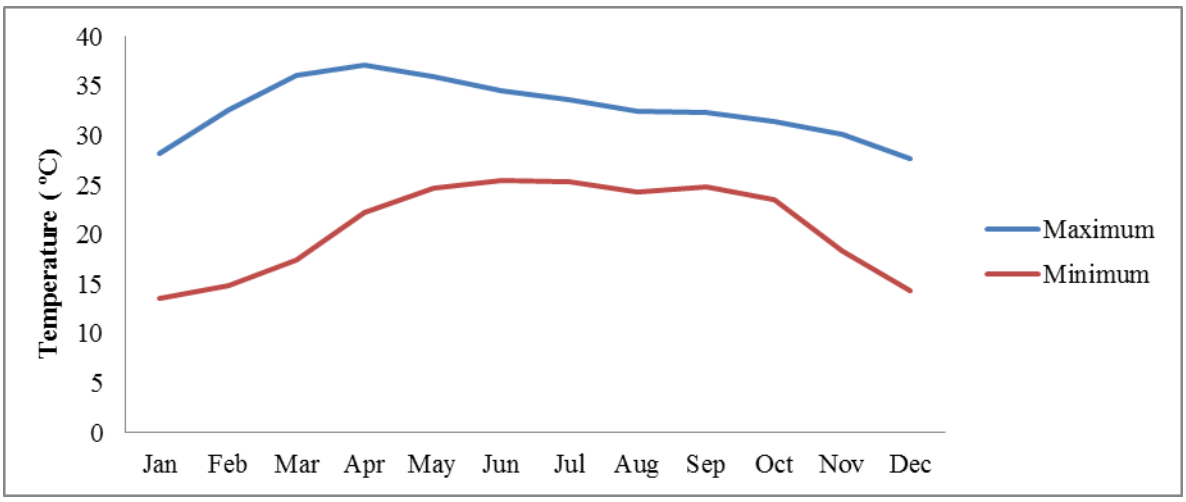
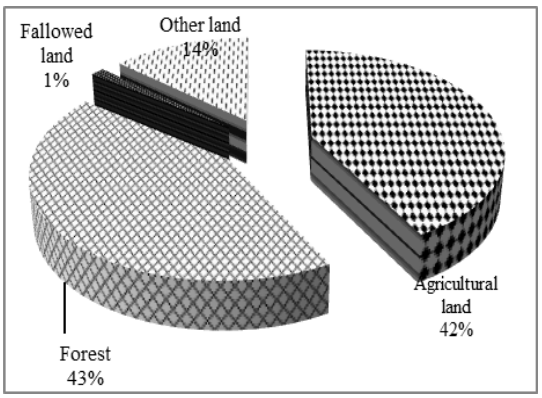


Figure 3.2 Monthly Average Temperature of Kambalu Township from 2011 to 2015
Source: (DMH, 2016)

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 with about 471 mm in three rainy days during from 16 July to 19 the July in 2015. Over flowing from Minn Myin and Tha Pan Zeik dams resulted to the flood in Kambalu Township. It mainly affected to the villages located near these dams, transportation and public infrastructure, crop cultivated areas and households. Flooded, destroyed and damaged areas under different cultivated crops in Kambalu Township were shown in Table 3.1. The flood affected crops were monsoon rice and 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 4,361 ha where monsoon rice was the most affected crop occupying about 34% of total damaged area and followed by maize with 30% (DoA, 2016).



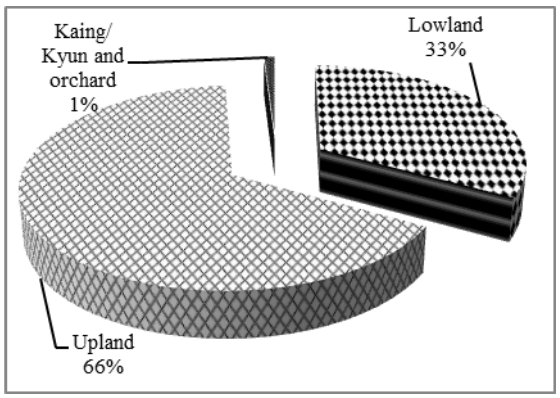


Figure 3.3 Land Utilization in Kambalu Township (2014-2015)

Source: (DoA, 2016)

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

Crops	Flooded area (ha)	Destroyed area (ha)	Damaged area (ha)	Damage (%)
Monsoon rice	2,113.31	1,925.94	1,468.64	33.68
Rice seedling bed	778.23	560.50	539.86	12.38
Groundnut	510.72	353.70	329.42	7.55
Green gram	323.76	295.83	281.26	6.45
Pigeon pea	437.88	437.88	373.53	8.50
Maize	1,554.84	1,420.48	1,298.26	29.77
Sugarcane	70.01	70.01	70.01	1.61
Total	**5,788.75**	**5,064.34**	**4,360.99**	**100.00**

Source: (DoA, 2016)

3.2 Data Collection and Sampling Procedure

Field survey was carried out in October 2016, one year period after flood in 2015. Both primary and secondary sources of data were used in this study. 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. 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. 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.

The survey collected information from 135 sample farm households in order to identify and compare before and after socioeconomic and agricultural conditions and coping strategies used by affected farm households by the year of 2015 flood event.

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. 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 the sample farm households utilized what coping strategy. Five key informant interviews were also conducted with 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 was provided the information about socioeconomic and agricultural conditions before and after flood and coping mechanisms employed by affected households, aids received from governmental organizations and non-governmental organizations (NGOs).

Secondary data was 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 was taken from Department of Meteorology and Hydrology.

3.3 Method of Analysis

The study was based 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 used to point out 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 it have 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 significant 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 Multiple regression analysis

To determine the factors affecting the total revenue function of monsoon paddy before and after flood, multiple regression analysis was used. The dependent variable was applied total revenue of monsoon paddy by sample farm households and independent variables 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. By comparing the total revenue received by monsoon paddy production before and after flood, the following multiple regression function was used.

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

Where,

TR = Total revenue of monsoon paddy (MMK/HH)

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)

μ_i = Disturbance term

CHAPTER IV

RESULTS AND DISCUSSION

4.1 Background Information of Sample Farm Households in the Study Area

Kambalu Township in Sagaing region was included one of the seriously affected areas of the flood in 2015 due to the heavy rains in Myanmar from the effect of Cyclone Komen. One 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 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 selected sample farm households were categorized based on their damaged cultivated crop area due to flood into three groups: seriously affected (group I); farm households damaged cultivated crop area of above 1.0 ha, moderately affected (group II); farm households damaged cultivated crop area of 0.4 ha to 1.0 ha and less affected (group III); farm households damaged cultivated crop area of less than 0.4 ha. In Table 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 of sample farm households were presented in Table 4.3 and 4.4. The average age of the sample farm household's head for three different groups were around 50, 52 and 46 years respectively within a range of 24 to 83 years.

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	(8.42%)
Zee Ka Nar	Zee Ka Nar	100	16	(16.00%)
	Shaw Phyu Kone	143	31	(21.68%)
Kya Khat Aingh	Kya Khat Aingh	42	25	(59.52%)
Koe Taung Boet	Koe Taung Boet	41	30	(73.17%)
Pay Kone (South)	Pay Kone (South)	178	25	(14.04%)
Total		**599**	**135**	**(22.54%)**

Source: (DoA, 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%)**

Farming experience of household's head was about 26 years (around 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 experience in farming than group III household's head. In the study area, majority of the household' head completed primary and middle education level with around 6 schooling years in all sample households, about 5 schooling years in group I and 6 schooling years in group II and III respectively. The maximum schooling years of 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 no schooling years in group II farm housheolds. The average family members of different affected groups 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 signinificantly 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, about 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

Among all groups, around 90% of sample farm household heads engaged in agriculture for their major income of the family. Only 5% and 2% farm household heads in group I and II were government staffs such as school teachers, village administrative officers while 2% of group I, 7% of group II and 8% of group III were dependent. In all three groups, 98%, 78% and 92% had no secondary occupation. 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, majority of family members in all groups did only farm work as primary occupation. Therefore, 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 4.3 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	1.62^{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	-	53	-	63	-	58	-	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

Items	Group I	Group II	Group III	Total	Pearson Chi-square
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. Figures in parentheses represent percentage.

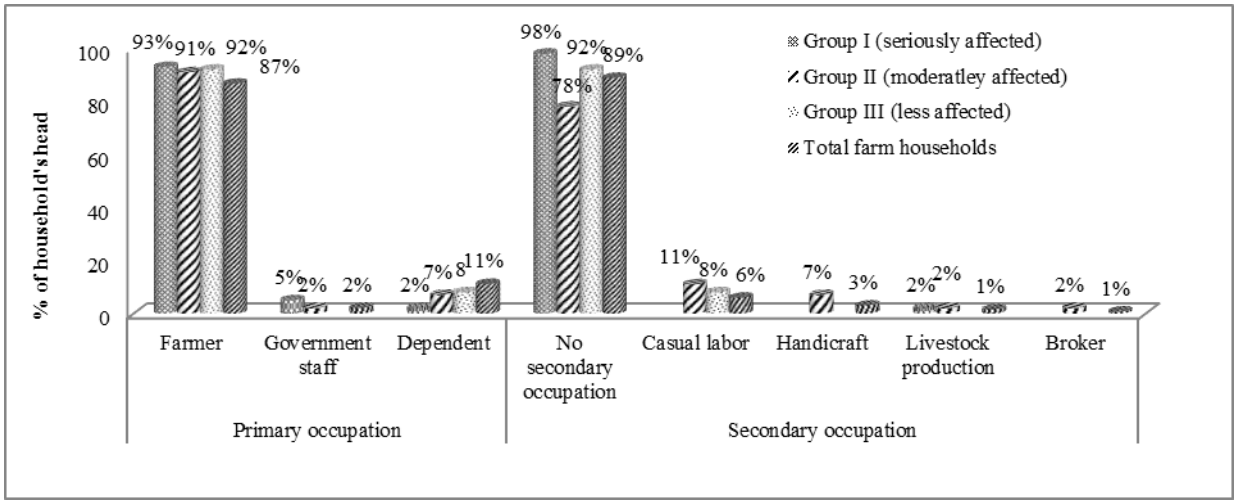


Figure 4.1 Primary and secondary occupation status of sample farm household's head

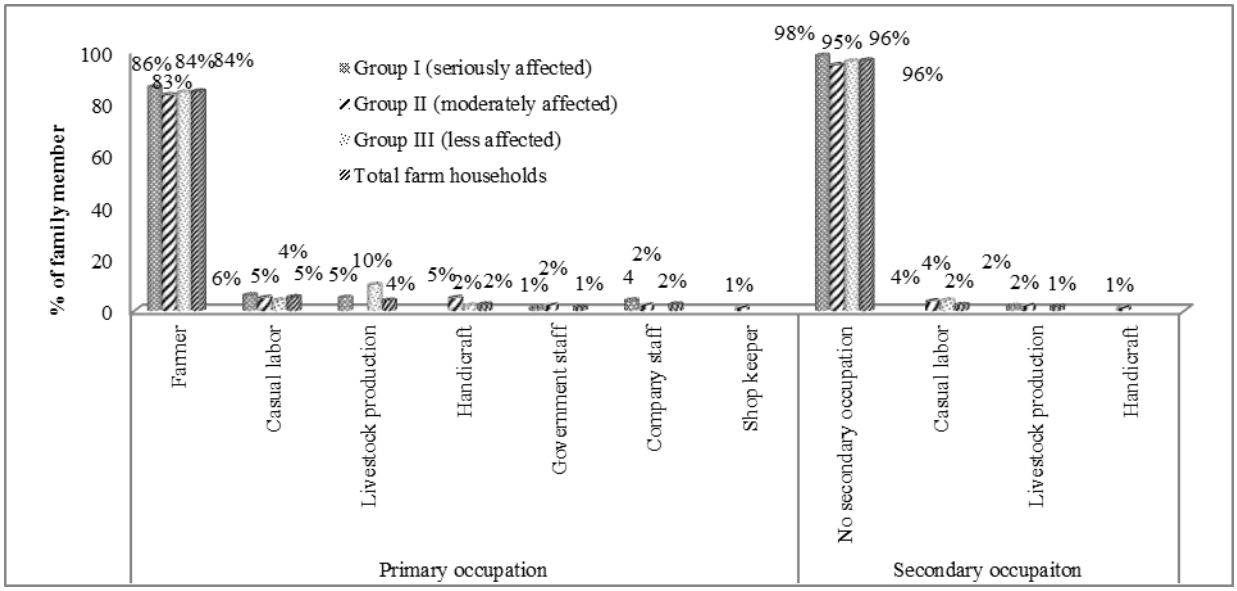


Figure 4.2 Primary and secondary occupation status of family members

4.3 Household and Productive Assets of Sample Farm Household Groups before and after Flood

4.3.1 Comparison of household assets before and after flood

Table 4.5 lists household assets of sample farm household groups before and after flood. 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 significantly different in phone asset 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 significantly different in mobile phone assets at 10% level in farm household for group I and III before and after flood but it didn't significantly different in group II.

4.3.2 Comparison of farm assets before and after flood

Table 4.6 presents the comparison of farming tools, equipment and machineries farm assets of sample farm households before and after flood. In seriously affected farm households, the farm assets such as harrow, plough and boat decreased and significantly difference of t-test results reduced from 1.82, 1.76 and 0.53 before flood to 1.44, 1.40 and 0.47 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 were increased after flood. Therefore, paired sample t-test showed that there was significantly different 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 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 was also found in the average possession of harrow and plough of group II farm

households at 5% level. Moreover, the farm assets (sprayer, water pump and storehouse) were decreased the average number owned by group II farm households as it was lost with flood while a few group II farm households used more tractor than after flood instead of harrow and plough. However the mean number of sprayer, water pump, storehouse and tractor were not significantly different before and after flood. The rest of farm assets such as bullock cart, well, thresher and rice mill were possessed the same number by group II farm households 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 farm asset (eg.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 were 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 significantly different at 1% level for harrow and plough and at 10% level for 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 Comparison of livestock assets before and after flood

Table 4.7 describes that the livestock assets of farm household groups before and after flood. 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 4 and 18 to 3 and 11 in group I farm households. Therefore, paired sample t-test showed that there was significantly different at 5% level for cattle and at 1% level for chicken before and after flood. As for group II, the average number of chicken was reduced

from nearly 24 before flood to 5 after flood. Therefore, the paired sample t-test showed that there was significantly different 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 no seriously loss 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. In all sample farm households, the average number of cattle and buffalo significantly decreased from about 3.75 and 1.42 before flood to approximately 3.27 and 1.18 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 Comparison of 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 after flood and followed by group II with 3.78 and 3.75 ha and group III with 4.18 ha before and after flood. The minimum and maximum of land holding size of three groups 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 showing that there was no different land possession before and after flood. 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 flooding in the study area didn't effect 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	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	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	Group I			Group II			Group III			Total		
	Before	After	t-test	Before	After	t-test	Before	After	t-test	Before	After	t-test
Cattle	4.38	3.75	2.473**	3.24	2.82	1.525ns	3.48	3.20	0.838ns	3.75	3.27	2.926***
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***
Buffalo	3.02	2.49	1.537ns	0.47	0.40	1.427ns	-	-	-	1.42	1.18	1.721*
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 Comparison of housing conditions before and after flood

The study area had a large area of forest that produced woods. Most of farm households used wood in building the house patterns. According to Table 4.9 results, the sample farm household groups constructed different types of houses. Among the three groups, only a few number of farm households in group I lived with Corrugated iron sheet + Brick wall + Brick floor. In group I, most of the farm households stayed in the same housing conditions before and after flood. About 15% of farm households in the owners 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 was 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 resistant to the disaster like flood. Therefore, it was observed that it didn't 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 forced to change from Corrugated iron sheet+ Bamboo wall + Wood floor to Corrugated iron sheet+ Bamboo wall. Thus Corrugated iron sheet+ Bamboo wall + Wood floor was constructed by decreasing from about 16% to 12% while Corrugated iron sheet+ Bamboo wall was lived by increasing from 44% to 48% of group III farm households 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 stayed 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.

4.4 Cropping Patterns, Crop Production and Income Composition of Sample Farm Household Groups before and after Flood

4.4.1 Cropping pattern of sample farm household groups before and after flood

In the study area, most of the farmers practiced with 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 were 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 didn't 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 Cropping patterns of 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 production activities and crop income of sample farm household groups

Table 4.11 shows crop production activities and crop income of group I farm households before and after flood. All sample farm households in group I cultivated monsoon paddy in lowland while about 71%, 29% and 15% of sample farmers planted sugarcane, groundnut and black gram as their main cultivated crops. In group I, average cultivated areas of those crops didn't significantly differ before and after flood. Although the average cultivated area of monsoon paddy didn't significantly differ before and after flood, but the average yield was highly decreased from over 2,600 kg/ha to about 1,139 kg/ha. Although the average price of monsoon paddy was increased from 278 MMK/kg to 290 MMK/kg, the average revenue of paddy was reduced from 2,770,982 MMK/season to 1,007,682 MMK/season due to the result of decreasing yield after flood. Therefore, paired sample t-test showed that there were significant different at 1% level for the average yield and revenue and 5% level for the average price 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. Although the average price of brown slab-sugar was increased from 460 MMK/kg before flood to 494 MMK/kg after flood, the average revenue was significantly reduced from 2,297,282 MMK/season before flood to 380,664 MMK/season after flood. Therefore, paired sample t-test showed that there was significant different at 1% level for average yield and revenue and 5% level for average price of brown slab-sugar. As a result of flood, the average yield of groundnut was significantly decreased from over 1,110 kg/ha to 776 kg/ha. The revenue on yield reduction didn't extremely decrease after flood because the average price of groundnut was slightly increased. Therefore, significant different was found in the average yield of groundnut at 10% level. For black gram, the average cultivated area, yield, price and revenue didn't significantly differ in group I farmers before and after flood.

As for group II, monsoon paddy was cultivated by all sample farmers before and after flood as described in Table 4.12. The most common crops in upland were sugarcane, sesame and niger with 15%, 16% and 9% of sample farmers respectively. In this group, the average cultivated area of common crops didn't significantly differ before and after flood. Monsoon paddy cultivated farmers faced with yield reduction from 3,114 kg/ha before flood to 1,197

kg/ha after flood. Although the price of paddy was slightly increased after flood, the average revenue of monsoon paddy was extremely decreased from 1,946,064 MMK/season to 737,938 MMK/season. Paired sample t-test showed that highly significant differences were found in average yield and revenue of group II farmers before and after flood. However, it was described that there was no significantly different in the average cultivated areas and price of monsoon paddy. In regard to upland crop production, average yield of brown slab-sugar was decreased from 2,209 kg/ha to 642 kg/ha but its price was increased from 475 MMK/kg to 575 MMK/kg after flood. As a result of low yield, there was significantly reduced in the average revenue from 1,302,255 MMK/season to 480,950 MMK/season. Therefore, paired sample t-test showed that there were significantly different at 5% level for average yield and price and at 5% level for average revenue of brown slab-sugar before and after flood. However, the paired sample t-test showed that the average yield, price and revenue for sesame and niger did not significantly differ for group II farmers before and after flood.

In group III, about 96%, 76%, 72% and 68% of sample farmers planted monsoon paddy, maize, groundnut and pigeon pea as the major crops as presented in Table 4.13. Also group III, the average cultivated area of monsoon paddy, groundnut and pigeon pea didn't significantly differ before and after flood. Group III monsoon paddy cultivated farmers also experienced with yield reduction from 2,703 kg/ha to 1,295 kg/ha due to flood. At the same time, they received lower average revenue on the increased price 702,104 MMK/season after flood compared with 1,018,958 MMK/season before flood. Therefore, the paired sample t-test revealed that there were significantly different in the average yield and revenue of paddy before and after flood. In upland, the average cultivated areas of maize had been significantly increased from 0.74 ha to 1.03 ha due to higher price in the previous year. On the other hand, its price was decreased from 226 MMK/kg before flood to 199 MMK/kg after flood and the yield of maize was significantly reduced from about 2,319 kg/ha to 1,356 kg/ha. As a result, average revenue was also diminished from 392,738 MMK/season before flood to 254,750 MMK/season after flood. Therefore, the paired sample t-test showed that there was significantly different at 1% level in maize cultivated areas, yield and price and 10% level in the revenue of maize before and after flood. For groundnut, paired sample t-test showed that

there was no significantly different in the average cultivated areas, yield, price and revenue of group III farmers before and after flood. In pigeon pea, the average cultivated area was not significantly different before and after flood, but the yield was significantly reduced from 522 kg/ha to 297 kg/ha in less affected farmers. Although the price of pigeon pea was significantly increased from 1,249 MMK/kg before flood to 1,332 MMK/kg after flood, the revenue was significantly decreased from 783,421 MMK to 429,222 MMK due to low yield. Paired sample t-test showed that there was significantly different at 5% for the average yield and 10% level for the average price and revenue of pigeon pea before and after flood.

Table 4.14 represents the average cultivated area, yield, price and revenue of main crops by all sample farm households in the study area. The main cultivated crops of all groups were monsoon paddy, sugarcane, groundnut, maize and pigeon pea with about 99%, 36%, 29%, 20% and 20% of sample farmers before and after flood. It was observed that there was no significantly different the cultivated areas of those crops before and after flood. In study area, most of the farmers experienced with high yield reduction of monsoon paddy from over 2,700 kg/ha before flood to 1,200 kg/ha after flood. However, the price didn't significantly differ before and after flood. The average revenue of monsoon paddy significantly decreased from 2,024,578 MMK/season to 855,034 MMK/season due to the result of low yield. Therefore, the paired sample t-test showed that there were significantly different for average yield and revenue of monsoon paddy at 1% level before and after flood. As for upland crop production, the average revenue of brown slab-sugar was extremely decreased from 1,667,504 MMK/season to 452,515 MMK/season due to the yield reduction from approximately 2,166 kg/ha to 625 kg/ha before and after flood. On the other hand, its price was slightly increased after flood. Therefore, paired sample t-test showed that highly significant differences were found in the average yield and revenue of brown slab-sugar before and after flood. For groundnut, the average yield were extremely decreased from 977 kg/ha before flood to 684 kg/ha after flood. The average revenue of groundnut was not significantly reduced because of high price after flood. Thus, highly significant different was found in the average yield of groundnut. Although the cultivated area of maize was increased after flood, the average yield, price and revenue was significantly decreased from about 2560 kg/ha, 213 MMK/kg and 572,173 MMK/season to approximately 939 kg/ha, 190 MMK/kg

and 176,365 MMK/season. Paired sample t-test showed that there was significantly different at 1% level for the average yield and 10% level for the average price and revenue of maize before and after flood. In addition to, the revenue of pigeon pea was significantly decreased from 598,846 MMK/season to 330,692 MMK/season because of the extreme yield reduction from 428 kg/ha to 248 kg/ha and the low price. As a consequence, significant differences were found in the average yield and revenue of pigeon pea for all different affected groups before and after flood.

Table 4.11 Crop production activities and crop income of group I

Crop		Cultivated area (ha)	Yield (kg/ha)	Price (MMK/kg)	Revenue/season (MMK)
Monsoon paddy (n=55,100%)	Before	4.08	2,605.00	278.00	2,770,982.00
	After	3.93	1,138.59	290.13	1,007,681.82
	t-test	1.029^{ns}	11.176^{***}	-2.241^{**}	7.389^{***}
Sugarcane (brown slab-sugar) (n=39, 70.9%)	Before	2.16	2,362.00	460.00	2,297,282.00
	After	2.12	598.00	494.00	380,664.00
	t-test	0.122^{ns}	6.804^{***}	-2.466^{**}	3.735^{***}
Groundnut (n=16, 29.1%)	Before	1.06	1109.76	716.56	818,208.00
	After	1.11	775.89	827.07	825,869.00
	t-test	-0.787^{ns}	1.802^{*}	-0.939^{ns}	0.090^{ns}
Black gram (n=8, 14.5%)	Before	1.52	436.16	955.66	599,375.00
	After	1.62	399.39	926.17	513,714.29
	t-test	-0.236^{ns}	0.304^{ns}	0.841^{ns}	0.482^{ns}

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

In this case, average yield and price of sugarcane were described by the yield of brown slab-sugar and groundnut by pods.

Table 4.12 Crop production activities and crop income of group II

Crop		Cultivated area (ha)	Yield (kg/ha)	Price (MMK/kg)	Revenue/season (MMK)
Monsoon paddy (n=55,100%)	Before	2.57	3,114.00	259.00	1,946,064.00
	After	2.00	1,197.00	260.00	737,938.00
	t-test	1.630^{ns}	10.454***	-0.037^{ns}	9.092***
Sugarcane (brown slab-sugar) (n=8, 14.5%)	Before	1.38	2,209.00	475.00	1,302,255.00
	After	1.52	642.00	575.00	480,950.00
	t-test	-0.798^{ns}	2.627**	-2.832**	2.369*
Sesame (n=9, 16.4%)	Before	3.55	214.79	1065.10	497,166.67
	After	2.11	191.46	1,137.02	544,333.33
	t-test	-1.333^{ns}	1.400^{ns}	-0.886^{ns}	0.386^{ns}
Niger (n=5, 9.1%)	Before	1.46	206.00	1,184.00	456,800.00
	After	1.38	156.00	1,174.00	355,000.00
	t-test	1.000^{ns}	1.633^{ns}	-1.732^{ns}	1.589^{ns}

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

In this case, average yield and price of sugarcane were described by the yield of brown slab-sugar.

Table 4.13 Crop production activities and crop income of group III

Crop		Cultivated area (ha)	Yield (kg/ha)	Price (MMK/kg)	Revenue/season (MMK)
Monsoon paddy (n=24, 96%)	Before	1.85	2,346.99	229.27	1,018,958.00
	After	1.89	1,681.06	245.81	7,02,104.17
	t-test	-1.000^{ns}	3.495***	-1.093^{ns}	2.975***
Maize (n=19, 76%)	Before	0.74	2319.50	226.24	392,738.10
	After	1.03	1355.89	199.20	254,750.00
	t-test	-3.218***	3.074***	3.718***	1.991*
Groundnut (n=18, 72%)	Before	0.96	890.62	925.44	809,500.00
	After	0.94	721.14	724.84	695,000.00
	t-test	-0.127^{ns}	0.956^{ns}	0.229^{ns}	0.024^{ns}
Pigeon Pea (n=17, 68%)	Before	1.29	521.58	1,249.29	783,421.05
	After	1.12	296.57	1,332.31	429,222.22
	t-test	0.053^{ns}	2.228**	-2.086*	1.824*

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

In this case, average yield and price of groundnut were described by pods.

Table 4.14 Crop production activities and crop income of all groups

Crop		Cultivated area (ha)	Yield (kg/ha)	Price (MMK/kg)	Revenue/season (MMK)
Monsoon paddy (n=134, 99.3%)	Before	3.06	2,702.51	263.30	2,024,578.33
	After	2.94	1294.62	266.05	855,034.29
	t-test	1.649^{ns}	12.027***	-1.000^{ns}	9.828***
Sugarcane (brown slab-sugar) (n=49, 36.3%)	Before	2.00	2,165.98	460.43	1,667,504.00
	After	1.90	624.98	577.03	452,515.31
	t-test	1.204^{ns}	7.727***	-1.293^{ns}	6.830***
Groundnut (n=39, 28.9%)	Before	0.95	977.02	836.03	780,290.60
	After	0.88	684.26	852.45	663,388.89
	t-test	1.076^{ns}	2.973***	-1.270^{ns}	1.243^{ns}
Maize (n=27, 20%)	Before	0.86	2,599.95	212.70	572,173.08
	After	0.97	938.69	189.84	176,365.38
	t-test	-1.259^{ns}	3.187***	1.812*	1.746*
Pigeon pea (n=27, 20%)	Before	1.13	428.35	1168.00	598,846.15
	After	1.10	248.36	1164.00	330,692.31
	t-test	1.368^{ns}	2.621**	0.055^{ns}	2.527**

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

In this case, average yield and price of sugarcane were described by brown slab-sugar and groundnut by pods

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 primary household income and followed by livestock production, handicraft making and working as casual labor etc.. Therefore, Figures 4.3, 4.4, 4.5 and 4.6 presented that 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 was drastically reduced 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 was 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 was decreased from 83% (71% and 12%) 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 with 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 occupied from government staff and carrier/driver.

Discussions of farmers and key informants on socioeconomic and agricultural conditions

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 was 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 Village _ group III)

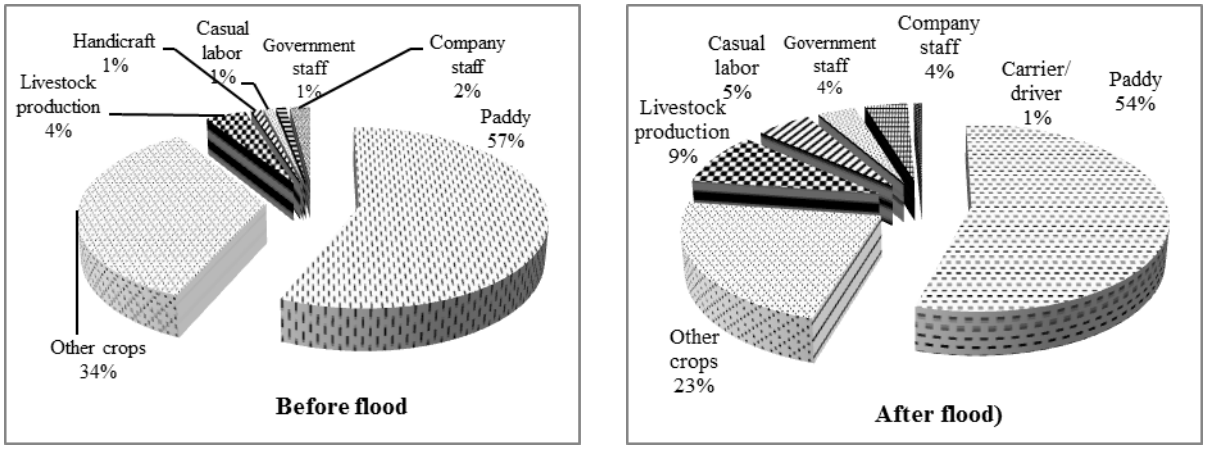


Figure 4.3 Income compositions of group I farm households before and after flood

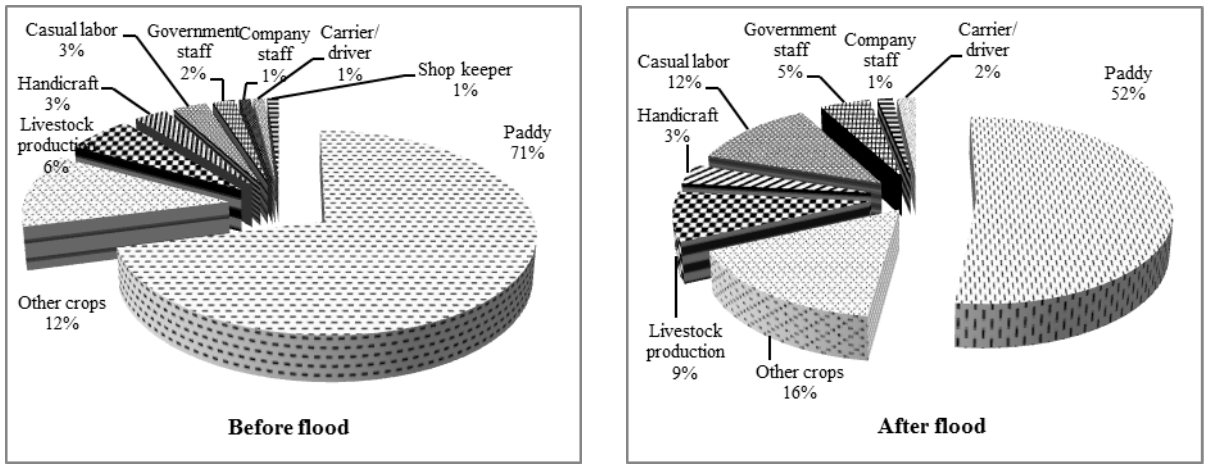


Figure 4.4 Income compositions of group II farm households before and after flood

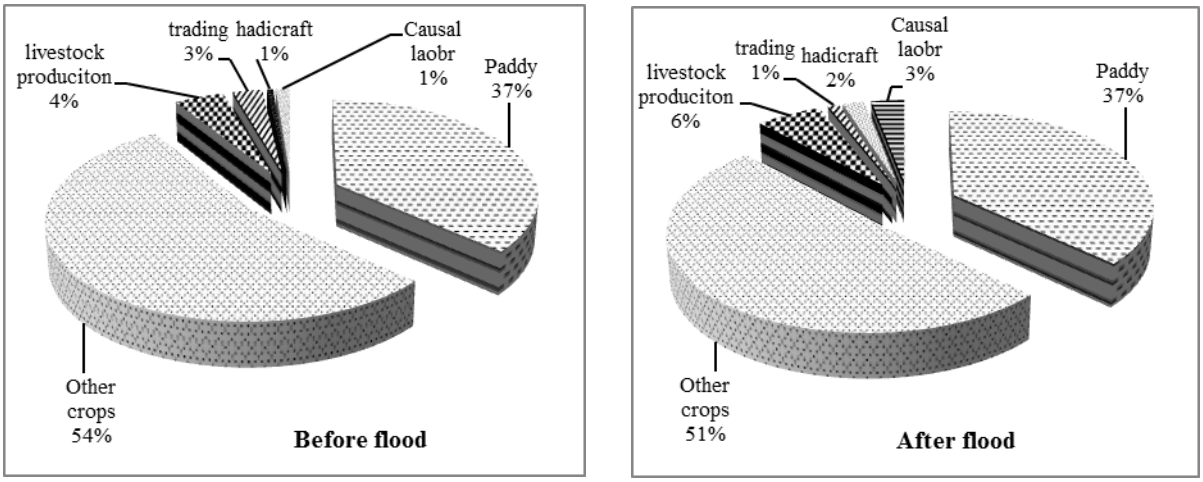


Figure 4.5 Income compositions of group III farm households before and after flood

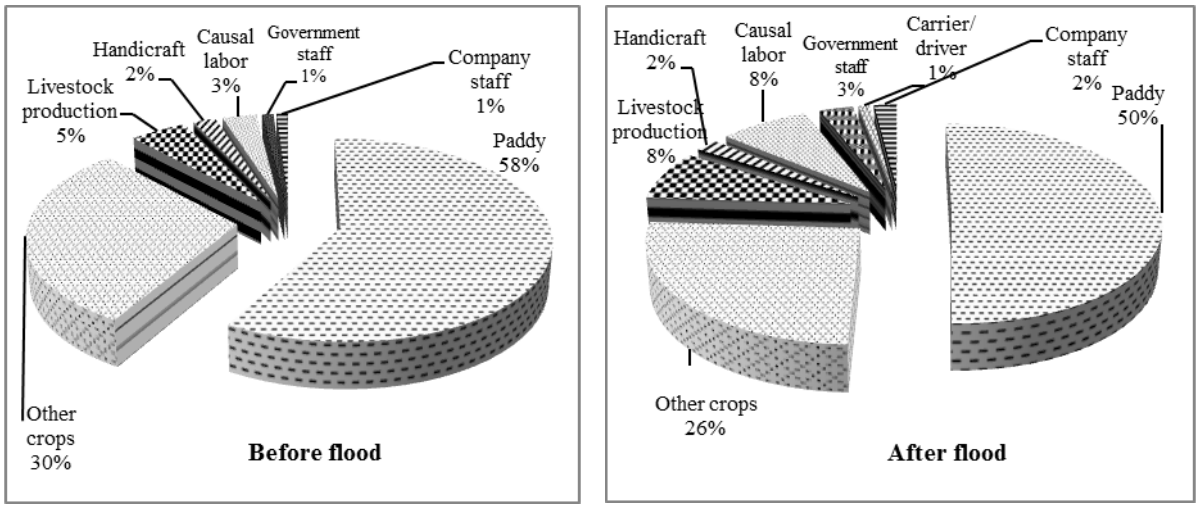


Figure 4.6 Income compositions of all sample farm households before and after flood

4.5 Losses and Difficulties of Sample Farm Household Groups after Flood

4.5.1 Losses of household property and houses of sample groups due to flood

Figure 4.7 shows losses of household property of sample farm household groups due to flood. In group I, household property such as clothes, mattress/beds, shoes, chairs, cooking pans and plates, harrows, ploughs, hoes, bullock carts, buckets, motor, chickens ,pigs and oxen, tents, storehouse, toilets ant seeds, rice, firewood and straw heaps were lost by 64% of

sample farm households. For group II, about 40% of sample farm households lost property included bicycle, harrow, plough, hoe, sprayer, storehouse, seeds, chickens, pigs, oxen, tents, bamboo, straw heap, meat-safe, table, cooking pans and bamboo baskets, rice brand, broken rice, rice, fire wood, toilet building and wood. In group III, only 28% farm households lost the household property of hoes, seeds, chickens, pigs and toilet were wasted due to flood. In all three groups, about 47% of sample farm households expressed that they had many losses of their property due to flood.

Flooding in the study area due to the effect of Cyclone Komen damaged to the roof, wall and floor of the house in some affected households as described in Figure 4.8. About 15%, 5% and 4% of group I, II and III damaged their housing portions due to flood. In summing all groups, only 10% of all sample farm households reported that their houses were destructed by the flood.

Discussions of farmers and key informants on the losses due to flood

In focus group discussion and key informant interview of group I, participants and key informant mentioned that they faced many losses of household property/asset including bullock carts and big pans used to produce brown slab-sugar etc. They also had many losses of chicken and pigs. Participants and key informant of group II expressed that they lost some household property/asset including water pump, bamboo and also straw heaps. Chicken and pigs were killed by flood. Participants and key informant in group III stated they lost a few household assets however the chicken was the most serious losses due to flood.

Some participants from focus group discussions of all groups stated that their housing conditions especially with roof and floor were damaged and collapsed due to flood.

(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 Village _ group III)

4.5.2 Yield loss of sample farm household groups after flood

Table 4.15 presented that the yield losses of the common crops grown by three different groups. The flood experienced by the sample farm household groups seriously destroyed to 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 with 75% yield losses on it. Continuously, about 44% and 18% of farmers estimated that they experienced with 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. As a consequence, about 18% and 53% of sample farm households stated that they faced with 100% and 75% yield losses in monsoon paddy while over 5% of farm households experienced with 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 reported that 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 with no yield in pigeon pea and maize production while about 4% encountered with 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 was happened at monsoon season due to heavy rain.

4.5.3 Losses of agricultural inputs and activities

Flood destroyed not only crops but also agricultural inputs and activities of sample farm household groups. The losses of agricultural inputs and activities faced by sample households were categorized and presented in Table 4.16. Agricultural land was deteriorated due to covering by sand, debris, sediment of sea water and collapsing the band due to flood. These impacts happened lead to reduce yield immediately after flood. The results of sample farmers facing the loss of agricultural land showed about 49%, 38% and 32% for group I, II and III in the Table.

Among the three groups, approximately 38% of group I and 20% of group II farm households had the damage and loss of agricultural equipment especially harrows, ploughs, boats, bullock carts, hoes and tents but those losses were faced by only a few farm households in group III. As a result of flood, small livestock losses such as poultry and pigs faced about 36% of group I and 31% of group II and III farm households in the study area. Destroyed and damaged of stored seeds for next production period and farm inputs like fertilizers and farm yard manure etc. faced nearly 35% of group I and II and 8% of group III sample farmers.

In all three groups, pasture and forage was damaged and lost by around 16% of group I farm households and followed by group II with about 2% but it no damage and losses in group III. Furthermore, there were also a few losses in each group on off-farm jobs and irrigation facilities due to flood.

In the study area, about 41%, 24%, 33% and 30% of all sample farm households faced with loss of agricultural land, damage and loss of agricultural equipment, loss of small livestock and loss of stored seeds and farm inputs. About 7%, 4% and 3% of all sample farm households experienced with damage of pasture or forage, loss of of-farm jobs and damage to irrigation facilities. Pearson Chi-square test showed that there was significantly different in damage and loss of agricultural inputs and pasture or forage at 1% level and loss of stored seeds and farm inputs at 5% level among the three groups. However, there was no significantly different in loss of agricultural land, loss of small livestock, loss of off-farm job and damage to irrigation facilities among three different affected groups.

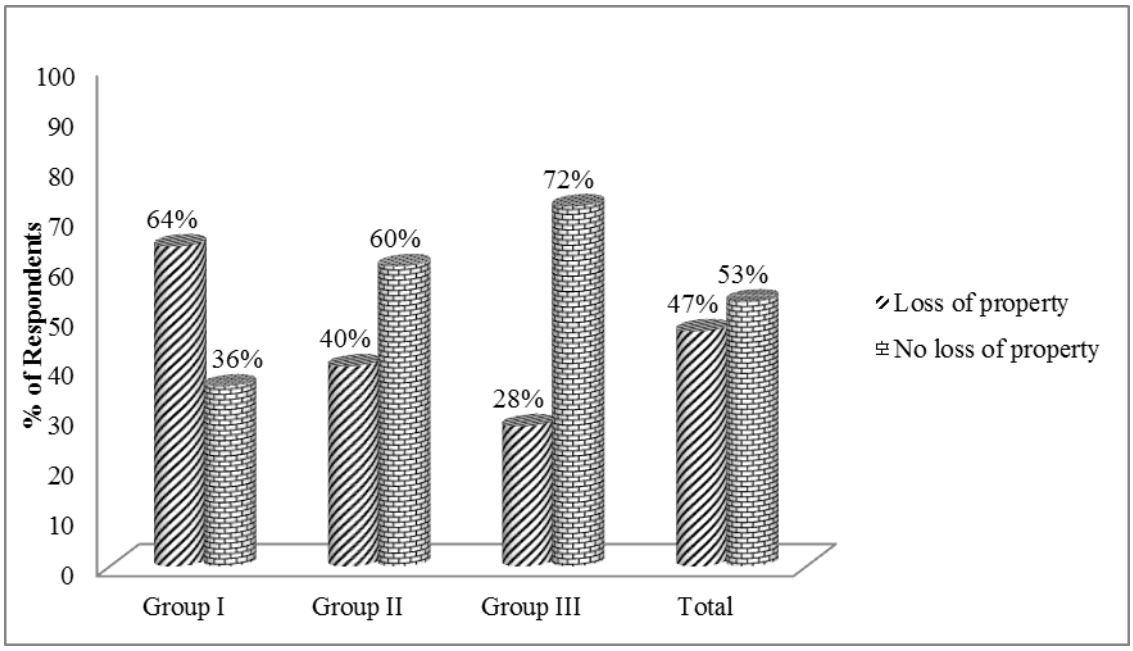


Figure 4.7 Loss of property by sample farm household groups in the study area

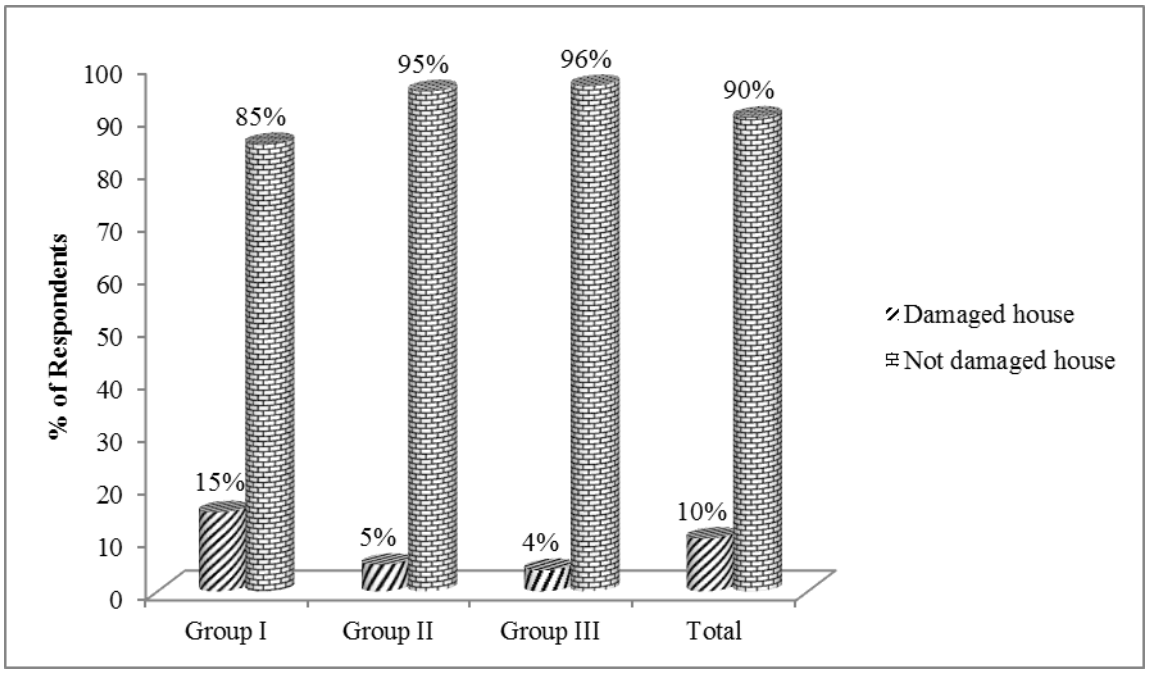


Figure 4.8 Housing damage by sample farm household groups in the study area

Table 4.15 Yield loss of sample farm household groups after flood

Items	% of farm households				
	Estimated yield losses				
	No loss	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

Table 4.16 Losses of agricultural inputs and activities of three groups after flood

Item	% of farm households				Pearson Chi-square
	Group I	Group II	Group III	Total	
Loss of agricultural land	49.09	38.18	32.00	41.48	0.289^{ns}
Damage and loss agricultural equipment	38.18	20.00	4.00	24.44	0.003***
Loss of small livestock	36.36	30.91	32.00	33.33	0.822^{ns}
Loss of stored seeds and farm inputs	34.55	34.55	8.00	29.63	0.032**
Damage of pasture or forage	16.36	1.82	-	7.41	0.004***
Loss of off-farm jobs	3.63	5.45	4.00	4.44	0.892^{ns}
Damage to irrigation facilities	3.64	3.64	-	2.96	0.626^{ns}

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

4.5.4 Difficulties in farming faced by sample farm household groups after flood

After flood, difficulties in farming faced by sample farm household groups are shown in Table 4.17. 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 with low yield was 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 lack 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, lack 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 resulted problems in the crop production

due to flood. 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 with the lack of farm implements after flood. Only about 12%, 18% and 4% of farmers in specific group encountered with the difficulty for draft animals to use in crop cultivation after flood.

In summing the three groups, low yield in the agricultural production were 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 with insufficient of farm capital investment and pest or disease infestation due to flood. Continuously, the flood would significantly reduce the demand for casual agricultural labor by decreasing agricultural activity and therefore 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 lack of quality seeds as the main difficulties in their farming too. Pearson Chi-square test showed that there were significantly different at 1% level for lack of farm investment and failure to adequate amount of fertilizer, 5% level for infestation of disease or pests, scare of farm labor, lack of quality seeds and 10% level for low yield and lack of farm implements. It was showd that there were no significantly different in soil problems, low crop price, lack of improved technology, and difficulty in land preparation after flood, transportation problems lack 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 reduce up to 50% as compared to before flood. Some affected farmers left the yield of monsoon paddy from 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)

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

Table 4.17 Difficulties in farming faced by sample farm household groups after flood

No.	Item	% of farm households				Pearson Chi-square
		Group I	Group II	Group III	Total	
1	Low yield	90.91	89.09	72.00	86.67	0.055*
2	Lack of 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	Scare of farm labor	63.64	63.64	40.00	59.26	0.095**
5	Failure to use adequate amounts of fertilizer	58.18	52.73	20.00	48.89	0.005***
6	Lack of quality seeds for sowing	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	Lack of improved technology	30.09	30.91	16.00	28.15	0.326 ns
10	Difficulty in land preparation after flood	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	Lack of farm implements	23.64	23.64	4.00	20.00	0.086*
13	Lack of draft animals	12.73	18.18	4.00	13.33	0.221 ns

4.6 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 was located near the Kambalu Township and accessed easily transportation. However, seriously and moderately affected groups were situated very far from Kambalu and faced with difficulties in transportation.

Table 4.18 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 household in group III didn't 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, receiving around 32% in group I, 20% in group II and 28% in group III of sample farm households. Among them, a group II farm household was the lowest receipt by 20%. About 16.4% of group I farm households obtained the general property such as corrugated sheet, wood, cooking pans and plates etc.. In group II, 43.6% of farm households received it from the Government, but group III farm households not received the general property. As a result, Pearson Chi-square test showed that there was significantly different at 1% level for the aids of farm input, clothes, food stuffs, financial aid, purified water and general property among three groups.

In regarding to 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 to, financial aids for about 56% of sample were donated by

the Government aid, 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 form 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 etc. employed various number of coping strategies: (1) reducing household expenditure, (2) borrowing money and (3) selling household assets and livestock etc.. The results from Table 4.19 showed 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 rate. 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 especially gold were also employed 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 significantly different 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 significantly different 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 while selling housing assets and livestock could make lower living standard for them.

Discussions of farmers and key informants on coping strategies after flood

Participants from focus group discussion of seriously affected group reported that they was coped 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 to, 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 4.18 Aids received by sample farm household groups after flood in the study area

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 4.19 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 from relatives/ neighbors	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 of household assets	40.00	34.54	24.00	34.81	0.379ns
5	Use own saving	21.82	16.36	16.00	18.52	0.715ns
6	Take children out of school	9.09	7.27	-	6.67	0.311ns
7	Migration	3.63	7.27	-	4.44	0.319ns
8	Sell 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 the revenue function of monsoon paddy before and after flood, multiple linear regression function 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, and family labor engaged in the farm, number of cattle owned by sample farm households, cultivated area of monsoon paddy and non-farm income.

Table 4.20 shows that descriptive statistics of dependent and independent variables of revenue function of monsoon paddy before and after flood. In the results of descriptive statistics, average revenue of monsoon paddy by all sample farm households was 2,024,578 MMK/ha and 855,034 MMK/ha before and after flood. Average age of household's head was about 50 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 before and after flood. The average number of cattle decreased from 3.75 before flood to about 3.27 after flood. The average cultivated area of monsoon paddy was 3.04 hectares and 2.93 hectares before and after flood. On the other hand, the average non-farm income of all sample farm households was decreased from over 500,000 MMK/Yr before flood to 400,000 MMK/Yr after flood.

Table 4.21 describes the factors affecting revenue of monsoon paddy before and after flood. Before flood, revenue of monsoon paddy in the study area was positively and significantly influenced by cultivated area of monsoon paddy and non-farm income at 1% level, age and schooling years of household's head and family labor at 5% level respectively. It means that age and schooling years of household's head increase by 1 year and family labor increase by 1 person, revenue of monsoon paddy will be 0.172 MMK, 0.862 MMK and 1.218 MMK increased. In the same way, 1 ha increases in cultivated area of monsoon paddy will increase total revenue of monsoon paddy by 4.387 MMK while 1 MMK increased in non-farm income will also increase the revenue of monsoon paddy by 0.204 MMK. Revenue of monsoon paddy was also positively but not significantly related to number of cattle but negatively related to family members before flood.

After flood, total revenue of monsoon paddy was positively and significantly influenced by family labor, cultivated area of monsoon paddy and non-farm income at 5%

level respectively. It means that 1 person increases in family labor, 1 ha increase in cultivated area of monsoon paddy and 1 MMK increase in non-farm income will be 1.147 MMK, 1.284 MMK and 0.220 MMK of the total revenue of monsoon paddy increased. The revenue of monsoon paddy was also positively but not significantly influenced by schooling year of household's head and number of cattle but negatively and not significantly related to age of household's head and family size.

Before and after flood, the F values showed that the selected model was significant at 1% level. The R^2 values 0.691 and 0.248 mean that it can explain the variation in the revenue of monsoon paddy by 69.1% and 24.8% before and after flood.

According to the regression results, age schooling year of household's head was significantly influenced the total revenue of monsoon paddy before flood. Therefore, it was observed that the older and the higher education level of household's head can earn more revenue in monsoon paddy production in the study area. On the other, monsoon paddy revenue obtained immediately after flood cannot show any significant relation in the age and education level of sample household's head. When comparing to the revenue of monsoon paddy production before and after flood, the positive and significant relationship can be found the independent variables of family labor, non-farm income and cultivated area of monsoon paddy. It indicated that the higher the value of these variables induced the revenue obtained from monsoon paddy.

Table 4.20 Descriptive statistics of dependent and independent variables in revenue function of monsoon paddy before and after flood

Variable	Unit	Mean		Maximum		Minimum	
		Before	After	Before	After	Before	After
Total revenue of monsoon paddy	MMK/season	2,024,578	855,034	9,000,000	5,625,000	300,000	-
Age	Year	48.66	49.66	83.00	83.00	20.00	20.00
Schooling year	Year	5.53	5.53	15.00	15.00	-	-
Family size	Number	5.54	5.57	13.00	13.00	2.00	2.00
Family labor	Number	2.63	2.66	8.00	8.00	1.00	1.00
Number of cattle	Number	3.75	3.27	25.00	17.00	-	-
Cultivated area of monsoon paddy	Hectare	3.04	2.93	20.00	20.00	-	-
Non-farm income	MMK/Yr	503,452	408,073	6,840,000	3,450,000	-	-

Table 4.21 Factors affecting revenue of monsoon paddy before and after flood

Independent variable	Unstandardized Coefficients (B)		Standardized Coefficients (β)		T-value		Sig.	
	Before	After	Before	After	Before	After	Before	After
Constant	-8.298*	0.886 ns			-1.697	0.191	0.092	0.849
Age	0.172**	-0.001 ns	0.133	-0.001	2.578	-0.011	0.011	0.991
Schooling year	0.862**	0.412 ns	0.117	0.093	2.208	1.132	0.029	0.260
Family size	-0.672 ns	-0.601 ns	-0.086	-0.128	-1.532	-1.478	0.128	0.142
Family labor	1.218**	1.147**	0.113	0.178	2.038	2.153	0.044	0.033
Number of cattle	0.331 ns	0.312 ns	0.086	0.110	1.498	1.266	0.137	0.208
Cultivated area of monsoon paddy	4.387***	1.284**	0.702	0.340	12.166	3.858	0.000	0.000
Non-farm income	0.204***	0.220**	0.138	0.169	2.651	2.080	0.009	0.040

Note: Dependent variable: revenue of monsoon paddy in affected farm households before and after flood

R^2=0.691, Adjusted R^2= 0.674, F=40.494*** (before flood)

R^2=0.248, Adjusted R^2= 0.207, F=5.995*** (after flood) ***, **, * are significant level at 1%, 5% and 10% and ns is not significant.

4.8 Provision Sources of Disaster Information in the Study Area

Provision disaster information is needed to prevent various numbers of risks. Therefore, the sources of disaster information provided to the sample farm households including about the flood disaster in 2015 year were collected as described in Table 4.22. About 18% and 11% of sample farm households in group I and II received the information from Television + Radio while about 10%, 13% and 16% in specific group obtained from only Television and about 11%, 6% and 4% in each group accessed from only Radio. Only 6% and 15% from groups I and II received the information from Department of irrigation and water management in Kambalu Township and 44% of group III accessed information from it. By distributing the information from farmer to farmer, 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 Television + 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 didn't access it.

Table 4.22 Provision sources of disaster information of the sample farm households

No.	Information 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 increasing disasters. Therefore, this study was an attempt a short term impact of flood by comparing socioeconomic and agricultural production of flood affected sample farmers before and after flood and to describe losses and difficulties facing in farming, aids received 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 before and after flood. Primary data were obtained from 135 flood affected farm households selected from six sample villages by purposive random sampling in Kambalu Township. It included four focus group discussions and five key informant interviews to fulfill the data from household surveys. In this study, 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 household's head was around 50 and 26 years with average 6 schooling years indicating that their lower level of education background. The average family size was about 6 members including 3 family labors and 1 student and therefore 58% of family members were dependent. 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 didn't very differ in comparing before and after flood because the impact of flood was not the serious on these. However, there were significantly different in the household assets of mobile phone among the three groups before and after flood because they used more mobile phone to be

accessed quickly and easily disaster information 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 group 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, chicken and buffalo observed based on the survey results. The reason was that the chicken was wasted with flood and the cattle and buffalo were sold to cope their immediate basic needs after flood. 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 didn't 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 didn't significantly affected on the land ownership of sample farmers. In the study area, the cropping pattern of sample farm household groups didn't significantly differ before and after flood. However, the average yield of main cultivated crops was significantly reduced in all affected groups because the flood seriously destroyed the cultivated fields. 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. Additional findings found that yield losses on the main cultivated crops of sample farm household groups after flood. Therefore, monsoon paddy and sugarcane were the highest yield losses estimating 75% to 100% in seriously and moderately affected group. In the case of less affected group, monsoon paddy and maize were the most serious with 75% and 100% yield losses in less affected group. In the study area, losses of agricultural land and equipment and small

livestock were the severe losses in sample farm household groups. The reason why is covering the sand and debris to agricultural land and floating the farming equipment and small livestock due to flood.

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 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 included: use own saving, take children out of school, migration and sells land or home.

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 the most serious crop of 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, non-farm income and cultivated area of monsoon paddy showed as significant factors to get high revenue for monsoon paddy production by engaging and investing more on it before and after flood. Age and education level of household's head is also important in managing and decision making on the farming activities to receive high revenue on the monsoon paddy production before flood, however this demographic characters seem not significantly influence the paddy revenue immediately after flood.

5.2Recommendation of the Study

In the study area, the impact of flood was mainly on crop production by reducing yield because it was seriously destroyed the cultivated fields. Consequently, affected farm households faced with low crop income and insufficient farm investment for the next season. The study was also found that the adverse impact such as losses of crop production, farm assets, livestock assets and household property on the sample farm households in the study area. Among these losses, yield reduction of

the common crops grown in this area can be seen as the worst short term impact while the land deterioration was the long term impact of flood. Therefore, the disaster risk assessment of crop production activities is essential in order to maintain and improve the livelihoods of affected farm households. The development of sustainable farming system through climate resilient varieties, improved technology and soil conservation practices etc. would be introduced in order to sustain crop production. There is also needed to create non-farm job opportunities and provide credit to be able to get high revenue of crop production by using more farm inputs to overcome the impact of flood.

In the study area, almost all of the sample farmers in less affected groups received the aids especially foods due to its convenient transportation situation. 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 is 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.

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, provision of the local weather forecast would help to reduce the adverse impacts of disaster on agriculture. Moreover, the information should be disseminated by timely and regularly to be able to prevent future risks.

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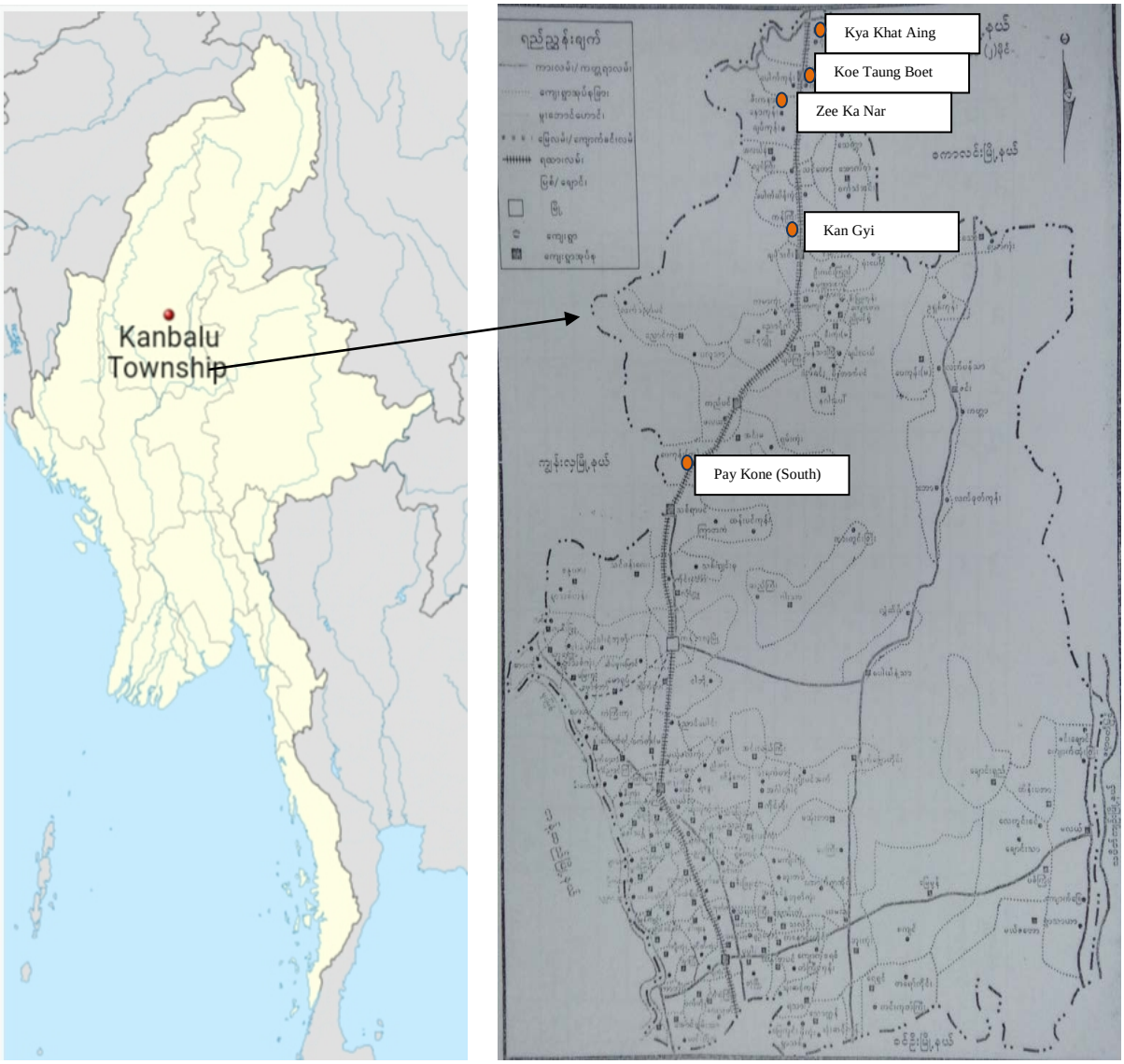
APPENDICES



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	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	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	Pay Kone (South)	Daw Aye Aye Myint	Female	57	9	Clerk from general administrative office

Photos are books which have been published by YAU_ACIAR_ Strengthening Institutional Capacity, Extension Services and Rural Livelihoods in the Central Dry Zone and Ayeyarwaddy Delta Region of Myanmar (ASEM-2011-043)

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