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Flood Impact on Socio-economic Status and Crop Production in Farm Households in Kambalu Township, Sagaing Region

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ABSTRACT

In Myanmar, agriculture is most sensitive to disasters as the nature of crop production is mainly dependent on weather conditions. Among the disasters, floods resulted from the effect of Cyclone Komen in 2015 had a severe impact on the livelihood of rural households that rely on agriculture. Therefore, This study was emphasized to estimate a short term impact of floods by comparing socioeconomic conditions and to determine the factors affecting on the revenue of monsoon paddy production before and after floods and coping strategies adopted by sample farm households in Kambalu Township, Sagaing Region. Primary data were obtained from 135 floods affected farm households from six sample villages by using purposive random sampling in the study area. Descriptive statistics, paired sample t-test and regression analysis were used to compare and analyze the data from sample farm households before and after floods. Based on the findings, the average age of household's head was around 50 years with average 6 schooling years and 26 years of working experience in farming. There were significantly different in the household, livestock and farm assets of mobile phone, cattle, chicken, harrow, plough and boat before and after floods. The flood extremely reduced yield of monsoon paddy, sugarcane and maize up to 52%, 71% and 64% respectively after flood. The lower yield of crop production resulted in lower farm income in the study area. Therefore, sample farm households faced with insufficient farm investments and they adopted commonly reducing household expenditure, borrowing money, selling household assets and livestock as their coping strategies. The regression analysis showed that, flooding in the study area had negative effect on the revenue of monsoon paddy production which is the main income source of sample farmers because of high yield reduction due to flood. However, family labor and non-farm income were significantly influencing factors to get high revenue for monsoon paddy production by engaging and investing more on it before and after the flood. As a result, there is a need to create non-farm income activities and credit, improved agricultural technology, disaster awareness information and adaption's education program to overcome the negative impact of disaster.

Key words: affected farm households, flood, monsoon paddy production, coping strategies

INTRODUCTION

The impacts of natural and man-made disasters have been increasing through the passage of time by losing lives and properties 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 people and societies becoming more vulnerable to disasters. Impact depends on development practices, environmental protection, human activity, regulated growth of cities, distribution of people, wealth and government structures (ISDR, 2004).

Myanmar has experienced a number of natural disasters such as floods, cyclones earthquakes and landslides that have caused serious damage in the recent years. The disaster affects not only the lives of the population but also production and productive assets especially in the rural area. More recent disasters in Myanmar included the tsunami in 2004, severe landslides in the mountainous region in 2005 and Cyclone Mala in 2006 (Ponja, Post Nargis Recovery, 2009). In 2008, Cyclone Nargis was the worst natural disaster in the history of Myanmar. It was also the most devastating cyclone to strike Asia. Moreover, as a country prone to heavy rainfall, floods occur regularly during the mid-monsoon period (June to August) in areas traversed by rivers or large streams (Mohamed, 2009). Therefore, on 30 July 2015, the floods that resulted from Cyclone Komen nearly spreading across 12 states of Myanmar's out of 14 states and regions had a severe impact on rural livelihoods that rely on agricultural activities and food security according to a joint Government-United Nations report (UNICEF, 2015). The six most-affected regions/states were Ayeyawady, Bago, Sagaing, Magway, Rakhine and Chin. 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. Sagaing is the second most affected state with over 30,000 ha of cultivated land washed away, followed by Bago and Magway(FAO, 2015). In the lower part of Sagaing region included in Central Dry Zone of Myanmar, Kambalu Township was the worst affected Township in terms of destroyed crop's areas on cultivated land (DoA, 2016). The reason why Kambalu Township was selected as the study area is to understand socioeconomic conditions and monsoon paddy production of affected farm households before and after floods.

Data collection and data analysis

Both primary and secondary sources of data were used in this study. Field survey was carried out in October 2016, one year period after flood in 2015. The primary data were gathered from 135 flood affected farm households of six sample villages with household interview by using purposive random sampling method.

Descriptive statistics and Paired sample t-test were used to identify and compare the primary sets of data with Microsoft excel and SPSS version 17 software.

The Log linear form of Cobb-Douglas function was used for total revenue of monsoon paddy production before and after flood was as follow:

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

Where,

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

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

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

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

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

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

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

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

D_{1i}= before and after flood in the

RESULTS AND DISCUSSION

Background information of sample farm households in the study area

Kambalu Township in Sagaing region was included one of the seriously affected areas in 2015 due to the heavy rains in Myanmar from the effect of Cyclone Komen. One hundred and thirty five sample farm households were collected from six sample villages of Pauk Sein Kone, Zee Ka Nar, Shaw Phu Kone, Kya Khat Aingh, KoeTaung Boet and Pay Kone (South) in Kambalu Township, Sagaing Region as described in Table 1.

Demographic characteristics and gender status of household's head

Demographic characteristics and gender status of household's head are presented in Table 2. The average age of all sample household's head was around 50 years within a range of 24 to 83 years with 26 years of farming experience in the range between three and 50 years. In the study area, the majority of the household's head completed primary and middle education level with around six schooling years. The maximum schooling years of sample household's head was about 15 while some are illiterate in the study area. The number of family members in average was around five members with the range of two to 13. In terms of family members, sample farm household possessed an average of three family labors and one student attending graduate or undergraduate level. Results of the average dependency ratio among the sample farm households were 58% of all family members. In the study area, about 87% of sample farm households were headed by males while 13% of household's head were females.

Table 1. Number of sample farm households in the selected villages of Kambalu Township

Village tract	Village	Sample farm households
KanGyi	PaukSeinKone	8
Zee Ka Nar	Zee Ka Nar	16
	Shaw PhyuKone	31
KyaKhatAingh	KyaKhatAingh	25
KoeTaungBoet	KoeTaungBoet	30
Pay Kone (South)	Pay Kone (South)	25
Total		135

Source: Department of Agriculture, 2016

Table 2. Demographic characteristics of sample farm household in the study area

Item	Mean	Range
Age of household's head	49.73	24-83
Farming experience of household's head	25.60	3-50
Schooling years of household's head	5.53	0-15
Family members	5.59	2-13
Family labor in sample farm households	2.66	1-8
No. of students in sample farm households	1.16	0-4
Dependency ratio	58.00	-
Gender	**Frequency**	**Percent**
Male	118	87.41
Female	17	12.59

Household assets of sample farm households before and after flood

Household assets of sample farm household before and after flood were shown in Table 3. In this table, all selected farm households possessed nearly the same number of their household assets except mobile phone before and after flood. The paired sample t-test described that there was significant difference in mobile phone possession in all farm households by increasing mean value from 1.46 before flood to 1.50 after flood. They bought more mobile phone than before flood. The reason was that they wanted to access the information especially on disasters as quickly as possible through the internet or SMS. The average numbers of motor cycle and bicycle for all affected farm households slightly reduced more than before flood because of the losses during flood. It was also observed that there was no significant difference in the average number of TV, radio, sky net, car, motor cycle, bicycle and sewing machine before and after flood among the affected farm households.

Table 3. Household assets of sample farm households before and after flood

Items	Before	After	t-test
Mobile phone	1.46	1.50	-1.745^{*}
TV	0.644	0.644	0.000^{ns}
Radio	0.33	0.33	0.446^{ns}
Sky net	0.10	0.10	-
Car	0.00	0.00	-
Motor cycle	0.71	0.70	0.576^{ns}
Bicycle	0.38	0.36	1.346^{ns}
Sewing machine	0.17	0.17	-

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

Farm assets of sample farm household before and after flood

During flooding, the average possession of farm assets such as harrows, ploughs and boats of all sample farm households extremely decreased from 1.58, 1.54 and 0.26 to 1.36, 1.33 and 0.24 because some of their farm implements floated along the river or stream. Therefore, the paired sample t-test showed that it was significantly different at 1% level for harrows and ploughs and at 10% level for boats before and after flood. However, it was found that the average possession of farm asset decreased slightly from 0.47 before the flood to 0.46 after the flood as it was covered by sand due to the flood. In addition, bullock carts and water pumps also decreased from 1.16 and 0.32 before the flood to 1.14 and 0.31 after the flood. Sprayer possession stayed the same before and after the flood in the study area. It was also

found that sample farm households used more tractors from 0.11 before the flood to 0.13 after the flood. However, paired sample t-test described that there was no significant difference in the average possession of bullock carts, sprayers, water pumps, tractors and well of sample farm households (Table 4).

Livestock assets of sample farm household before and after the flood

The farm households in the study area used cattle for crop production activities while chicken, pig, duck and sheet also were raised for their extra family income. In all sample farm households, the average number of cattle significantly decreased from 5.17 before the flood to 4.44 after the flood as they were sold to cope with their immediate basic needs due to the flood. On the other hand, the average number of chickens also extremely reduced from around 21 to 9 after the flood as they were killed by flooding. However, it was found that pigs were lost slightly from 2.13 to 1.50 in the study area while sheeps and ducks do not differ much before and after the flood (Table 5).

Table 4. Farm assets of sample farm households before and after the flood

Item (Number)	Before	After	t-test
Harrow	1.58	1.36	4.055***
Plough	1.54	1.33	4.295***
Boat	0.26	0.24	1.745*
Bullock cart	1.16	1.14	1.420ns
Sprayer	0.43	0.43	0.000ns
Water pump	0.32	0.31	0.377ns
Tractor	0.11	0.13	-1.420ns
Well	0.47	0.46	1.420ns

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

Table 5. Livestock assets of sample farm households before and after the flood

Item (Number)	Before	After	t-test
Cattle	5.17	4.44	2.797***
Chicken	20.91	9.45	2.777***
Duck	0.08	0.19	1.069ns
Pig	2.13	1.50	1.568ns
Sheep/goat	0.45	0.45	-

Note: *** is significant at 1% and ns is not significant

Crop yield of sample farm households before and after the flood

Most of the farmers in the study area mainly cultivated monsoon paddy in lowland. In upland, the main cultivated crops were sugarcane, maize, groundnut and sesame in sample farmers before and after the flood.

In the study area, all sample farmers experienced 52% yield reduction of monsoon paddy because they received the yield of over 2,700 kg/ha before the flood and 1,200 kg/ha after the flood. The paired sample t-test showed that it was significantly different for average yield of monsoon paddy at 1% level before and after the flood. As for upland crop, the average yield of brown slab-sugar extremely decreased from approximately 2,166 kg/ha to 625 kg/ha

before and after the flood. As a result, they encountered 71% yield reduction due to the flood. Therefore, paired sample t-test showed that highly significant differences were found in the average yield of brown slab-sugar before and after the flood. According to the results, the average yield of maize extremely decreased from 2,599 kg/ha before the flood to 939 kg/ha after the flood. As a result, they faced yield reduction by 64% for maize due to the flood. Paired sample t-test showed that it was significantly different at 1% level for the average yield of maize before and after the flood. Paired sample t-test showed that it was significantly different at 1% level for the average yield of groundnuts before and after the flood. However, the average yield of sesame with 30% reduction was not significantly different before and after the flood (Table 6).

Table 6. Crop yield of sample farm households before and after flood

Crop	Before (kg/ha)	After (kg/ha)	Yield reduction (%)	t-test
Monsoon paddy	2,702.51	1294.62	52.10	12.072***
Brown slab-sugar	2,165.98	624.98	71.15	6.396***
Maize	2,599.95	938.69	63.90	3.187***
Groundnut	977.02	684.26	29.96	2.975***
Sesame	229.02	161.37	29.54	1.579ns

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

Income compositions of sample farm household before and after flood

All sample farm households in the study area mainly relied on agriculture for their main household income, followed by livestock production, handicraft making and working as casual labor. Therefore, crop income was the highest portion for all farm households with about 80% of total household income before and after the flood. The income composition of those was occupied by about 58% of paddy and 30% of other crops before flood as compared to 50% of paddy and 26% of other crops after flood because of high yield monsoon paddy production due to flood. After flood, the income composition of livestock production, causal labor, government staff and company staff significantly increased from 5%, 3%, 1% and 1% to 8%, 8%,3% and 2% respectively. In the study area, the income share of handicraft is the same before and after the flood. Among them, 1% income composition of carrier/ driver is the increased one after flood.

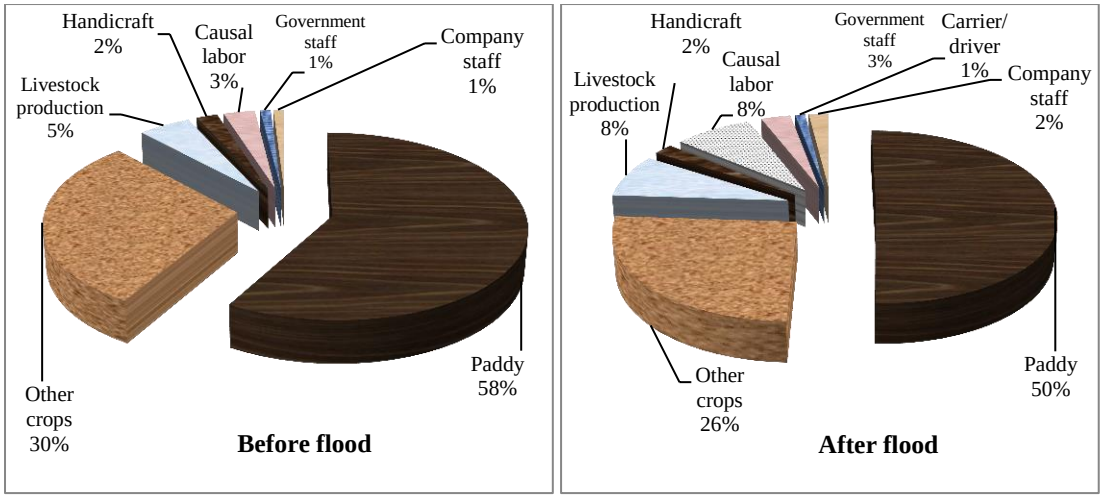

Fig. 1. Income compositions of sample farm households before and after flood

Difficulties in farming faced by sample farm household after flood

After the flood, the difficulties in farming mainly faced by sample farm households were described in Figure 2. The impact of flood highly reduced yields of the main cultivated crops in the study area. Therefore, low yield in the agricultural production was also the main difficulties for about 87% of all sample farm households due to the flood. As a result, about 76% and 73% of all sample farmers faced insufficient farm investment and pest or disease infestation due to the flood. Simultaneously, about 59% of sample farmers had to face labor scarcity for farm after flood. Approximately 49% and 50% sample farmers had inadequate amount of fertilizers and quality seeds as the main difficulties in their farming too.

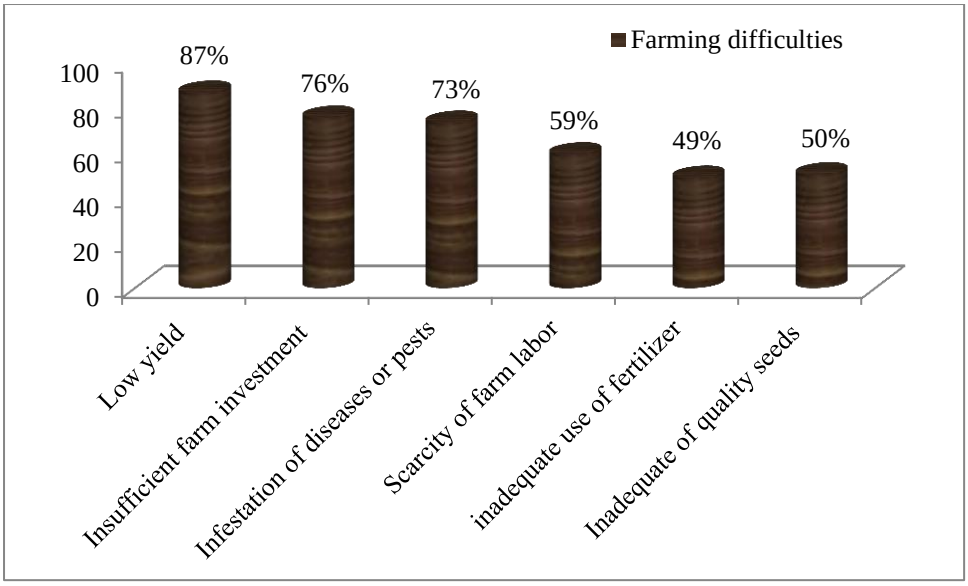

Fig. 2. Difficulties in farming faced by sample farm households after flood

Coping strategies used by sample farm household after flood

The results from Figure 3 show the most common coping strategies adopted by sample farm households in the study area. In response to property damage including crop fields, livestock and agricultural inputs, farm households employed various number of strategies to cope with flooding. The majority of the sample farm households in the study area used reducing household expenditures as their first most used coping strategy and the second most used strategy for all sample farm households was borrowing money from relatives/neighbors with high interest rate. Moreover, around 41% of the sample farm households adopted selling livestock to cope with their immediate basic needs due to the flood while selling household assets especially gold were also employed by about 35% farm households as their coping strategies after flood.

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

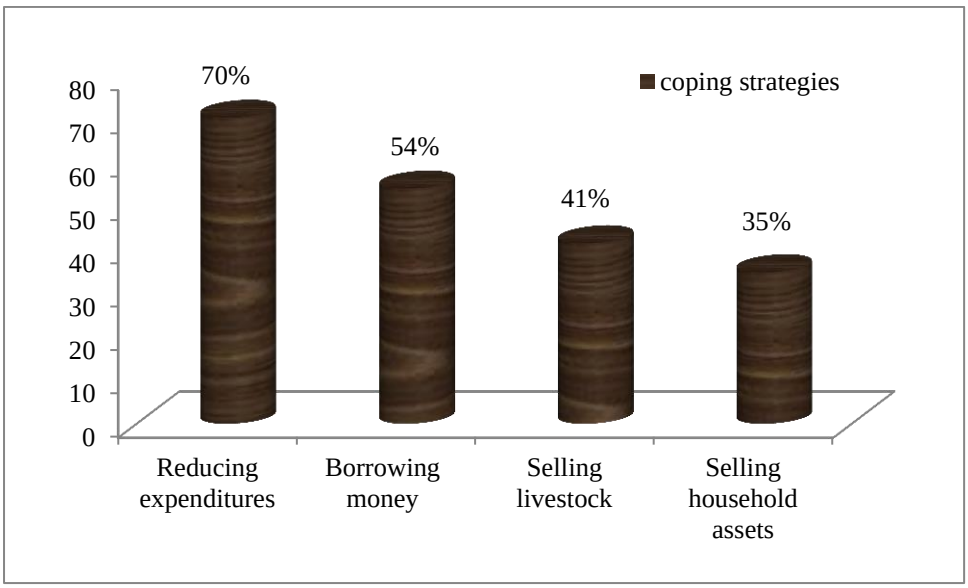

Fig. 3. Coping strategies used by sample farm households after flood

Factors Affecting Revenue of Monsoon Paddy before and after Flood

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

The descriptive statistics of dependent and independent variables of revenue function of monsoon paddy were shown in Table 7. In the results of descriptive statistics, average revenue of monsoon paddy by all sample farm households was 531572 MMK/ha (431.47 USD/ha) while the highest revenue was 1853250 MMK/ha (1504.26 USD/ha) and the lowest was zero. Average age of household's head was about 49 years with a range of 20 to 83 years and their average schooling year was 6 years. Average family size of all farm households was about 6 persons with about 3 family labors on average. The average number of cattle owned by affected farm households was 4. The average cultivated area of monsoon paddy was 3.04

hectares. On the other hand, the average non-farm income of all sample farm households was 460059 MMK/Yr (373.42 USD/Yr) with the maximum 6840000 MMK/Yr(5551.94 USD/Yr) and minimum zero non-income. In this case, dummy variable was used as before and after the flood in the study area where before the flood represented 0 that occupies 50% of the total area and after flood represented 1 that occupies another 50%.

The factors affecting revenue of monsoon paddy in affected farm households are described in Table 8. Before and after the flood, total revenue of monsoon paddy was positively and significantly influenced by family labor and non-farm income at 1% level respectively. It means that each 1% increases in family labor and non-farm income will increase by 1.424% and 0.127% of the total revenue of monsoon paddy increased. Additionally, the dummy variable was negatively correlated with revenue of monsoon paddy at 1% level showing that revenue of monsoon paddy in affected farm households reduced 2.770% after the flood. Revenue of monsoon paddy was also positively but not significantly related to age and schooling year of household's head and number of cattle, while it was negatively correlated to the cultivated area of monsoon paddy.

The F values showed that the selected model was significant at 1% level. The R2 values 0.220 means that it can explain the variation in the revenue of monsoon paddy per hectare by 22% before and after the flood.

Table 7. Descriptive statistics of dependent and independent variables in revenue function of monsoon paddy

Variable	Unit	Mean	Maximum	Minimum
Total revenue of monsoon paddy	USD/ha	431.47	1504.26	0
Age	Year	49.16	83	19
Schooling year	Year	5.53	15	0
Family labor	Number	2.63	8	1
Number of cattle	Number	3.51	25	0
Cultivated area of monsoon paddy	Hectare	2.99	20.23	0
Non-farm income	USD/Yr	373.42	5551.94	0
Before and after flood in the study area (dummy)	After flood = 1 (50%)		Before flood = 0 (50%)	

Table 8. Factors affecting revenue of monsoon paddy before and after flood

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

Note: Dependent variable: revenue of monsoon paddy per hectare before and after flood
R2=0.220, Adjusted R2= 0.199, F=10.537***
*****, **, * are significant level at 1%, 5% and 10% and ns is not significant.**

Summary and Conclusion

This study was an attempt to analyze the short term impact of flood on socioeconomic conditions and agricultural production of sample farm households before and after the flood. The study was observed that average age and farming experience of the sample household's head were around 50 and 26 years indicating that their age and years of farming experience is enough to make better decision on farming. However, they attained lower level of education background with average 6 schooling years indicating less knowledge to prevent and aware disaster impact.

It can also be found that most of the household assets did not differ much in comparing before and after the flood. However, there were significant differences in the household assets of mobile phone among the sample farm households because they used more mobile phone to access disaster information quickly and easily from internet or SMS. The highest significantly losses of farm assets such harrows, ploughs and boats was found in sample farm households because some of their farm implements were floated along the stream when it was flooding in the study area. Moreover, significant losses of cattle and chicken observed based on the survey results. The reason was that the chicken was wasted due to the flood and the cattle were sold to cope their immediate basic needs after flood.

As for crop production, the average yields of main cultivated crops were significantly reduced after the flood. This lower yield resulted to lower farm income which leads to insufficient farm investment for the upcoming season. In the study area, sample farm households commonly used coping strategies like selling household assets and livestock could cause to lower living standard for sample farmers in the long term and borrowing money with high interest rate which leads to higher debt in the future.

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

In the study area, yield reduction of the common crops grown in this area can be seen as the worst short term impact among the losses. To cope with the impact of flood, sample farmers commonly used coping strategies based on their resources and knowledge. It also needed to provide the training program and disaster awareness information to prevent and aware the risk and to cope the disaster impact. On the other hand, there is a need to create non-farm income activities and provide credit to overcome the impact of flood and to get high revenue of crop production including monsoon paddy by investing more farm inputs.

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