EFFECTS OF FLOOD ON THE LIVELIHOOD OF RURAL FARMERS UNDER THE SADAR UPAZILLA OF GAIBANDHA DISTRICT

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CERTIFICATE

This is to certify that the thesis entitled **"EFFECTS OF FLOOD ON THE LIVELIHOOD OF RURAL FARMERS UNDER THE SADAR UPAZILLA OF GAIBANDHA DISTRICT"** submitted to the Department of Agricultural Extension and Information System, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTERS OF SCIENCE (M.S.)** in **AGRICULTURAL EXTENSION AND INFORMATION SYSTEM**, embodies the result of a piece of bonafide research work carried out by **MD. SUJON AKANDO**, Registration No. 19-10344 under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that any help or source of information, received during the course of this investigation has been duly acknowledged.

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Dedicated to
My
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EFFECTS OF FLOOD ON THE LIVELIHOOD OF RURAL FARMERS UNDER THE SADAR UPAZILLA OF GAIBANDHA DISTRICT

ABSTRACT

Floods have caused difficulty in mobility, increased risk for living at houses, and erosion of social assets. Likewise, damage of agricultural production, livestock and fisheries were occured. Increased health hazards, loss of agricultural production, less return from animal husbandry, poor performance of social institutions, changes in cropping pattern and reduction in the crop production are immediate effects of flood on the livelihood of farmers. The main purpose of this study was to determine the effects of flood on the livelihood of rural farmers under the Sadar Upazilla of Gaibandha district and explore the contribution of the selected characteristics of the growers on their livelihood status due to effects of flood. The selected characteristics were age, education, family size, farm size, annual family income, training exposure, extension contact and innovativeness. Data were gathered from proportionally and randomly selected 101 farmers of two villages of Poshim Komornoi and Fakirpara of Sadar upazila under Gaibandha district by using a pretested interview schedule during the period of 1st September to 30 October, 2021. Apart from descriptive statistical methods, Pearson's Product Moment Correlation Co-efficient analysis was used in order to analyze the data. Findings indicated that the majority (46.53%) of the respondents belongs to medium livelihood status, 32.67% belongs to high and 20.79% were under low livelihood status. Out of eight selected characteristics of the respondents, education, annual family income and extension contact had positive significant relationship with their livelihood status due to effects of flood. The rest of the variables namely: age, family size, farm size, training exposure and innovativeness did not show any significant relationships their livelihood status due to effects of flood. To upgrade livelihood status of the study area; educational status, training program in different aspect, motivational campaigning and provide guidance and also increasing of awareness of flooding effect by different GO and NGO extension agencies are necessary.

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ABBREVIATIONS AND ACRONYMS

AEZ	=	Agro-Ecological Zone
BBS	=	Bangladesh Bureau of Statistics
BCSRI	=	Bangladesh Council of Scientific Research Institute
cm	=	Centimeter
CV %	=	Percent Coefficient of Variation
DAS	=	Days After Sowing
DMRT	=	Duncan's Multiple Range Test
et al.,	=	And others
e.g.	=	exempli gratia (L), for example
etc.	=	Etcetera
FAO	=	Food and Agricultural Organization
g	=	Gram (s)
i.e.	=	id est (L), that is
Kg	=	Kilogram (s)
LSD	=	Least Significant Difference
m^2	=	Meter squares
ml	=	MiliLitre
M.S.	=	Master of Science
No.	=	Number
SAU	=	Sher-e-Bangla Agricultural University
var.	=	Variety
ºC	=	Degree Celceous
%	=	Percentage
NaOH	=	Sodium hydroxide
GM	=	Geometric mean
mg	=	Miligram
P	=	Phosphorus
K	=	Potassium
Ca	=	Calcium
L	=	Litre
µg	=	Microgram
USA	=	United States of America
WHO	=	World Health Organization

CHAPTER I

INTRODUCTION

1.1 Background

A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living (ILO, 2006; DFID, 1999). Livelihood is represented as a whole of dynamic interactions between actors and five vital capitals i.e. human, natural, physical, financial, and social capital. These capitals constitute livelihood building blocks (Carney, 1998).

Rural livelihoods are not limited just to income derived solely from farming but it is a holistic way of looking on their livelihood strategies. Regarding strategies Scoones (1998) and Ellis (2000) considered agricultural intensification, livelihood diversification, and migration as the three core livelihood strategies. In addition, multiple employments are also a potential livelihood strategy on part of the rural people when the farm does not provide an adequate amount of income to the peasant families (Dharma, 1994; Upton, 1996).

Bangladesh is a flood plain country with an area of about 147,570 sq. km; 6.7% of which consist of rivers and island water bodies (Ahmed 2001). Due to its unique natural settings, Bangladesh is most vulnerable to several natural hazards and every year natural calamities upset people's lives in some part of the country (UNEP 2001). Flood is the most common of them and some 30 to 35% of the total land surface of the country is flooded every year during monsoon season (Milliman *et al*. 1989).

Thousands of people die, millions become homeless, and properties and infrastructures are greatly damaged by the calamities of flood every year all over the world (Dewan, 2015, Parvin, *et al*., 2016). Since, Bangladesh stands on typically sedimentary and flat land at the gateway of the Ganges-

Brahmaputra-Meghna (GBM) basinsand is extensively documented as a country with highlyvulnerable to flooding and cyclone (Ruane, 2013).

Bangladesh is one of the most climate-vulnerable (especially related to flood) countries in the globe, the farmers of this country are extremely inclined to agricultural damage (Huq *et al*., 2015). It is worth noting that the small-scale farmers in the agricultural countries such as Bangladesh are primarily distressed by flood due to their extreme reliance on agriculture for sustaining their livelihoods (Fakhruddin *et al*., 2015). The country is crisscrossed by hundreds of rivers. Bangladesh faces floods almost every year (Younus and Harvey, 2014). An increase of water level of a sea, river and lake may cause flood and occurrences of flood may take place because of severe hydro and climatological actions.

People from all classes including poor, middle class and rich face difficulties in leading their normal life during and after a devastating flood. Normal floods are seen as a blessing because they bring economic and environmental benefits by making arable land fertile and leading to an augmentation of agricultural production, while high magnitude floods are viewed as disastrous as they inundate large areas and cause widespread damage to crops, livestock and property as well as devastation to life and livelihoods (Blaikie *et al*. 1994, Handmer *et al*. 1999, Few 2003). As a result, the flood caused significant losses to agriculture (e.g. seed stocks, irrigation, livestock, farmland), and resulted increase in poverty and misery of affected small farmers who were residing on cops production (Mirza *et al*., 2003; Uddin *et al*., 2017).

1.2 Statement of the problem

The magnitude of the floods depend upon a number of factors like intensity and duration of rainfall, ground conditions, drainage characteristics, siltation of river-bed, erosion of banks, and human settlements in flood plains and on river banks (Islam *et al*., 2015). Historically, floods have become a common phenomenon in Bangladesh due to its low-lying landscape. Almost every year,

a major part of the country is flooded. Including the other damages, the farmers are generally identified as the most affected group due to the weak alarming system of flood and post-flood management strategies (Ara, 2019).

Bangladesh is most susceptible to global warming. This is owing to its topographical position, over population, high poverty rate, occurring regular floods, low lying from the sea and dependency on its nature and resources. Bangladesh experienced extreme climatic events that causing dramatic changes in people's lives as well as in agriculture (Ara, 2019). The regularity of natural calamities has been going up than previous years because of climate alteration, which eventually leading huge loss to people, society as well as effects on the environment. Huge amount of agricultural land is being brushed away and crops go under water through river erosion, sedimentation and inundation caused by the floods (Ara, 2019).

The major disasters that affect in Bangladesh are floods, cyclones, storm surges, flash floods, drought, tornados, riverbank erosions, and landslides. Floods constitute about 50% of all natural disasters, and as a result, life and livelihoods are regularly affected by flooding (Ali *et al*. 2019). Floods affect about 215 million people per year, 95% of whom live in Asia (Saulnier *et al*. 2018). Between 1980 and 2008, Bangladesh experienced 219 natural disasters that caused over USD$16 billion in total damage (Uddin *et al*. 2019). Agriculture sector is mostly affected during flood. The foremost adverse effect of flood on agriculture is water logging in the cropping area. Crops do not survive under water after a certain period and crops production gets affected severely after that period. Flood is a long-lasting disaster and cash crops are easily damaged by flood which ultimately pose an adverse effect on overall economic loss (Rahman, 2014).

A livelihood is sustainable when it can cope with and recover from stresses and shocks, and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base (DFID, 2000). It was

also proved by the many researchers such as Ashley and Carney (2002) sustainable livelihoods thinking has also been criticized for underplaying the importance of one or more critical factors including vulnerability, gender and market. In this disaster, many people lost their lives, land area was affected and caused a loss of billions of dollars through damage to livelihood including housing, agriculture and livestock, health, infrastructure and family assets but the most immediate effects of erratic flood on rural livelihoods was on crop production. Nearly two-thirds of the total population and 80% of the country's poor live in rural parts of the country which is heavily dependent on agriculture. Majority of the population resides on crops farming. Rice, wheat, sugar cane, vegetables and fruits are grown here and the major crops damaged by devastating floods.

On the basis of the above discussion, the researcher undertook an investigation entitled "**effects of flood on the livelihood of rural farmers**". The main purpose of the study was to determine the effect of flood on different parameters of selected areas regarding livelihood status of rural farmers to ascertain the contribution of the selected characteristics of the farmers to their livelihood status. However, the study attempts to find out the answers to the following questions:

1. To what extent the farmers livelihood status regarding income generating activities and what activities have been done against flood?
2. What are the selected characteristics of the farmers in the flood prone areas?
3. To what extent relationships exist between the selected characteristics of the farmers and their livelihood status regarding the effects of flood?

1.3 Specific objectives of the study

In order to give proper direction to the study the following specific objectives are formulated:

1. To assess the extent of the activities of rural farmers considering livelihood status due to the effects of flood,
2. To describe following determinant factors of the respondents:
   a) Age
   b) Education
   c) Family size
   d) Farm size
   e) Annual family income
   f) Training exposure
   g) Extension contact
   h) Innovativeness
3. To explore the relationships between the selected characteristics of the farmers and their livelihood status regarding flooding consequence

1.4 Assumptions of the study

An assumption is the idea that an apparent fact or principle is correct in light of the available evidence (Goode and Hatt, 1952). The following assumptions were made by the researcher while undertaking the present study:

1. The subjects selected for the study were able to reply sufficiently to queries designed by the researcher.

2. The responses furnished by the respondents were applicable and dependable.

3. Information given by the selected respondents was representative of the study area.

4. The researcher who took action as interviewer was well adjusted to the social and cultural environment of the study area.

5. The respondents include in the sample were competent proper responses to the items included in the interview schedule.

6. The data collected by the investigator were free from bias and prejudice.

7. The characteristics of the rural people as well as the indicator of livelihood status in flooded areas were normally and independently distributed with their respective means and standard deviation.

8. The environment conditions of the rural people were more or less similar throughout the study area.

9. The findings of the study were expected to be helpful for planning and implementation of various programs in connection with the livelihood status of rural farmers of the country.

1.5 Scope of the study

The frequency of natural disasters has been increasing over the years, resulting in loss of life, damage to property and destruction of the environment. Flood losses reduce the assets of households, communities and societies through the destruction of standing crops, dwellings, infrastructure, machinery and buildings, apart from the tragic loss of life. In some cases, the effect of extreme flooding is dramatic, not only at the individual household level, but also in the country as a whole. In the Asian region, the picture is more serious rather than the developed countries. Floods in South Asia are mainly driven by the unique hydro meteorological and monsoonal influences in the region.

The people of flood affected areas use their indigenous knowledge and techniques to cope with such diverse situation. So it is important to indicate and improve the indigenous knowledge to overcome bad effect during flood. Bangladesh is most susceptible to global warming. This is owing to its topographical position, over population, high poverty rate, occurring regular floods, low lying from the sea and dependency on its nature and resources. The foremost adverse effect of flood on agriculture, livestock and fisheries is water logging in the area. Crops do not survive under water after a certain period and crops production gets affected severely after that period. Flood is a long-lasting

disaster and cash crops including livestock and fisheries are easily damaged by flood which ultimately pose an adverse effect on overall economic loss.

Identifying and understanding factors that cause or influence the problem as well as its intensity at farm family level deserves rigorous empirical research where food safety and shortage has been pronounced and has great importance for policy implications and interventions. The results of the study will provide policy related information that helps to prioritize among the many possibilities depending on the relative extent of influences of its determinants.

More specifically, it will help concerned bodies in their effort to formulate policies and develop intervention mechanisms that are modified to the specific need of the study area. Furthermore, this study will attempt to make further contribution to the previous studies and can be used as a source material for further studies. The findings will also help to investigate how floods effect on livelihood of rural people regarding agricultural activities including livestock and fisheries and increase vulnerability of agriculture to natural disasters. Consequently, this study can have a most important influence to improve livelihood of farmers to household activities (agriculture, livestock and fisheries) in Bangladesh.

1.6 Limitations of the study

The respondents of the study were selected from Sadar Upazila of Gaibandha district. But the findings may be applicable in other area of Bangladesh where the physical, socio-economic and cultural conditions are alike with those of the study area. However, in order to conduct the research in a meaningful and manageable way it becomes necessary to impose certain limitations in regard to certain aspects of the study, considering the time money and necessary resources available to the researcher. The study was conducted with the following limitations

1. The study was confined to a selected area *i.e.* Sadar Upazila of Gaibandha district.

2. Population of the study was limited to the flood affected households.

3. Households of selected study area have many variables but in this study only nine variables were selected for investigation.

4. Data furnished by the respondent households were considered to be valid and reliable. The researcher relies on the information furnished by the respondents while interviewing.

5. All data and other information were collected within short possible time.

6. Limited facts and figures collected by the investigator considering prevailing situation.

7. unwillingness of the respondents to provide information was overcome through establishing rapport.

1.7 Definition of the important terms

In order to avoid confusion and misunderstanding, certain terms used throughout the study are defined as follows:

1.7.1 Livelihood

Livelihood is a means of keeping one alive. The meaning of the word also changed to mean support for a person's life. That naturally came to mean your job, which provides the monetary support to keep you going.

- Livelihood is the job or other source of income that gives you the money to buy the things you needs (British English).

- The definition of livelihood is the way you make your living and pay for the basic things you need in life. It is a way of earning money in order to live. It is the means of living, especially of earning enough money to feed oneself etc. In

other word livelihood means of support or subsistence. A means of supporting one's existence, especially financially or vocationally; living: to earn a livelihood as a tenant household. The quality or state of being lively. Livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living (Carpenter *et al*., 2012).

1.7.2 Age

Age of a respondent was defined as the period of time in years from his/her birth to the time of interview.

1.7.3 Education

Refer to the completed years of schooling by the respondents at the time of interview.

1.7.4 Family size

Family size was defined as the numeral of individual in the family including family chief and other trustful members who lived and ate together.

1.7.5 Farm size

Farm size of a respondent refers to the area of homestead, cultivated land, fruit land, area of pond, area of poultry rearing, cattle husbandry and others land their family owned or obtained.

1.7.6 Annual family income

It was defined as the total earning of the respondent from agricultural, non agricultural and other sources during the previous year.

1.7.7 Training exposure

It referred to the total number of days that a respondent had received training in his/her entire life from Proshika or other organizations under different training programmes.

1.7.8 Extension contact

It is referred to the respondents becoming accessible to the influence of diverse information media through different extension schooling methods.

1.7.9 Innovativeness

Innovativeness is the scale to which an personality is somewhat prior in adopting agricultural innovations, new thoughts, practices and things than the other members of a social system (Rogers, 1995). This was comprehended by the promptness of accepting innovations by an entity in relation to others and was deliberate on the basis of time dimension.

1.7.10 Assumption

An assumption is "the supposition that an obvious fact or principle is the true in glow of the accessible evidence" (Goode and Hatt, 1952).

1.7.11 Hypothesis

A research hypothesis is a predictive statement capable of being tested by scientific methods that related independent variables and dependent variables. As definite by Goode and Hatt (1952), "A hypothesis is a proposal which can be place to a trial to find out its validity. It may seem opposite to or in accord with common sense. It may provide evidence to be correct on incorrect. In any occurrence, it leads to an empirical test".

1.7.12 Null hypothesis

A null hypothesis posture that there is no relationship linking the concerned variables. If a null hypothesis is discarded on the basis of a statistical test, it is implicit that there is a relationship between the concerned variables. Variable A general indication in statistical research characteristics that occur in a number of individuals, objects, groups etc. and that can take on various values for example the age of an individual.

CHAPTER II

REVIEW OF LITERATURE

The purpose of this chapter is to review the earlier studies and opinions of experts and social scientists having relevance to this investigation based on the major objectives of the study. Attempts have been made in this chapter to review that finding based on the effects of flood on the livelihood status of rural farmers. In spite of sincere effort adequate numbers of direct related literatures were not readily available for this study. However, the literatures of available studies have been briefly discussed in this chapter.

2.1 An overview of floods in Bangladesh

Bangladesh is at high risk of flood among the South and Southeast Asian countries. The annual flow of water especially during the wet season is remarkable, which eventually becomes threatening for this low-lying country (Dewan, 2015). Bangladesh is well-known with the occurrence of large-scale natural disasters. This condition continuously weakens government and international endeavours to increase socio-economic conditions. Between 1960 and 1970, thirteen tropical cyclones hit the seaside areas of the country. The most notable among those was the cyclone and storm surge in the November 1970 that accumulated the death toll of nearly 0.3 million people. Severe floods occurred 1954, 1955, 1956, 1962, 1963, 1968, 1970, 1971, 1974, 1984, 1987, 1988, 1998, 2000, 2002, 2004, 2007, and 2017. The shocking inundations of 1987 and 1988 in Bangladesh drawn global attention. However, damages throughout some dangerous floods is displayed in Table 2.1.

Table 2.1: Some remarkable floods and destruction caused by floods

Incident	Effect
1974 flood	36% area was flooded, projected damage cost US$ 57.9 million, over twenty-eight thousand seven hundred people died
1987 flood	More than 57,000 square kilometre area was drowned, probable damage cost US$ 1.0 billion and 2055 people died
1988 flood	61% area was submerged, 45 million peoples were affected, 2300 people died, damage cost about US$ 1.2 billion
1998 flood	68% area went under water, 1100 people died, persons affected 31 million people affected, 500,000 homes were damaged, 4500 km embankment and 23,500 km roads demolished, damaged 500,000-hectare land yield and total financial loss around US$
2000 flood	24% area affected, loss of shrimp and rice productions, water logging, Aquaculture loss, intrusion of saline water
2002 flood	10% area affected, loss of shrimp production, agricultural loss, loss of shelter
2004 flood	38% area was inundated, 750 people died, 36 million people affected, 3,100 km embankment and 58,000 km roads were destroyed, damaged crops of 1.3 million hectare of land, total loss cost around US$ 2.2 billion
2007 flood	50% area affected by flood, killed about 1110 people and affected 13,771,380 people, $114,000,000 economic damage
2017 flood	More than 8 million people were affected. The flood also caused deaths and injuries, loss of livestock and food supplies, and damage to infrastructure and housing. It also caused severe damage to the agriculture sector, including crop losses of the main food staple rice, with most of the damage concentrated in the northern districts.

Source: GOB (2005); Hofer and Messerli (2006); Huq *et al*. (2015); Global Information and Early Warning System (GIEWS) (2017)

2.2 Effects of flood

Bangladesh is situated between the foothills of the Himalayas and the Bay of Bengal. Approximately 60% of the country's land mass is less than 6 m above the mean sea level (Rayhan, 2010). Further, Bangladesh is located in a low-lying river delta with three major river basins of South Asia, namely Ganges, Brahmaputra, and Meghna (GBM). Hydrology and water resources of the GBM basins are likely to have significant effects due to global warming and climate change, which would change future peak discharges of the GBM basin and could lead to more serious flooding in Bangladesh (Mirza, 2002). For instance, more frequent extreme precipitation could increase the possibility of flash floods, and increased precipitation in the GBM basins may increase the magnitude, depth, and spatial extent of riverine and rain floods (Mirza *et al.*, 2003).

As the majority of the people in Bangladesh live in rural areas, their lives and livelihoods are directly or indirectly dependent on land and water. Frequent and devastating flooding jeopardizes the lives and livelihoods of these people (Younus and Harvey, 2014). Effectss of flood on livelihood are considered a critical issue, especially in rural areas where livelihoods depend on agriculture and aquaculture (Shaw, 2006). It is estimated that, in rural areas, 60% of the population are farmers or fishermen (Brouwer *et al.*, 2007). It has been observed that frequent flooding takes a heavy toll, especially on these poor families in low-lying areas, who either lose their lives or lose what few assets they have carefully accumulated (Brouwer *et al.*, 2007). In Bangladesh, about 40% of the population lives below the poverty line and 82% live on US $2 per day (Rayhan, 2010). High population density, poverty, and lack of resources to manage the floods and evacuate people enhance the severity and suffering of the people.

Since land resources are scarce and population density is high in Bangladesh, people, especially the rural poor, are forced to settle in the flood-prone areas.

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Moreover, as Bangladesh is mainly an agricultural country and since the river basins as well as the floodplains are alluvial, a large number of settlements have been developed along the riverside areas throughout the country. This practice has increased the extent to which people, as well as their shelters and the resources essential for their livelihoods, are exposed to floods. Floods make people vulnerable, as they take away their livelihoods at the first instance and leave them with little resources to overcome from the situation (Shaw, 2006; CIRDAP, 1991). The effects of floods on the poor, especially those living in flood-prone rural areas, is even greater. The reasons behind this are a lack of assets and inadequate food supplies. Flood not only deteriorates the social lives of people but also the economy as a whole. It causes considerable damage to standing crops, livestock, poultry, houses, transportation and communication systems, educational and institutional buildings, and other social facilities. It also deteriorates the normal functions of life affecting homesteads, agricultural land, daily activities, water supply, sanitation conditions, and economic structure. These combined effects on society, the economy, and physical infrastructures jeopardize the livelihoods of the rural poor (Parvin *et al*., 2016).

The country incurs a huge amount of agricultural losses around every year due to flood. On average, flood causes a loss of TK 2,400.00 (USD 33.8) per year to a poor rural household, whereas the overall Gross National Income (GNI) per capita is USD 1785 (Azad, *et al*., 2013). A recent flood took place in 2007 which caused damage of around 604,481 metric tons of crops nationwide (BBS, 2011) and that damage worth around 5.91 billion taka (about 84.4 million U.S. dollars) (People's Daily, 2007). Another dreadful flood occurred in 1998 that affected around 68% of the country (Banerjee, 2010) and caused an overall decrease of 48 percent of agricultural production in rural households (Del Ninno *et. al*., 2001).

Tareq *et al*. (2018) show how climate-induced waterlogging has been significantly affecting the lives and livelihoods of the people living in Tala, a

south-western coastal Upazila, situated in the Satkhira district of Bangladesh, by analyzing the satellite image. It reports that the intrusion of saline water for shrimp cultivation has aggravated the waterlogging problems over the years. A major reason found for such waterlogging is the discharge of the natural flows of water flows through the Farakka barrage by the mainstream country.

Using an embedded case study methodology with a particular focus on Bagerhat district of Southwest Bangladesh, MacMahon (2017) explores that poverty, gender inequality, and limits of knowledge have increased the sensitivity of communities to environmental change and erode their capacity to respond in a proactive and positive ways. Environmental stress, shocks, and disturbances affect people's livelihoods in Bangladesh.

Ayeb-Karlsson *et al*. (2016) apply a new methodology – personal livelihoods history – to understand how people build resilience against environmental stresses such as floods, riverbank erosion, and drought and in what ways their strategies sometimes fail. The researchers collected personal livelihoods information from 28 informants and has found that floods, riverbank erosion, and drought cause damage to agricultural lands, crops, houses, and properties in seven study sites across Bangladesh. As a result, people manage to adopt their agricultural practices, switching to alternative livelihoods or using migration as an adaptive strategy.

Parvin *et al*. (2016) conducted a empirical field study in one of the most flood-prone upazila Goalanda under Rajbari district to study the effects of floods on their livelihood, especially on the income and occupations of the rural poor. At the same time, it aims to learn from their coping mechanisms. It was reported that floods make people vulnerable, as they take away their livelihoods at the first instance and leave them with little resources to overcome from the situation. Because of floods, rural poor communities face job loss, and two-thirds of their income is reduced, which limits their capabilities of

preparedness, response, and recovery to subsequent floods. People cope with the situation by bearing substantial debts and a loss of productive assets.

Islam *et al.* (2015) reported that most of the farmers (81.81%) in char area of flood lands were affected by flood as their crops were washed away by flood water as agricultural lands (59%) were inundated in a high magnitude flood. During flood, almost 88.89% farmers pass their days having no alternative occupation, and cannot afford to meet basic needs of their family as most of the Char lands were inundated for about two or three months, resulting in no crop production during that period. People reside in roads, schools and even on the top of the roof as there was no flood shelter in the study area. Besides these, rehabilitation programs were also not sufficient. It is also revealed that siltation over agricultural land reduces its fertility and productivity. To cope with this problem, people of Char land formulated and undertaken various adaptation techniques in their own way which varies depending on their socio-economic and environmental aspects, such as education, income, occupations and living conditions, as there was no organizational support.

Rana and Islam (2015) conducted a study to explore the co-relation between two variables- agricultural losses incurred due to floods and change in agricultural population in an area, and thus to identify the extent of 'flood-forced' livelihood shifting from agriculture to other sectors in rural Bangladesh. The study is conducted on four districts having mutually different levels of exposure to floods. The study reveals that in a 20 years period between 1991 and 2011, the number of people engaged in agricultural sectors decreases continuously; the decreasing rate, however, is not equal for all of the study districts. The non-flood prone district has a very slow decreasing rate of 1.52% per year, while the rate is more than 4% in highly flood prone districts that suffer from high agricultural losses every year due to floods. Two statistical analysis tools- co relation co efficient and rsquared value are used in the research to find out the linkages between the two variables. Rsquared value,

however, calculated in the research shows that more than 76% of agricultural population decrease in a highly flood prone district in Bangladesh could be result of the floodcaused agricultural losses, while the figure is found 41% in case of district less exposed to flood.

Ashraf *et al*. (2013) conducted a study in Southern Punjab at district Muzaffargarh to explore the effectss of flood on livelihoods and food security of rural communities. Total 120 flood affected people were interviewed for the sake of data collection. The findings revealed that agriculture was the major income source of the area and flood affected the natural capitals (land, irrigation, orchards and livestock) pushing the income generating sources into darkness. These situations made the people food deficit and food insecure as they had to use contaminated commodities especially water. Generally that disaster pushed the farmers' prosperity to several years back. Integration of public and private sector along with NGO'S and national and international funding agencies can help to gain their resilience.

Lind *et al*. (2008) observed that the loss in case of flooding has many dimensions. In addition to economic loss and loss of life and injury, there may be irreversible loss of land, of historical for cultural valuables and loss of nature or ecological valuables.

Hanson *et al*. (2007) stated that Asia is struck by 70% of all floods in the world and the average annual cost of floods over the past decade is approximately 15 Billion USD. Economic losses and effectss have remained high and constitute a large developmental burden. It was suggested from this study that there is a need for new types of strategies in order to cope with the financial burden from hazardous events. One of the largest deltas in Vietnam is seriously threatened by floods. Lives and property are threatened by annual flood events which impose a substantial burden on the community. The area has experienced increased flooding due to its dense ad increasing population and its location in a low land.

Brouwer *et al*. (2007) states that, Bangladesh is a highly flood prone country. Eighty (80) percent of the country consists of floodplains and several other minor rivers. These floodplains sustain a predominantly poor rural population. Once every ten (10) years roughly one-third of the country gets severely affected by floods while in catastrophic years such as 1988, 1998 and 2004, more than 60% of the country was inundated. Floods caused social disruptions and resulted in scarcity of drinking water as surface water got contaminated.

Borrows and De Bruin (2006) indicated that among natural catastrophes, flooding has claimed more lives than any other single natural hazard. In the decade 1986 to 1995, flooding accounted for 31% of the global economic loss from natural catastrophes and 55% of the casualties. The damaging effects of flooding are likely to become more frequent, more prevalent and more serious in the future.

Nott (2006) pointed out that the direct effectss of a flood are closely related to the extent of affected area and depth of floods water. The extent of a flood has a direct relationship with the recovery times of crops, pastures and the social and economical dislocation effects to populations of a country. Floods are the most costly and wide reaching of all natural hazards. They are responsible for up to 50,000 deaths and adversely affect some 75 million people on average worldwide in every year.

Carey (2005) argues that human populations worldwide are vulnerable to natural disasters. Certain conditions such as geographical location or people's income level can affect the degree to which natural disasters effects people's homes and livelihoods.

Know-Risk (2005) observed that the economic effects of natural disasters shows a marked upward trend over the last several decades worldwide. The floods have led to loss of human life, destruction of social and economic infrastructure and degradation of already fragile ecosystems and social structures. The study indicates that social effectss include changes in people's

way of life, their culture, community, political systems, environment, health and wellbeing, their personal and property rights and their fears and aspirations. In this study it was suggested in the results that, social effectss are linked to the level of well being of individuals, communities and society. It includes aspects related to the level of literacy and education, the existence of peace and security, access to basic human rights, systems of good governance, social equity, positive traditional values, knowledge structure, customs and ideological beliefs and overall collective organizational systems.

Lindsell and Prater (2003) argue that social effectss can cause significant problems for the long term functioning of specific types of households and businesses in an affected community. A proper contingency plan is needed in order to readies the effects of the flood and to protect the livelihood.

Mirza *et al.* (2003) stated that in Southern Nepal, flooding leads to large scale disruption of social and economic lives. The rivers bring large sediments whose deposition on agricultural lands harms productivity. The poor mostly live in these floodplains (vulnerable zones) because they have no opportunity to live in less hazardous areas. In Nepal, every year floods cause death, cultivated fields and irrigation, bridges and rural infrastructure. He argues that policy makers, donors and relief and development agencies treat flood disaster as isolated events that break the continuity of the normal way of life.

Mohapatra and Singh (2003) reported that among all natural disasters, floods are the most frequent to be faced in India. On an average, floods have affected about 33 million people between 1953 and 2000. This figure may have risen due to population growth. From the global level outlined above, it is clear that floods have had adverse effects on people's lives and livelihoods. The number of reported homeless persons following floods is particularly high because of the vulnerability of dwelling on rain and flood. Floods frequently cause major infrastructure damage including damage of roads, railway lines, airports, electricity supply systems, water supply and sewage disposal systems. Bridges

over rivers are particularly exposed to damage and disruption of transportation systems follows. The economic effects of flood are often much greater than the flood itself (Parker, 2000).

Kundzewicz *et al*. (2002) argues that floods are natural phenomenon for which the risks of occurrence are likely to continue to grow, increasing levels of exposure and insufficient capacity among the factors responsible for the rising vulnerability. Water related events such as floods have been a major concern since the dawn of human civilization. They continue to hit every generation of human beings, bringing suffering and death as well as immense and still growing, material losses.

Rashid (2000) described the 1998 floods that hit Bangladesh as the worst in the last century. Almost two-thirds of the country was submerged under water and millions were affected. A total of 33 million people were marooned of whom 18 million needed emergency food and health services in 52 districts. The floods continued for more than 65 days. Those floods destroyed basic infrastructure like roads and bridges as well as houses, crops, animals and cattle. The most damaging aspect of the flood was the destruction of people's means of livelihood. The response to the floods included distribution of food, medicine and clothing for the poor.

Smith and Ward (1998) argued that direct losses to floods occur immediately after the event as a result of the physical contract of the flood waters with humans and with damageable property. However, indirect losses which are less easily connected to the flood disaster and often operate on-long time scales, may be equally, or even more important. Depending on whether or not losses are capable of assessment in monetary values, they are termed tangible and intangible.

2.3 Relationship between the selected characteristics of farmers and livelihood status

2.3.1 Age and livelihood status

Alam (2001) found that there was a significant negative relationship between age and living status of the beneficiaries of social forestry project of Caritas.

Rahman (2002) found that age of resource poor RDRS PETRRA farmers showed significant relationship with their livelihood. Similar observations were found by Kabir (2003) and Amin (2002). Similar result was found in the studies of Islam (2002), Islam (2003) and Rahman (2002) in their respective studies.

Mortuza *et al.* (2004) observed in his study that age had no significant relationship with their livelihood status of the respondents.

Rokanuzzaman (2004) found that age did not show any significant relationship with their livelihood status due to joining the CBIM-2 project activities of the beneficiaries.

Bhattacharjee and Behera (2018) estimate a composite Livelihood Index by combining the household level data collected from a flood prone area of the eastern Indian state of West Bengal. The results suggest that livelihood index found to be significantly influenced by the age of household head.

2.3.2 Education and livelihood status

Kabir (2003) found that education had not significant relationship with livelihood status of the respondents.

Mortuza *et al.* (2004) found that family education had significant positive relationship with the livelihoods of the respondents. Amin (2002) found similar result.

Rokanuzzaman (2004) found that education had no significant relationship with their livelihood status due to joining the CBFM-2 project activities of the beneficiaries.

2.3.3 Family size and livelihood status

Islam (2002) and Islam (2001) showed a significant positive relationship between family size of the beneficiaries of the respective NGOs and their living status in terms of food consumption and household assets.

Studies of Alam (2001), Rashid (2001), Islam (2002), Rahman (2002) and Kabir (2003) showed that there was no significant relationship between family size and livelihoods of beneficiaries of Caritas, BRAC. Grameen Bank, RDRS and PDBF, respectively.

Ali (2003) conducted a study on effects of micro-credit in the poverty alleviation of BRAC women beneficiaries in a selected area of Dinajpur district. He found a significant positive relationship between family size of the beneficiaries of BRAC and their annual income and food consumption.

Mortuza *et al.* (2004) found family size of group member had no significant relationship with their livelihood status of the respondents.

Rokanuzzaman (2004) found that family size had no significant relationship with their livelihood status due to joining the CBFM-2 project activities of the beneficiaries.

Bhattacharjee and Behera (2018) reported that livelihood index found to be significantly influenced by the family size.

2.3.4 Farm size and livelihood status

Islam (2002) conducted study on poverty alleviation of the rural women through some of the selected activities of Grameen Bank, He reported that there was no significant relationship between farm size of the beneficiaries of

Grameen Bank and their livings status.

Ali (2003) conducted a study on effects of micro-credit in the poverty alleviation of BRAC women beneficiaries in a selected area of Dinajpur district. He found a significant positive relationship between farm size of the BRAC's beneficiaries and their living condition.

Islam (2004) observed that farming and living expenditure showed significant positive relationship with the extent of knowledge on livelihood in his study entitled as 'extent of knowledge and information system in rural community for improving rural livelihood of farmers'.

Mortuza *et al.* (2004) found that farm size had significant positive relationship with livelihood status of the respondents. Rahman (2002) also found the similar result.

Rokanuzzaman (2004) found that farm size had no significant relationship with their livelihood status due to joining the CBFM-2 project activities of the beneficiaries.

Bhattacharjee and Behera (2018) reported that livelihood index found to be significantly influenced by the land holding size.

2.3.5 Income and livelihood status

Nurzaman (2002) found in his study that family income of the FFS and Non-FFS farmers had no significant relationship with their knowledge on IPM.

Hossain (2000) found that family income of the farmers had significant relation with their knowledge on Binadhan-6.

Mortuza *et al.* (2004) found that family income had not significant relationship with livelihood status of the respondents. Kabir (2003) and Rahman (2002) found similar result.

Islam (2004) observed that annual income showed significant positive relationship with the extent of knowledge on rural livelihood.

Bhattacharjee and Behera (2018) reported that livelihood index found to be significantly influenced by the household income.

2.3.6 Training experience and livelihood outcomes

Hossain (2001) found that the length of the training of the respondents had positive relationship with their knowledge of crop cultivation.

Mannan (2001) in his study found that the training received by the farmers had a positive significant relationship with their knowledge on food and nutrition.

Mortuza *et al.* (2004) observed in his study that training exposure had positive significant relationship with their livelihood. Kabir (2003) also found similar result.

Waheduzzaman (2004) observed in his study entitled: "effects of NGO-interventions livelihoods of women in a fishing community" that training exposure of the women beneficiaries had significant relationship with their livelihood status.

2.3.7 Extension media contact and livelihood status

Rashid (2001) found no significant relationship between extension media contact of the beneficiaries of BRAC and their socio-economic condition in his study on effects of BRAC activities on income and women's empowerment in selected area of Mymensingh district.

Alam (2001) reported in his study entitled: "study on socio-economic aspects of the participating group members of Caritas social forestry project" that there was a highly significant relationship between extension media contact of the Caritas beneficiaries and their socio-economic status.

Kabir (2003) observed in his study that change in living condition of the

beneficiaries towards improving livelihood status had no significant relationship with contact PDBF personnel.

Islam (2004) observed that extension medial contact showed significant positive relationship with the extent of knowledge on livelihood in his study entitled as 'extent of knowledge and information system in rural community for improving rural livelihood of farmers'.

Rokanuzzaman (2004) found that extension media contact had no significant relationship with their livelihood status due to joining the CBFM-2 project activities of the beneficiaries.

2.3.8 Organizational participation and livelihood status

Islam (2004) observed that innovativeness showed significant positive relationship with the extent of knowledge on livelihood in his study entitled as 'extent of knowledge and information system in rural community for improving rural livelihood of farmers'.

2.4. Conceptual framework of the study

Variables together are the cause effect and thus, there is cause-effect relationship everywhere in the universe. The conceptual framework of Rosenberg and Hovland (1960) was kept in mind while framing the structural arrangement for the dependent and independent variables of the study. The hypothesis of a research while constructed properly contains at least two important elements i.e. a dependent variable and independent variables. A dependent variable is that factor which appears, disappears or varies as the research introduces, removes or varies the independent variables (Townsend, 1953). Here, the effects of flood on the livelihood status of rural farmers has been selected as dependent variable and the characteristics of the rural people were considered as the independent variables. It is not possible to deal with all characteristics in a single study. It was therefore, necessary to limit the characteristics, which include age, education, family size, farm size, annual

family income, extension contact and innovativeness. In view about discussion and prime findings of review of literature, the researcher constructed a conceptual framework of the study which is self explanatory and is presented in figure 2.1.

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┌─────────────────────────┐              ┌─────────────────────────┐
│       INDEPENDENT       │              │                         │
│        VARIABLES        │              │     FOCUS VARIABLE      │
└─────────────────────────┘              └─────────────────────────┘
              │                                       │
              ▼                                       │
┌─────────────────────────────┐                       │
│ ┌─────────────────────────┐ │                       │
│ │ Selected characteristics│ │                       │
│ │   of the respondents    │ │                       │
│ └─────────────────────────┘ │                       ▼
│ ┌─────────────────────────┐ │
│ │ 1. Age                  │ │
│ └─────────────────────────┘ │
│ ┌─────────────────────────┐ │
│ │ 2. Education            │ │
│ └─────────────────────────┘ │
│ ┌─────────────────────────┐ │
│ │ 3. Family size          │ │
│ └─────────────────────────┘ │        ┌──────────────────────────┐
│ ┌─────────────────────────┐ │        │   Effects of flood on the│
│ │ 4. Farm size            │ │ ───▶   │  livelihood status of rural│
│ └─────────────────────────┘ │        │         farmers          │
│ ┌─────────────────────────┐ │        └──────────────────────────┘
│ │ 5. Annual family income │ │
│ └─────────────────────────┘ │
│ ┌─────────────────────────┐ │
│ │ 6. Training exposure    │ │
│ └─────────────────────────┘ │
│ ┌─────────────────────────┐ │
│ │ 7. Extension contact    │ │
│ └─────────────────────────┘ │
│ ┌─────────────────────────┐ │
│ │ 8. Innovativeness       │ │
│ └─────────────────────────┘ │
└─────────────────────────────┘
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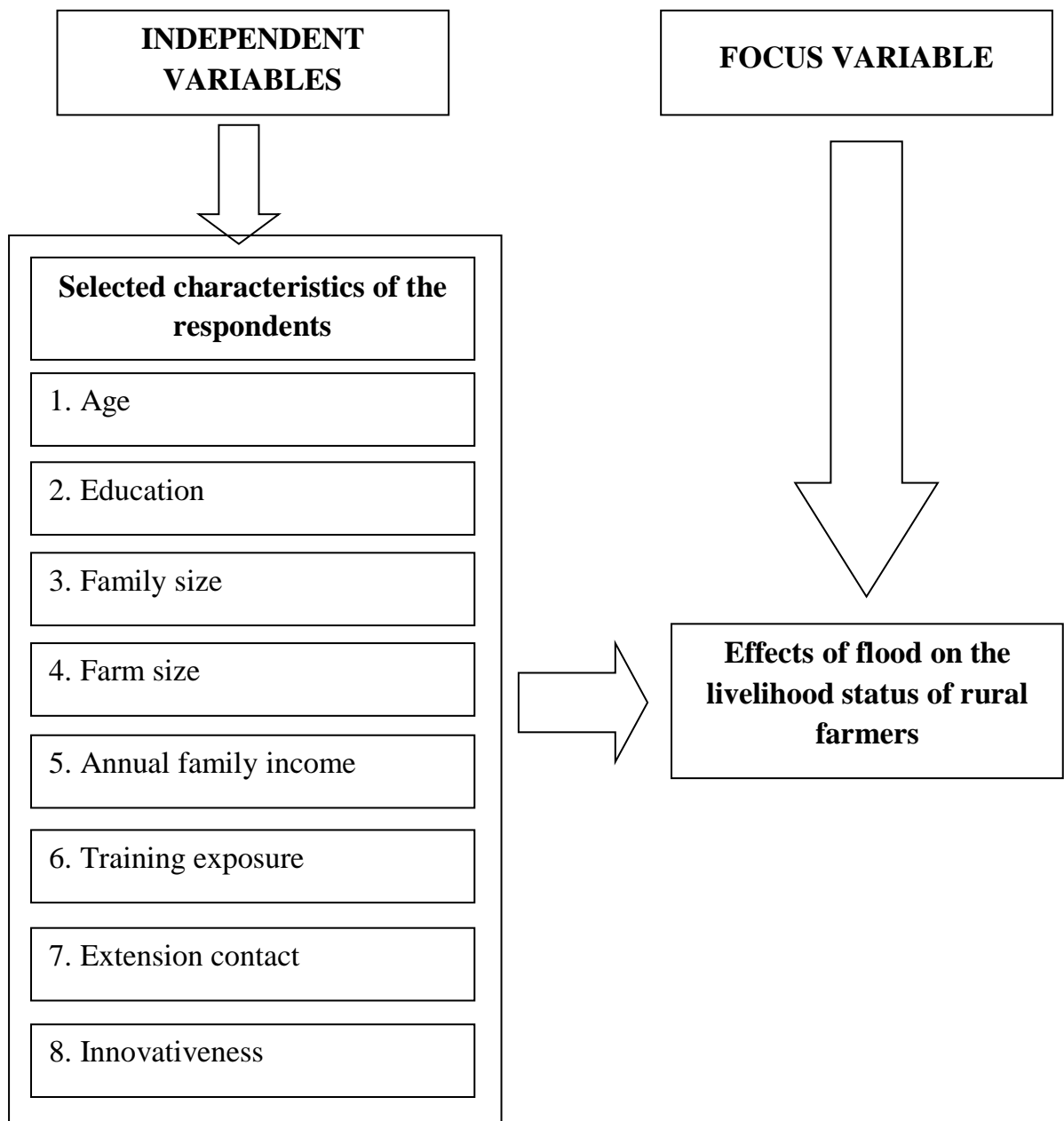
Figure 2.1. Conceptual framework of the study

CHAPTER III

MATERIALS AND METHODS

Methodological issues followed in conducting the present study have been presented in this chapter. The methods used and a chronological description of the methodology followed in conducting this research work has been presented in this chapter.

3.1. Locale of the study

Sadar upazila of Gaibandha district was selected purposely as the locale of the study. It is situated between 25°60´ and 25°66´ north latitude and between 89°10´ and 89°27´ east longitude. Two villages namely, Poshim Komornoi and Fakirpara of Kholahati union under Gaibandha Sadar upazila were selected randomly. Agriculture was the major occupation in the study area and the area has well accessibility through road and highways. Generally, flood water overflows this area. This area made the soil of this area fertile and suitable for paddy, jute, spices, sugarcane, turmeric, pulses and vegetables etc. However, Gaibandha Sadar upazila consists of thirteen unions among which Kholahati union has comparatively more number of farmers. Besides, local communication system in this union is satisfactory. This area under the present study was affected seriously by flood every year. Crop, livestock and fisheries are affected by flood seriously and livelihood status of rural people of this area are being degraded day by day. Considering the above facts, time and budget, the present study was conducted in Kholahati union under Gaibandha Sadar upazila of Gaibandha district.
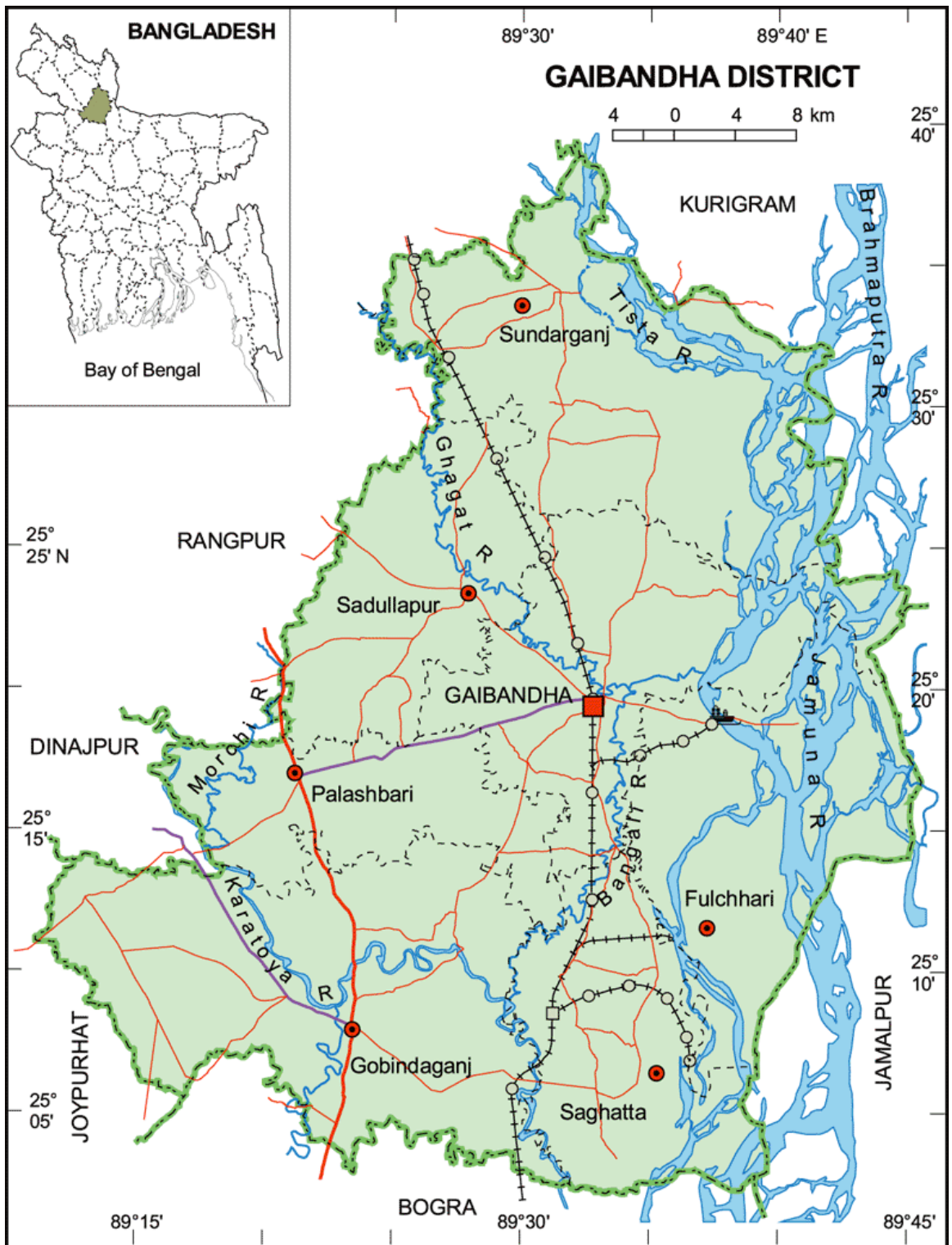
Figure 3.1. Map of Gaibandha district showing different upazila

Figure 3.2. Map of Gaibandha Sadar Upazila showing study area

3.2 Population and sample

People who permanently reside in the selected villages constituted the active population of this study. As all population of the study area cannot measure, head of the farm families of two villages under Kholahati union was the population of the present study. However, representative sample from the population were taken for collection of data following random sampling technique. One farmer (who mainly operated the farming activities of the family) from each of the farm families was considered as the respondent. An updated list of all farm family heads of the selected villages was prepared with the help of SAAO and local leader. The list comprised of a total 506 farm families in the study area. These rural families constituted the population of this study. Twenty percent of the farm families of these villages were randomly selected as representative sample by using a Table of Random Numbers (Kerlinger, 1973). Thus, 101 farm family head constituted the sample of the study. Further ten farmers (10 percent) were selected randomly from the population except the sample included in the reserved list, which were interviewed when the respondent in the original sample list were not available at the time of interview. A detailed structure of population and sample has been presented in the Table 3.1.

Table 3.1: Distribution of population and sample of the selected villages

Village	Population (Families)	Sample size	Reserved list
Poshim	292	58	6
Fakirpara	214	43	4
Total	506	101	10

3.3. Variables and their measurement techniques

A variable is any characteristics which can assume varying or different values are successive individual's cases (Ezekiel and Fox, 1959). An organized research usually contains at least two identical elements i.e. Independent and dependent variable. An independent variable is the factor which is manipulated by the researcher in his attempt to ascertain its relationship to an observed phenomenon. A dependent variable is the factor, which appears, disappears or varies as the experimenter introduces, removes or varies the independent variables (Townsend, 1953). According to the relevance of the research area, the researcher selected 8 characteristics of the respondents as the independent variables (e.g. age, education, family size, farm size, annual family income, training exposure, extension contact and innovativeness). On the other hand, effects of flood on the livelihood status of rural farmers was the dependent variable. The following sections contain procedures of measurement of dependent and independent variables of the study.

3.3.1. Measurement of independent variables

The independent variables of the study were age, education, family size, farm size, annual family income, training exposure, extension contact and innovativeness. The procedure followed in measuring the independent variables have been discussed in the subsequent sections.

3.3.1.1. Age

Age of the respondents was measured in terms of actual years from their birth to the time of interview, which was found on the basis of verbal response of the rural people (Azad, 2003). A score of one (1) was assigned for each year of one's age. This variable appears in item number one (1) in the interview schedule as presented in Appendix-I.

3.3.1.2. Education

Education was measured by assigning score against successful years of schooling by a respondent. One score was given for passing each level in an educational institution (Amin, 2004). For example if a respondent passed the final examination of class five or equivalent examination, his education score was given five (5). Each illiterate respondent was given a score of zero (0). A person not knowing reading or writing but being able to sign only was given a score of 0.5. This variable appears in item number two (2) in the interview schedule as presented in Appendix-I.

3.3.1.3. Family size

The family size was measured by the total number of members in the family of a respondent. The family members included family head and other dependent members like husband/wife, brother and sister, parents, children etc. who lived and ate together. The total number of family members was considered as his family size score. If a respondent had five members in his/her family, his/her family size score was given as five (5) (Khan, 2004). This variable appears in item number three (3) in the interview schedule as presented in Appendix-I.

3.3.1.4. Farm size

Farm size of a respondent referred to the total area of land on which his family carried out farming operation, the area being in terms of full benefit to the family. The term refers to the cultivated area either owned by the respondent or cultivated on share cropping, lease or taking from other including homestead area. It was measured in hectares for each respondent using the following formula (Khan, 2004):

$$FS = A + B + ½(C + D) + E + F$$

Where,

FS = Farm size

A = Homestead area (Including pond)

B = Own land under own cultivation

C = Land given to others as shared crop

D = Land taken from others as shared crop

E = Land given to others as lease

F = Land taken from others as lease

The data was first recorded in terms of local measurement unit i.e. kani or decimal and then converted into hectare. The total area, thus, obtained is considered as his farm size score (assigning a score of one for each hectare of land). This variable appears in item number four (4) in the interview schedule as presented in Appendix-I.

3.3.1.5. Annual family income

Annual income referred to the total financial return of a household from farm (Crops, livestock, poultry and fish) and nonfarm sources (business, job, remittance and others) in one year. It was expressed in Taka. In measuring this variable, total earning in Taka of a respondent was converted into score. A score of one was given for every 1000 Taka (Waheduzzaman, 2004). This variable appears in item number five (5) in the interview schedule as presented in Appendix-I.

3.3.1.6. Training exposure

Training experience of a respondent was measured by the total member of day he/she attended in different training programs in his life. A score of one (1) was assigned for each day of training attended. Data obtained in response to item number six (6) of the interview schedule as presented in Appendix-A.

3.3.1.7. Extension contact

It was defined as one's extent of exposure to different communication media related to farming activities. Extension media contact of a respondent was measured by computing extension media contact score on the basis of their nature of contact with eighteen extension media by taking seven personal, four group and seven mass media. Each respondent was asked to indicate his nature of contact with four alternative responses, like frequently, occasionally, rarely and not at all basis to each of the eighteen media and score of three, two, one and zero were assigned for those alternative responses, respectively (Hasan, 2006). These four options for each medium were defined specially to each medium considering the situation, rationality and result of pre-test. Logical frequencies were assigned for each of the four alternative nature of contact is presented in item number seven (7), Appendix-I. Extension media contact of the respondent was measured by adding the scores of eighteen selected extension media. Thus extension media contact score of a respondent could range from 0 to 54, where zero indicated no extension media contact and fifty four indicated highest level of extension media contact.

3.3.1.8. Innovativeness

Innovativeness of the rural people of the study area was measured by computing an innovativeness score on the basis of 8 selected activities (agricultural or non-agricultural in the flooded areas) innovations. Score was assigned on the basis of time dimension. Since the exact date of introduction of the selected innovations in the study area was not specifically known, the relative earliness of the adoption of a particular innovation by a respondent was ascertained by considering how long before he first adopted that innovation prior to the date of interview. The higher the length of time of his first adoption, the earlier he was adopting the innovation than other members of his social system. A score of one (1) was assigned for each year of adoption of a

particular innovation prior to the date of interview subject to a minimum of 3 for adopting the innovation for 3 years or more prior to the date of interview. The scores for all the 8 innovations were added together to constitute the innovativeness score of a respondent. This score, thus, could raged from 0 to 24. Zero (0) indicating no innovativeness at all and 24, the highest degree of innovativeness. This variable appears in item number eight (8) in the interview schedule as presented in Appendix-I.

3.3.2. Measurement of Dependent Variable

The dependent variables in this study, was effects of flood on the livelihood status of rural farmers. Measurement procedure of this variable has been presented in the following sections. Selected respondent's activities on the livelihood indicators regarding effect of flood was measured by asking them 17 questions on different aspects. The total marks for all the activities was 51. Different activities on effects of flood was scored at four categories and score was given as 0 for 'no', 1 for 'low', 2 for 'medium' and 3 for 'high'. A respondent involved in higher level of activities on livelihood indicators, obtained the full marks, while no or low or medium active respondents was given marks proportionately. The total score obtained by a respondent was taken as his livelihood score. This score could range from 0 to 51 where '0' indicting very low and '51' indicting the highest livelihood status. According to the obtained score, respondents were classified in to three categories *viz.*, '0-17' as 'low', '18-34' as 'medium' and '>34 (35-51)' as 'high' livelihood status. This variable appears in item number nine (9) in the interview schedule as presented in Appendix-I.

3.3 Hypothesis

A null hypothesis states that there is no relationship between the concerned variable. If a null hypothesis is rejected on the basis of statistical test, it is concluded that there is a relationship between the concerned variables. However, following null hypotheses was formulated for the present study:

- There was no relationship between the selected characteristics of the farmers and the effects of flood on the livelihood status of rural farmers.

The selected characteristics are: age, education, family size, farm size, annual family income, training exposure, extension contact and innovativeness.

3.4 Collection of Data

Data were collected by the researcher himself during 1st September to 30 October 2021. To get valid pertinent information, the researcher made all possible efforts to explain the purpose of the study to the respondents. Interviews were conducted with the respondents in their homes and farms. While staring interview with respondent, the researcher look all possible care lo establish rapport with him/her so that she/he did not feel hesitant or hesitate to furnish proper response to the questions and statements in the schedule. The questions were clearly explained wherever any respondent felt difficulty in understanding properly. The Sub-Assistant Agricultural Officer (SAAO), Agricultural officer, DAE rendered good cooperation in arranging appointments with the respondents.

3.5 Compilation of Data

After completion of field survey data from all the interview schedules were compiled, tabulated and analyzed according to the objectives of the study. In this process, all the responses in the interview schedule were given numerical coded values. Local units were converted into standard units. The responses to the questions in the interview schedules were transferred to a master sheet to facilitate tabulation. Tabulations and cross tabulations were done on the basis of categories developed by the investigator himself.

3.6 Categorization of the respondents

It was necessary to develop suitable categories to determine the livelihood status of rural farmers considering the flooding effect in selected aspects. For

the purpose, the respondents were classified into different categories on the basis of obtained scores on the effects of flood on the livelihood status of rural farmers. Seventeen questions at different aspects were asked them to justify their level of livelihood status. The respondents were classified as low, medium and high livelihood status on the basis of their activities. Categories were also developed for describing each of the selected characteristics of the rural people. Nature of the data and mode of the categorization prevailing on the social system guided the researcher in developing categories in respect of selected characteristics.

3.7 Statistical analysis

Data collected from the respondents were analyzed and interpreted in accordance with the objectives of the study. The analysis of data was performed using statistical treatment with SPSS (Statistical Package for Social Sciences) computer program. Statistical measures as number, range, mean, standard deviation and rank order were used in describing the variables whenever applicable. In order to explore the effects of flood on the livelihood status of rural farmers performed by the respondents and their selected characteristics, Pearson's Product Moment Correlation Co-efficient (r) was used (Ray and Mondal, 2004).

Throughout the study, five percent (0.05) level of significance was used as the basis for rejecting any null hypothesis. If the computed value of (r) was equal to or greater than the table value of (r) at the designated level of significance for the relevant degree of freedom, the null hypothesis was rejected and it was concluded that there was significant relationship between the concerned variable. Whenever the computed value of (r) was found to be smaller than the tabulated value of (r) at the designated level of significance for the relevant degrees of freedom, the null hypothesis could not be rejected. Hence, it was concluded that there was no relationship between the concerned variables.

CHAPTER IV

RESULTS AND DISCUSSION

This chapter deals with the result and discussion of present research work. Necessary explanations and appropriate interpretations have also been made showing possible and logical basis of the findings. However, for convenience of the discussions, the findings are systematically presented in the following sections.

4.1 Selected characteristics of the respondents

This section deals with the classification of the farmers according to their various characteristics. Behaviour of an individual is largely determined by his characteristics. In this section the findings on the farmer's selected eight characteristics have been discussed. The selected characteristics are (i) age, (ii) education, (iii) family size, (iv) farm size, (v) annual family income, (vi) training exposure, (vii) extension contact and (viii) innovativeness. Range, mean and standard deviations of these characteristics of the rural farmers of Sadar Upazila of Gaibandha district are described in this section. A summary profile of the farmer's characteristics has been given in Table 4.1.

Table 4.1 Prominent features of the selected characteristics of the farmers

Sl. No.	Characteristics (with measuring unit)	Range		Mean	Standard deviation
		Possible	Observed		
1.	Age (years)	-	20-75	44.72	11.88
2.	Education (schooling years)	-	0-16	5.71	4.76
3.	Family size (number of members)	-	2-10	5.03	1.75
4.	Farm size (hectare)	-	0.02-3.12	0.51	0.45
5.	Annual family income ('000'Taka)	-	20-1230	253.11	209.99
6.	Training exposure (number of days)	-	0-7	0.85	1.38
7.	Extension contact (score)	0-54	2-24	11.11	3.69
8.	Innovativeness (score)	0-24	0-17	8.81	2.57

4.1.1. Age

The age of the farmers of the study area varied from 20 to 75 years, with average of 44.72 years with the standard deviation of 11.88 (Table 4.1). According to their age, the respondents were classified into three categories as "young aged" (up to 35 years), "middle aged" (36- 50 years) and "old aged" (above 50 years). The distribution of the farmers according to their age is shown in Table 4.2.

Table 4.2 Distribution of the farmers according to their age

Categories	Years	Respondents	
		Numbers	Percent
Young aged	≤ 35	23	22.77
Middle aged	36 to 50	51	50.50
Old aged	Above 50	27	26.73
Total		101	100

Age is one of the most vital factors concerning to one's livelihood. Data represented in Table 4.2 indicates that slightly more than fifty percent (50.50%) of the respondents were middle aged as compared to 22.77% being young and 26.73% old. This seems logical because heads of the farm families were selected as respondent. With the increase in age they find few alternatives for livelihood except farming activities in parents' farm thus become committed in agricultural activities. This lead to understanding that livelihood status of rural farmers would reflected more by the middle-aged group in the present study. Therefore, extension agencies should compensate a clear attention to the middle-aged farmers improve their life style.

4.1.2. Education

Education level of the respondent farmers ranged from 0-16 in accordance with year of schooling. The average education score of the respondents was 5.71 with a standard deviation of 4.76 (Table 4.1). On the basis of their level of education, the farmers were classified into five categories as shown in Table 4.3.

Table 4.3 Distribution of the farmers according to their level of education

Categories	Basis of Categorization (schooling years)	Respondents	
		Numbers	Percent
Illiterate	0	6	5.94
Can sign only	0.5	33	32.67
Primary	1-5	11	10.89
Secondary	6-10	37	36.64
Above secondary	Above 10	14	13.86
Total		101	100

Data presented in the Table 4.3 indicated that 36.64% of the farmers had secondary level of education compared to 5.94% illiterate, 32.67% could sign their name only, 10.89% had primary level education and only 13.86% had above secondary level of education. People that have a higher education are more likely to express their positive attitudes to improve their locality through improving agricultural activities, livestock rearing, fisheries activities, housing development, improving communication etc. and they also require more information about livelihood status through reading leaflets, booklets, books and other printed materials in this case. Education helps the farmers to expand their outlook and spread out mental horizon by helping them to develop favorable attitude, correct perception and knowledge about production technology and postharvest practices. Comparatively educated person is relatively more responsive to the technology and new innovation.

The findings of this study, however, indicate that 38.61% of the farmers were illiterate or could not or it will be sign their name only which is supposed to face a great difficulty in operating development works regarding livelihood status. Such consideration indicates the need for improving literacy level among the farmers for practicing development work in the locality. Although 36.63% farmers had secondary education but they are not enough to face adverse situation due to natural calamities like flood, bank erosion, cyclone etc. So, motivational program should be arranged to make farmers' attention for safe life against different disasters.

4.1.3. Family Size

The number of family members of the farmers ranged from 2 to 10 with an average of 5.03 and standard deviation of 1.75 (Table 4.1). Based on the family size of the farmers in the study area were classified into three categories as small, medium and large family as shown in Table 4.4.

Table 4.4 Distribution of the farmers according to their family size

| Categories | Basis of categorization (No. of family member) | Respondents | |
		Numbers	Percent
Small family	Up to 4	46	45.54
Medium family	5-6	37	36.63
Large family	Above 6	18	17.83
Total		101	100

Data furnished in the Table 4.4 indicated that the highest proportion (45.54%) of the respondents had small family size, while 36.63% of the farmers belonged to the category of medium family compared to 17.83% of them having large family size. Data indicated that the average family size (5.03) of the respondents in the study area is nearest to the national average of 5.60 (BBS, 2009).

4.1.4. Farm Size

Farm size of the respondents ranged from 0.02 hectare to 3.12 hectares with the mean of 0.51 hectare and standard deviation of 0.45 (Table 4.1). On the basis of their farm size, the farmers were classified into five categories followed by DAE (1999) as shown in Table 4.5.

Table 4.5 Distribution of farmers according to their farm size

Categories	Basis of categorization (ha)	Respondents	
		Numbers	Percent
Landless	< 0.02	1	0.99
Marginal farmer	0.03 to 0.20	19	18.81
Small farmer	0.21 to 1.00	74	73.27
Medium farmer	1.01 to 2.50	6	5.94
Large farmer	> 2.50	1	0.99
Total		101	100

Data presented in the Table 4.5 demonstrated that highest proportion (73.27%) of the farmers had small farm compared to 18.81% having marginal farm and only 5.94% had medium farm. The findings indicated that above 90% of the farmers had marginal to small farm size. Size of the farm is highly related to improve livelihood status of a farmer. It contributes to gross and net income. Most of the people of Bangladesh inhabit in the rural areas and majority of them have small income from small operational land. Many of them in rural area are without sufficient skill and knowledge on agricultural and development activities. This is a great treat for achieving better life. Therefore government extension agencies and NGO's should pay attention to take steps for marginal and small farm holders on the priority basis. The extension agencies will not able to give them land but can easily train them up for modern agricultural technology related to improve their life style.

4.1.5. Annual family income

Annual family income of the farmers in the study area was ranged from 20 to 1230 thousand taka with a mean of 253.11 thousand taka and standard deviation of 209.99 (Table 4.1). On the basis of annual family income, the respondents were categorized into three classes namely low, medium and high income categories shown in Table 4.6.

Table 4.6 Distribution of farmers regarding annual family income

Categories	Basis of categorization ('000' taka)	Respondents	
		Numbers	Percent
Low income	Up to 100	21	20.79
Medium income	100 to 220	36	35.65
High income	Above 220	44	43.56
Total		101	100

Data revealed in Table 4.6 that the highest proportion of the respondents (43.56%) had high annual family income while 35.65% and 20.79% of them had medium and low annual family income, respectively. Findings reveal that the most of the respondents (56.43%) had medium to high annual family income in the selected study area. Annual family income of a farmer is an important indicator of how much he/she can invest in his farming or attempt to take business. Generally higher income give confidence one's integrity to achieve better routine and to show his/her individual better status in the society which ensure better livelihood status. The higher income increases the risk taking capacity of a farmers' to involve in a new action regarding better life style. Farmers with low income generally invest less in their farms and most of them are interested to high return with low input. It is therefore, likely that in most of the cases self development work might be hampered with hesitation.

4.1.6. Training exposure

The score of training exposure on different agricultural program or technological operation of the farmers ranged from 0-7 days. The mean was 0.85 days and standard deviation was 1.38 (Table 4.1). On the basis of training exposure, the respondents were categorized into three groups as shown in Table 4.7.

Table 4.7 Distribution of the farmers according to their training exposure

Categories	Basis of categorization (Days)	Respondents	
		Numbers	Percent
No training	0	50	49.50
Low training	1-3	45	44.55
Medium training	Above 3	6	5.95
Total		101	100

Table 4.7 showed that near about 49.50% farmers had no training on agricultural and self development activities while 44.55% of the farmers had low training exposure and only 5.95% percent farmers had medium training exposure. It means that an irresistible majority (94.05%) of the farmers had no or low training exposure. It is logical that there is always a relationship between training exposure and the activities on livelihood status in the rural areas. Because training received develops the farmers' knowledge, skill, and attitude in production and processing of agricultural activities including livestock and fisheries. The findings suggest that training experience might be the most important factor for the respondents to change their livelihood status.

4.1.7. Extension contact

The score of extension contact on livelihood status ranged from 2-24 with possible score range of 0-54. The mean was 11.11 and standard deviation was 3.69 (Table 4.1). On the basis of extension contact, the respondents were categorized into three groups as shown in Table 4.8.

Table 4.8 Distribution of the farmers according to their extension contact

Categories	Basis of categorization (score)	Respondents	
		Numbers	Percent
Low contact	Up to 10	55	54.46
Medium contact	11 to 20	43	42.57
High contact	Above 20	3	2.97
Total		101	100

The results on extension contact indicate that more than fifty percent the farmers (54.46%) had very low extension contact while 42.57% had medium and only 2.97% had medium extension contact. Findings indicate that the respondents under the study area are not well connected with different extension services. But it is generally known that extension contact may be a good source of different information. Extension contact helps the farmers for better understanding and to get recent information regarding daily activities as well as different social work including self development which is related to improve livelihood status. The finding reveals that the respondents of the study area had very poor contact with different media. It is proved that there is always need a relationship between contact with different media and adoption of innovation. In order to increase livelihood status, contact with different media of the fanners should be increased.

4.1.8. Innovativeness

The observed innovativeness scores of the respondents ranged from 0 to 17 against the possible range of 0 to 24 (Table 4.1). However, the average was 8.81 and the standard deviation was 2.57. Based on their innovativeness scores, the respondents were classified into three categories: "low innovativeness", "medium innovativeness" and "high innovativeness". The distribution of the respondents according to their innovativeness is shown in Table 4.9.

Table 4.9 Distribution of the farmers according to their innovativeness

Categories	Basis of categorization (score)	Respondents	
		Numbers	Percent
Low innovativeness	Up to 8	38	37.62
Medium innovativeness	9-16	61	60.40
High innovativeness	Above 16	2	1.98
Total		101	100

The finding presented in Table 4.9 indicates that the highest proportion (60.40%) of the farmers had medium innovativeness as compared to 37.62% and only 1.98% having low and high innovativeness respectively. The result would help the extension planners to chalk out future extension programmes for transferring technologies to the potential farmers to improve their livelihood status. Higher innovativeness may also help the farmers to operate their daily activities easily and make their life wonderful.

4.2. Livelihood status of rural farmers

Scores on livelihood indicators of the respondents ranged from 9 to 49 against the possible range of 0 – 51 having an average of 29.46 and standard deviation of 11.06 (Table 4.10). On the basis of livelihood scores, the respondents were classified into three categories namely, 'low, 'medium and 'high'. The distribution of the respondents according to livelihood score is given in Table 4.10.

Table 4.10 Distribution of the farmers according to their livelihood status

Categories	Basis of categorization (score)	Respondents		Mean	Standard deviation
		Numbers	Percent		
Low	0-17	21	20.79		
Medium	18-34	47	46.53	29.46	11.06
High	35-51	33	32.68		
Total		101	100		

Data of Table 4.10 shows that 46.53% of the farmer felt in medium category followed by 32.68% in high category and 20.79% respondents were in low livelihood status category.

Livelihood status in an area is to be considered as vision of overall scenarios focusing their way of living and their activities related to overcome their difficulties in daily life. It is act or state of understanding; clear perception of fact or truth, that helps an individual to foresee the consequence he may have to face in future. It makes individuals to become rational and conscious about related field. To achieve better livelihood status, farmers should have adequate facilities to overcome difficulties considering existing situation which make their life easier. The major disasters that affect in Bangladesh; floods are the common natural disaster which make the rural people degraded their life style. Floods constitute about 50% of all natural disasters, and as a result, life and livelihoods are regularly affected by flooding (Ali *et al*. 2019). The destruction of wealth by the floods makes it imperative for the community members to shift dependence on agricultural income to non-agriculture income or diversify their common livelihoods. Livelihood strategies comprise the range and combination of activities and choices that people make/undertake in order to achieve their livelihood goals. The concept of sustainable livelihoods takes a social and environmental systems approach to human livelihoods and the environment. It builds on identifying assets and capabilities, seeking to address the barriers and vulnerabilities to sustainable livelihoods (Uddin *et al*., 2020).

4.3. Relationship between the selected characteristics of the farmers and their livelihood status due to effects of flood

Co-efficient of correlation was computed in order to explore the relationship between the sleeted characteristics of the farmers and their livelihood status. Table 4.11 was used for descriptive interpretation of meaning of 'r'.

Table 4.11. The meaning for 'r' value

'r' value	Meaning
0.00 to0.19	A very low correlation
0.20 to 0.39	A low correlation
0.40 to 0.69	A moderate correlation
0.70 to 0.89	A high correlation
0.90 to 1.00	A very high correlation

Source: Cohen and Holliday, 1982

Pierson's Product Moment Co-efficient of Correlation (r) has been used to test the hypothesis concerning the relationship between two variables. Five percent (5%) and one percent (1%) level of probability were used as the basis of acceptance or rejection of a hypothesis. The Table value of 'r' was calculated at (101-2) = 99 degrees of freedom. The summary of the results of the co-efficient of correlation indicating the relationships between the selected characteristics of the respondents and their livelihood status due to the effects of flood is shown in Table 4.13.

Table 4.12 Co-efficient of correlation showing relationship between selected characteristics of the farmers and their livelihood status

Dependent variable	Independent variable	Computed value of "r"	Tabulated value of "r" with 99 degrees of freedom	
			at 0.05 level	at 0.01 level
Effects of flood on the livelihood status of rural farmers	Age	0.037(^{NS})	0.164	0.254
	Education	0.241(*)		
	Family size	-0.045(^{NS})		
	Farm size	0.046(^{NS})		
	Annual family income	0.447(**)		
	Training exposure	0.069(^{NS})		
	Extension contact	0.197(*)		
	Innovativeness	-0.014(^{NS})		

^{NS} Not significant

* Significant at 0.05 level of probability

** Significant at 0.01 level of probability

4.3.1 Relationship between age of the respondents and their livelihood status due to effects of flood

Relationship between age of the respondents (farmers) and their livelihood status due to effects of flood was determined by testing the following null hypothesis: "There is no relationship between age of the farmers and their livelihood status due to effects of flood".

The calculated value of the co-efficient of correlation between the concerned variables was found to be 0.037 as shown in Table 4.12. The following observations were made regarding the relationship between the two variables under consideration.

> ➢ The computed value of 'r' (r= 0.037) was found to be smaller than the tabulated value (r= 0.164) with 99 degrees of freedom at 0.05 level of probability.
> ➢ The null hypothesis is accepted.
> ➢ The relationship between the concerned variables was not significant.
> ➢ The relationship showed a positive trend between the concerned variables.

Based on the above findings, the researcher concluded that age of the farmers had positive and non-significant relationship with their livelihood status due to effects of flood. This meant that age of the farmers was not an important factor in changing the livelihood status of the study area. But it can be concluded that higher aged farmer can be contributed to minimize various social and natural difficulties.

4.3.2. Relationship between education of the respondents and their livelihood status due to effects of flood

The co-efficient of correlation (r) between the concerned variables was computed and found to be 0.241 presented in Table 4.12 which led to the following observations:

➢ The relationship showed a positive direction.
➢ The computed value of 'r' (0.241) was found to be greater than the Table value of 'r' (0.164) with 99 degrees of freedom at 5% level of probability.
➢ The concerned null hypothesis was failed to accept.
➢ The co-efficient of correlation between the concerned variable was significant at 5% level of probability.

The finding implies that the education of the respondents had significant positive relationship with their livelihood status due to effects of flood. The finding is quite balanced because education helps to improve life style through gathering knowledge and experience easily.

4.3.3 Relationship between family size of the respondents and their livelihood status due to effects of flood

Relationship between family size of the farmers and their livelihood status due to effects of flood was determined by testing the following null hypothesis: "There is no relationship between family size of the farmers and their livelihood status due to effects of flood". The calculated value of the co-efficient of correlation between the concerned variables was found to be -0.045 as shown in Table 4.12. The following observations were made regarding the relationship between the two variables under consideration.

➢ The computed value of 'r' (r= -0.045) was found to be smaller than the tabulated value (r= 0.164) with 99 degrees of freedom at 0.05 level of probability.

- The null hypothesis is accepted.
- The relationship between the concerned variables was not significant.
- The relationship showed a negative trend between the concerned variables.

Based on the above findings, the researcher concluded that family size of the farmers had negative and non significant relationship with their livelihood status due to effects of flood. This indicated that family size of the farmers in the study area was not an important factor for improving their livelihood status.

4.3.4 Relationship between farm size of the respondents and their livelihood status due to effects of flood

The co-efficient of correlation (r) between the concerned variables was computed and found to be 0.046 presented in Table 4.12 which led to the following observations:

- The relationship showed a positive direction.
- The computed value of 'r' (0.046) was found to be smaller than the Tabulated value of 'r' (0.164) with 99 degrees of freedom at 5% level of probability.
- The concerned null hypothesis was failed to accept.
- The co-efficient of correlation between the concerned variable was not significant at 5% level of probability.

The finding implies that the farm size of the respondents had non-significant positive relationship with their livelihood status due to effects of flood. This indicated that farm size of the farmers in the study area was not an important factor for improving their livelihood status.

4.3.5 Relationship between annual family income of the farmers and their livelihood status due to effects of flood

Relationship between annual family income of the farmers and their livelihood status due to effects of flood was determined by testing the following null hypothesis: "There is no relationship between annual family income of the respondents and their livelihood status due to effects of flood". The calculated value of the co-efficient of correlation between the concerned variables was found to be 0.447 as shown in Table 4.12. The following observations were made regarding the relationship between the two variables under consideration.

- ➢ The computed value of 'r' (r= 0.447) was found to be larger than the tabulated value (r= 0.254) with 99 degrees of freedom at 0.01 level of probability.
- ➢ The null hypothesis was failed to accept.
- ➢ The relationship between the concerned variables was significant.
- ➢ The relationship showed positive trend between the concerned variables.

Based on the above findings, the researcher concluded that annual family income of the respondents had positive and significant relationship with their livelihood status due to effects of flood. This indicated that annual family income of the respondents was an important factor to upgrade their livelihood status.

4.3.6 Relationship between training exposure on wheat cultivation of the respondents and their livelihood status due to effects of flood

Relationship between training exposure of the respondents and their livelihood status due to effects of flood was determined by testing the following null hypothesis: "There is no relationship between training exposure of the respondents and their livelihood status due to effects of flood". The calculated value of the co-efficient of correlation between the concerned variables was

found to be 0.069 as shown in Table 4.12. The following observations were made regarding the relationship between the two variables under consideration.

> The computed value of 'r' (r= 0.069) was found to be smaller than the tabulated value (r= 0.164) with 99 degrees of freedom at 0.05 level of probability.

> The null hypothesis is accepted.

> The relationship between the concerned variables was not significant.

> The relationship showed a positive trend between the concerned variables.

Based on the above findings, the researcher concluded that training exposure on livelihood activities of the respondents had positive and non-significant relationship with their livelihood status due to effects of flood. This implies that farmers with higher training exposure on different vital issue were likely to have lower level of constraints faced by natural disasters. Training provides the structures, techniques and awareness to manage time and work load efficiently, which increases productivity and motivates farmer more to achieve more. Training received develops the farmer's knowledge, skill, and attitude in positive manner. The farmer who has no training cannot gain enough knowledge, skill and practical experience. Such consideration indicates the need for improving knowledge and skill level of the farmers by supplying enough training on the management of bad situation due to the bad effect of flood.

4.3.7 Relationship between extension media contact of the farmers and their livelihood status due to effects of flood

Relationship between extension media contact of the farmers and their livelihood status due to effects of flood was determined by testing the following null hypothesis: "There is no relationship between extension media

contact of the respondents and their livelihood status due to effects of flood."
The calculated value of the co-efficient of correlation between the concerned
variables was found to be 0.197 as shown in Table 4.12. The following
observations were made regarding the relationship between the two variables
under consideration.

➢ The computed value of 'r' (r= 0.197) was found to be larger than the
tabulated value (r= 0.164) with 99 degrees of freedom at 0.05 level of
probability.
➢ The null hypothesis was failed to accept.
➢ The relationship between the concerned variables was significant.
➢ The relationship showed a positive trend between the concerned
variables.

Based on the above findings, the researcher concluded that extension media
contact of the respondents had positive and significant relationship with their
livelihood status due to effects of flood. This implies that farmers with higher
extension media contact were likely to have lower level of constraints faced
due to terrible effects flood.

4.3.8 Relationship between innovativeness of the respondents and their livelihood status due to effects of flood

The co-efficient of correlation (r) between the concerned variables was
computed and found to be -0.014 presented in Table 4.12 which led to the
following observations:

➢ The relationship showed a negative direction.
➢ The computed value of 'r' (-0.014) was found to be smaller than the
Table value of 'r' (0.164) with 99 degrees of freedom at 5% level of
probability.
➢ The concerned null hypothesis was accepted.

➢ The co-efficient of correlation between the concerned variable was not significant at 5% level of probability.

The finding implies that the innovativeness of the respondents had non-significant negative relationship with their livelihood status due to effects of flood. Moreover, it can be said that the farmers who are more innovative have more knowledge on the management of detrimental effect of flood.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1. Summary

The study title was undertaken as titled "effects of flood on the livelihood status of rural farmers under the Sadar Upazilla of Gaibandha district" with the objectives of (i) To assess the extent of food safety knowledge among the rural households, (ii) To describe the determinant factors of the respondents (age, education, family size, farm size, annual family income, training exposure, extension contact, innovativeness and cosmopoliteness) and (iii) To explore relationships between the selected characteristics of the respondents and their knowledge on food safety.

Kadir para union Union of Sreepur upazila under Magura district was the locale of the study. The sample of 101 farmers was drawn from a population of 550. Data were collected during 1st September to 30 October, 2021 using a pre-tested interview schedule. A summary of the major findings is given below:

5.1.1. Individual characteristics of the respondents

Age: Age of the respondents ranged from 20 to 75 years with an average of 44.72 years. Majority of the respondents (50.50%) were middle aged followed by 22.77% and 26.73% young and old-aged respectively.

Education: The highest proportions (36.64%) of the farmers were in the secondary level. Primary, above secondary, can sign only and illiterate level of literacy found 5.94, 13.86, 32.67 and 5.94 percent, respectively. It means, a major portion of the respondents (49.50%) of the respondent were illiterate or having education up to primary level.

Family Size: The highest proportion (45.54%) of the farmers had small family size, while 36.63% and 17.83% belonged to the medium family size and large family size, respectively.

Farm size: The highest proportion (73.27%) of the farmers had small farm size, while 5.94% and 18.81% belonged to the medium farm and marginal farm respectively.

Annual family income: The highest proportion (43.36%) had high annual family income compared with 35.65% having medium income and 20.79% having low annual family income.

Training exposure: Most of the respondents (49.50%) had no training compared to 44.55% and 5.95% having low training and medium training, respectively. It means majority (94.05%) of the farmers had no to low training on livelihood indicators.

Extension contact: Maximum farmers (54.46%) had low extension contact compared to 42.57% and 2.97% having medium and high extension contact, respectively. It means above 50% of the farmers had low extension contact.

Innovativeness: The highest proportion (60.40%) of the respondents had medium innovativeness as compared to 37.62% and 1.98% having low and high innovativeness respectively. It means that majority of the respondents were in medium innovativeness.

5.1.2. Livelihood status due to effects of flood

The highest proportion (46.53%) of the farmers in the study area was in medium livelihood status followed by 32.68% in high category and 20.79% respondents were in low livelihood status category.

5.1.3. Relationship between the selected characteristics of the farmers with their knowledge on food safety

Correlation analysis indicates that education, annual family income and extension contact had significant positive relationship with their livelihood status due to effects of flood. On the other hand, age, family size, farm size, training exposure and innovativeness of the farmers had no significant relationship with their livelihood status due to effects of flood.

5.2. Conclusions

Findings of the study and the logical interpretations of their meaning in the light of other relevant facts prompted the researcher to draw the following conclusions:

I. Finding shows that majority (46.53%) of the farmers had medium levels of livelihood status. Besides 20.79% farmers were in low level. Therefore, it can be concluded that livelihood status of the study area belongs to moderate satisfactory level and has scopes to upgrade.

II. Education of the farmers showed significant relationship with their livelihood status due to effects of flood. So, it may, therefore be concluded that formal education of the respondents had contribution to upgrade their livelihood status.

III. Annual family income of the farmers had significant positive relationship with their livelihood status due to effects of flood. The farmers having higher annual income and being economically solvent always try to upgrade their living status. Considering the above facts, it may be concluded that the effects of flood on the livelihood status of rural farmers is remarkable to the farmers having higher annual income.

IV. Contact with different extension media of the farmers had positive significant relationship with their livelihood status due to effects of

flood. It can be concluded that any attempt to increase the communication behaviour of the farmers would be helpful to upgrade social status.

5.3. Recommendations

5.3.1. Recommendations for policy implications

Based on the findings and conclusions of the study, the following recommendations are presented:

i.   Majority (46.53) of the respondents were under medium level of livelihood status. Therefore, it may be recommended that attempts should be taken by DAE and other extension providers to arrange training, motivational campaigning and provide guidance to upgrade livelihood status.

ii. Education of the respondent had significant positive relationship with their livelihood status due to effects of flood. Therefore it may be recommended that attempts should be taken to establish adult learning centre to increase educational level as well as awareness on social and technical activities related to agriculture, communication etc. which helps to upgrade social status.

iii. Extension agencies should realize the existing problems of natural calamities like flood, cyclone etc. and take necessary steps to minimize these risks. Necessary inputs such as agricultural equipments, safe protection measures against insect and pest, shelters due to natural hazard to be made available to the respondents at right time and at fair prices.

5.3.2. Recommendations for further study

A small piece of study as has been conducted which cannot provide all information for the proper understanding on livelihood status due to effects of flood. Therefore, the following suggestions are made for further study:

1) The present investigation explored the relationships of the eight characteristics of the respondents with their livelihood status due to effects of flood. Further research may be conducted by taking other characteristics to observe relationships with their livelihood status due to effects of flood.

2) The present study was conducted in two villages named Poshim Komornoi and Fakirpara under Gaibandha Sadar upazilla. So, similar studies may be undertaken in other parts of the country to verify the findings of the present study.

3) A positive trend of relationship was obtained between education of the growers and their livelihood status due to effects of flood. Hence, further studies are necessary to verify the relationship between the concerned variables.

4) The present study has been carried out among the male farmers only. So, a similar study may be conducted with the farm women to examine their views and opinions regarding the effects of flood on the livelihood status of rural farmers.

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Appendix I. English version of the interview schedule

Department of Agricultural Extension & Information System
Sher-e-Bangla Agricultural University, Dhaka-1207

A questionnaire on
An interview schedule on entitled

Effects of flood on the livelihood status of rural farmers under the Sadar Upazilla of Gaibandha district

Serial No.   : ………………………………….

Name of the respondent   : ………………………………..

Address   : ………………………………..

                                 : ………………………………..

                                 : ………………………………..

Please answer the following questions. Information given by you will be kept secret and only be used for research work

1. Age

What is your age? ------------------------ Years.

2. Education:

 a) Illiterate ………………. (0)

 b) Can sign only ……………. (0.5)

 c) Studied up to class …………….... (1 per class)

3. Family size

 Please mention the number of your family members in the following groups:

 a) Male member   ……………………………..

 b) Female member ……………………………….

 c) Total member   …………………………….

4. Farm Size

Please mention the area of your land possession:

Sl. No.	Types of land ownership	Land Area	
		Decimal	Hectare
A.	Homestead area (Including pond)		
B.	Own land under own cultivation		
C.	Land given to others as shared crop		
D.	Land taken from others as shared crop		
E.	Land given to others as lease		
F.	Land taken from others as lease		
G.	Fallow land		
	Total		

Farm size = A + B + C/2 + D/2 + E + F

5. Annual family income (Tk.)

Please mention production and annual family income of your family from different sectors in the last year.

Sl. No.	Source of income	Amount of production	Price per unit (Tk.)	Total (Tk.)
A). Agriculture				
1.	Rice			
2.	Jute			
3.	Wheat			
4.	Potato			
5.	Pulse			
6.	Oilseed			
7.	Spices and condiments			
8.	Vegetables			
9.	Fruits			
10.	Other crops			
11.	Fish culture			
12.	Poultry rearing			
13.	Cattle rearing			
B) Business				
C) Service				
D) Labour				
E) Others				

Total annual income = A+B+C+D+E = …………………………….

6. Training Exposure

Do you attend any training on agriculture or any other self development activities during last 5 years? **Yes**☐   **No**☐

If yes, Please mention the training courses you have attended so far

Sl. No.	Subject	Place	Duration(day)
1.			
2.			
3.			
4.			
5.			

7. Extension contact

Please mention the extension contact you have attended so far

Type of media	Name of information media	Extent of contact			
		Frequently	Occasionally	Rarely	Not at all
		3	2	1	0
Personal Contact (7)	Friends/relatives				
	Extension agents				
	Extension officials				
	BADC officials/UFPO				
	NGO personnel/AHI/UMO				
	Input dealers				
	Model farmer				
Group Contact (4)	Demonstrations				
	Field days				
	Training days				
	Group meetings				
Mass Contact (7)	Radio				
	Television				
	Newspaper				
	Leaf lets or booklet				
	Reading agricultural books				
	Agricultural fair				
	Audio-visual aids				
Total (18)	18 media				

8. Innovativeness

Please mention extent of use of the following modern Agricultural Practices.

Sl. No.	Name of Innovation	Do not use (0)	Used		
			Below 1 year (1)	1-3 years (2)	Above 3 year (3)
1.	Use of organic manure instead of chemical fertilizers				
2.	Use of green manure in crop production				
3.	Use of modern technology (Power tiller/ Pump etc.) in agriculture				
4.	Use of HYV/Hybrid Seed				
5.	Use of improved techniques of food or grain storage during flood				
6.	Improved housing technique or living style during flood				
7.	Save poultry, cattle, goat, fishes etc. during flood				
8.	To save people due to over flow of water in the flooded areas				

9. Effects of flood on livelihood status of rural farmers

Sl. No.	Livelihood indicators - Effects of flood on		Scoring on effects of flood				Total
			No (0)	Low (1)	Medium (2)	High (3)	
1.	Agricultural activities	Preparation of soil					
		Cultivation					
		Harvesting and storage					
2.	Livestock	Cattle and goat Rearing					
		Dairy purpose					
		Poultry farming					
3.	Fisheries	Biofloc fish farming					
		Rice field fisheries					
		Aqua culture practices					

4.	Trading activities	Grain and vegetable marketing					
		Shop keeping					
		Livestock business					
5.	Health care conditions						
6.	Housing conditions						
7.	Transport facilities						
8.	Education facilities						
9.	Water supply and sanitation facilities						
	Total						

Thank you for your kind cooperation.

Date:...............................

....
Signature of Interviewer

Appendix II. Correlation matrix

Variables	Age	Education	Family size	Farm size	Annual family income	Training exposure	Extension contact	Innovative-ness	Livelihood status
Age	1	-0.117	0.132	-0.009	-0.164	0.203(*)	0.063	0.184	0.037(NS)
Education		1	0.176	0.043	-0.118	0.338(**)	0.055	-0.117	0.241(*)
Family size			1	0.218(*)	0.117	0.056	0.149	0.004	-0.045(NS)
Farm size				1	0.475(**)	0.165	0.239(*)	0.167	0.046(NS)
Annual family income					1	0.079	0.108	0.136	0.447(**)
Training exposure						1	0.168	-0.017	0.069(NS)
Extension contact							1	0.387(**)	0.197(*)
Age								1	0.014(NS)
Education									1

* Significant at 5% level of probability   ** Significant at 1% level of probability   [NS] Non-significant