

EFFECT OF FLOODS ON FARMER'S LIVELIHOOD: A CASE STUDY FOR BUILDING AGRICULTURE RESILIENT TO FLOODS IN BANGLADESH

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Abstract: 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. This paper identifies and analyses the historical perspective of the flood in Bangladesh and its impacts mainly on the livelihood of farmers. It also emphasizes on the current remedies as well as what can be done to save the small-scale farmers from the devastating floods. This synthesis was based on the information published in different grey literature, research articles, government and non-government reports, media sources, and so on.

Keywords: Flood, Farmer, Climate change, Agriculture, Resilient, Bangladesh.

1. Background of the Study

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) basins and is extensively documented as a country with highly vulnerable to flooding and cyclone (Ruane, 2013). Since this country is one of the most climate-vulnerable (especially related to flood) countries in the globe, the farmers of this country are extremely predisposed to agricultural damage (Huq et al., 2015). It is worth noting that the small-scale farmers in the agricultural countries such as Bangladesh are predominantly agonized 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. It may happen in unanticipated scales and frequencies that eventually may cause death of lives, damage of crops and infrastructure as well as livelihood (Integrated Flood Management Concept Paper, 2009).

Bangladesh is an exceedingly susceptible to flood (Brouweret *al.*, 2007). There are four different kinds of inundations occur in Bangladesh; flash floods, riverine floods, rain floods and storm-surge floods (Mirzaet *al.*, 2003). Flash floods arise in the river that located in north and east part of Bangladesh in which circumstance water level suddenly rise to a large extent. Riverine floods occur from the winding of foremost rivers and their branches usually increase as well as drop deliberately more than 10-20 days and make severe disruption to assets and the loss of life (Mirzaet *al.*, 2003). When the rivers reach at their peak, the complexity and level of floods and allied impairment become more comprehensive. Heavy and prolonged local rainfall in the monsoon causes rain floods. The degree of intensity and penetration of flood from rain water fluctuates with the monsoon from time to time and depend on the volume and concentration of rainfall and existing water heights in the river. The fourth type of floods occur by storm in the seaside zone of Bangladesh that comprises of big inlets, wide tidal wave and lowland islands (Rahman, 2014).

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. 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. 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).

The primary objective of this study is to analyse how farmers can become more resilient to flood in Bangladesh. The findings of this study are expected to investigate how floods effect on agriculture and increase vulnerability of agriculture to natural disasters. Consequently, this study can have a most important influence to improve resilience of farmers to agriculture in Bangladesh.

2. Materials and Methods

The methodology of this paper is mainly based on the review of journal and newspaper articles, reports, surveys, and data, both qualitative and quantitative, are used from the secondary sources. The synthesis of this study came up with the data used from these sources. Relevant information, data, and sources used in this paper gathered from a systematic review of pertinent works regarding the flood, and published in English only.

3. Results and Discussion

3.1 Flood: from the world perspectives

Table 1 represents the information of the most devastating floods in the world. The statistics show that the flood did not leave any part of the globe, from west to east, south to north. However, the impacts of flood varies from country to country as the post-flood management capacity and capabilities are not the same.

Table 1: The most devastating flood incidents in different parts of the world (Dewan, 2015)

Date	Place	Impacts	Estimated economic loss
May 2014	Balkans Flood	Died: 37, Displaced: tens of thousands	2.5 billion
September 2013	Colorado, USA	Died: 8, Missing: 6	1 billion
June 2013	Uttarkhand, India	Died: 6500	45 billion
July 2010	Indus Basin, Pakistan	Died: 2000, Affected: 20 million	43 billion
June-August 2010	Dadeldhura, Nepal	Died: 98, Missing: 8, Affected: 39,000	294.4 million

3.2 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-1.

Table 2: Some remarkable floods and destruction caused by floods

[GOB, 2005; Hofer and Messerli, 2006; Huq et al., 2015; Global Information and Early Warning System (GIEWS), 2017]

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\$ 2.8 billion
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.

3.2.1 Impacts of flood on agriculture

Major people of the country completely rely on agriculture for their subsistence. As the landholding size is very small, so maximum people don't have any extra land. Because of river erosion, sedimentation and inundation, a huge part of cultivable land is being washed away or became infertile with the touch of floods. Due to this a small number of affluent farmers have shifted from household to profitable farming, particularly the rural community alongside the river. The paddy productivity of the land in the flooded region has decreased by above 40%. The productivity of the land has been decreased for nearly all kinds of crops in all these communities. Flooding make the soil moist which eventually make winter crops cultivation challenging. There is an association amongst floods and agriculture. The agriculture of Bangladesh is affected by annual flooding. Several crops notably rice and jute produced in the monsoon cannot increase devoid of flood water. The water provides the moisture and soil fertility which are necessary to produce crop. Over the years, Bangladeshi farmers have well adapted their life-styles and agriculture with the yearly flooding that occur

and decline in due time reaching average height. The agriculture of Bangladesh is, therefore, dependent on flood and is also flood-vulnerable (Paul, 1984). Regular inundation occurs while water submerges around one-fifth surface land of the country and it is necessary for refilling ground water levels. These floods also essential to nourish fields by accumulating fine sediments and to destroy pests. Thus, they enhance the overall productivity in agriculture (Braun and Shoeb, 2008).

3.3 Agriculture, farmers and resilience in Bangladesh

Resilience is defined as the ability to recognize the risk, to be easy and act appropriately to face the stress and trauma during the disasters and have a greater capability to recover from enduring effects (COAG, 2011). The characteristics of disaster resilient communities are- (i) functioning well while under stress: the resilient community takes initiatives to make people ready for calamities and are very quick to respond properly in crises; (ii) successful adaptation: the community has the capability to defend themselves and their resources as well as to minimise physical, economic and social losses by adaptation; (iii) self-reliance: the community helps with the required funds which supports to re-build social, institutional and financial condition; and (iv) social capacity: a resilient community is empowered by capable societal communication hub which helps individuals and families during emergency period (COAG, 2011).

In Bangladesh it is yet a question of debate whether the farmer communities have become resilient to flood or not. There are some prominent reasons behind why farmers in Bangladesh are not being resilient for which the farmers are still thriving to be resilient to flood which has a harmful outcome on agriculture. The reasons include- (a) changes in cropping pattern: cropping pattern is greatly affected by floods. Due to overflowing and flood, in maximum cases, farmers cannot transplant paddy on time. It makes delay in collecting of paddy and sowing of crops seeds for winter season. After floods, it takes a considerably long time to regain the usual arable soil condition. This phenomenon changes the cropping pattern. The total crop production is usually decreased due to change in cropping pattern; (b) increase the practice of borrowing money for farming: due to the devastating impacts of flood, to invest in farming the affected farmers take loan or borrow money from local money lenders on an excessively high rate for re-cultivation. They can hardly repay that huge amount of money and ultimately, they cannot fully engage themselves in agriculture; (c) high price of seeds: stocked seeds of cereals and vegetables are destroyed during floods. The price of seeds goes up and the farmers must buy them from outdoor of

local area. The deprived farmers can hardly afford to buy expensive seeds and for this reason they are bound to practice the wet seed which results in a reduced amount of germination; (d) less return from animal husbandry: livestock are died because of unexpected outbreak of diseases during pre- and post-flood conditions. It is also tough to keep the cattle fit and manage their proper feedstuff during floods because of poor food management. This situation incurs low income from the animals that eventually lead the farmers not to fully come back in agriculture; and (e) recession in economic condition: the regular floods abolish farmers' adaptation capacity, though they attempt to handle their losses and continue their farming. This situation leads them to be poor (Rahman, 2014). Thus, extreme floods reduces ability of the farmers to handle with even next normal flood (Younus and Harvey, 2014).

3.3.1 Improving flood resilience by farmers

Farmers worldwide have well-known coping mechanisms to deal with seasonal uncertainties, variable weather and natural hazards. To sustain consumption, they may switch crops, work longer hours or sell land or other productive assets. Some even migrate to less disaster-prone areas to avoid chronic poverty. It is recommended that there are some important steps can be taken to improve farmers resiliency to floods, such as increasing the rate of loan after floods as well as growing crops after the floods on the sandbanks formed by river deposits (Rahman, 2014), and guaranteed aid deters post-disaster migration (Uddin *et al.*, 2017).

3.4 Building farmer's resilience to floods

To a wide range, growing resilience can be attained by lowering vulnerabilities and boosting adaptive capability. For each kind of risk, it might be gained by decreasing exposure, lessening sensitivity and enhancing adaptive capacity. It can operate in any of these field like biophysical, economic and social. One approach of achieving enhanced resilience is to decrease shocks transmission amongst categories of risks, between extents and areas and to establish advantage between scales or domains to prevent increasing and long-standing effects (Gitz and Meybeck, 2012). It is necessary to improve the ability of communities to enhance their resilience. For better response to increase resilience it is needed to increase the ability of government organizations to act in response to emergencies, improve river embankments and coastal polders, especially low-lying areas that are vulnerable to flood. Besides, establishing emergency cyclone shelters and resistant homes, modifying cultivation methods of rural households, decreasing intrusion of saline water, particularly in areas reliant on agriculture and executing early warning and disaster management systems are required to build resilience to flooding. (World Bank, 2016). Resilience might be accomplished with

decreasing susceptibilities and enhancing capability of being adapted (Gitz and Meybeck, 2012). There are some significant factors which address the barriers and help farmers to build resilience to floods. These are explained below;

3.4.1 Increasing adaptive capacity of farmers

The first issue is farmers need to improve the ability of absorption of the risk and second one is to increase the adaptability and management capacity (Smit and Wendel, 2006). The farmers must have the capability to defend themselves and their resources as well as to minimise physical, economic and social losses by adaptation (COAG, 2011).

3.4.2 Early warning and emergency management systems

Early warning system can help the farmers to save their crops. Sometime the flash floods come during harvesting. If farmers get the warning early, they can have time to harvest their crops. The other issue may help farmers to build their resilience is to improve the emergency management systems. It is very helpful for them to manage their agricultural products at the time of crisis (World Bank, 2016). The flood Forecasting and Warning Centre of Bangladesh Water Development Board (BWDB) mainly taken the responsibility of the inundation prediction by forecasting early weather to make aware farmers about their agricultural production (Mirza *et al.*, 2003).

3.4.3 Agricultural insurance

The millions of small-scale farmers are not covered properly by the existing insurance systems. For this reason, institutional framework for assistance would perform an important role in offering local and demand-based climate guidance to farmers for inspiring them to practice insurance procedures. This minimizes the consequences of weather/climate by acquiring necessary resources more rapidly to safeguard livelihoods. The methods of index-based weather insurance need assistant of nationwide climatological as well as hydrological facilities to confirm excellent climate data, observing devices and processes to low quality meteorology information to generate actual grain production indicators in an agro-ecological zone (Gitz and Meybeck, 2012).

3.4.4 Developing flood tolerant varieties

Flash floods frequently touch lowland crops where inundation water runs for around fortnight in several regions of the country. In Bangladesh, more than 2.0 million hectares cultivable lands are adversely influenced by excess water and occasionally experience flash floods and totally inundated for 1-2 weeks resulting crop destroy (Rahman, 2014). Climate change is not an easy matter to solve quickly. It will take long time to lessen the effect of global warming.

However, Government of Bangladesh has already taken steps to develop climate resilient varieties of crops and research organizations are continuing their research to develop newer flood tolerant varieties (Gitz and Meybeck, 2012).

3.4.5 Increased awareness about the importance of using sustainable farming practices

Integrated farming is not only adapted to the environmental conditions and the diet of farmers, it is also a way of making the most of natural resources in their surroundings without damaging them. The sustainable access to inputs must be carefully planned, farmers must be trained on seed storage and on “home-made” simple pest and disease treatments. Resilient seed banks can also play a key role in case of an emergency when crops are destroyed by a flood.

3.4.6 Disseminating right information

Hazard recognition is often figure out through quantitative and qualitative methods and approaches to build resilience. Different organization of Bangladesh such as department of agricultural extension, Bangladesh agricultural research council works to disseminate the information to field level about crops selection according to area and soil characteristic, provide suggestion to cultivate flood tolerant varieties to flood-prone area. Organizational support can contribute early information about the susceptibility to climate phenomena that will increase the resilience of farmers (Gitz and Meybeck, 2012).

3.4.7 Strengthening technical and institutional capacities

The services delivered by national meteorological and hydrological departments should realize the information demand of farmers and agricultural related services. These organizational services should also have the mainstream to improve the climate and weather data commodities. Farming care servicing and society-based institutions must involve themselves in the expansion of possible future strategies including modern mechanization, enhancing effective news gathering, observing and evaluation, improvement of impact viewpoints and controlling options taking local demands into account and simplify exchange of information to the farmers to build the resilience (Gitz and Meybeck, 2012).

3.4.8 Poor performance of social community

Enhancing of social networks, native organizations and rules and associations is crucial for controlling climate hazards. Native nets figure the ranchers’ societal interactions results to sharing choices (Meinkeet *al.*, 2006). This participatory decision is a very effective connection to receive any information about upcoming natural disaster (Selvarajuet *al.*,

2004). The farmers can be able to secure the resources if they have strong social networks (Rahman, 2014).

3.4.8 Construction of embankment

Bangladesh Practices two type of flood management structural and non-structural flood management. The structural measures are mainly engineering structure build for protect the flood for example Inundation Dam, Canal Development, Seaside Embankment and so on. The non-structural flood management comprises of the Inundation Plain Zoning & Management (Mirza *et al.*, 2007). To build resilience to agriculture it is important to construct flood embankment, channel improvement and coastal embankment to flood prone zone. Bangladesh Government has already built such embankments but these are not enough. (Mirza *et al.*,2003).

3.4.10 Government strategy/policies

The Government of Bangladesh is decidedly committed for safeguard and betterment of the atmosphere, to conserve as well as to protect the natural assets, diversity, swamplands, forests, fisheries and livestock to achieve sustainability of agriculture. Bangladesh Government has financed more than 10 billion Dollars to reduce the vulnerability of the country for the last 35 years. These investments were made for inundation management schemes, coastal polders, cyclone shelters and lifting of road and rail network over the level of flood. Moreover, the Government has established state of the art warning systems for floods, cyclones and storm surges and is developing communal disaster vigilance. To protect the country, Bangladesh Climate Change Strategy and Action plan 2009 has created and is being put into action (GOB, 2009). In addition, the government has undertaken various projects/programs to avert the damages done by flood. Some of them are- (a) coastal embankment project considered for increasing grain production in seaside zones by averting flooding; (b) agricultural research program to develop flood adapted crop varieties; (c) projects for providing subsidies on agricultural inputs after floods; and (d) projects for adaptation against floods, comprehensive disaster management, reconstruction and maintenance of remaining deluge dams and planning, design and construction of river training works.

4. Conclusions

Flood has become a regular phenomenon in Bangladesh. Urgent steps are to be taken to save especially the small and marginal farmers from gross financial loss and to continue an expected agricultural growth by comprising suitable technologies, effective dissemination

systems, and economic support. The study focused the farmers' resilience to floods with respect to agriculture in Bangladesh and explored that Bangladesh has already achieved mentionable progress in preparing the devastating effects of floods. The study suggests that more appropriate policy intervention, investments on climate-smart agricultural research, the participation of private sector in disaster preparedness, and a holistic planning approach can help to understand the dimensions of better flood management.

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