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# UNDERSTANDING HIGH DISASTER RISK OF FLASH FLOOD IN *HAOR* REGION OF BANGLADESH

**Abstract**

The *haor* region, a wetland ecosystem situated in the north-eastern part of Bangladesh in the Meghna river basin, is one of the disaster hot-spots of the country. The area is geographically excluded and ecologically vulnerable. Furthermore, it is a part of Bangladesh where poverty is prevalent and natural disasters like floods and flash floods are very common. In 2017, the entire *haor* region of the country was inundated due to early flash flood, generated by relentless rain and onrush of flood water from the rivers upstream. Along with the destruction of huge crops, the flash flood caused havoc in the region by affecting livelihood opportunities including fisheries, duck farming, animal husbandry etc. Based on that, the study takes an attempt to identify the underlying factors responsible for high disaster risk of flash flood in the *haor* region. The study argues that high disaster risk in the region is attributed to multidimensional vulnerability factors which limit the coping capacity of the people living there and make them susceptible to disasters. Apart from the unique physical location and hydrological setting that makes the *haor* region severely exposed to flash floods, the study identifies socio-political, economic, environmental, institutional and governance related factors responsible for high disaster risk in the region.

## 1. Introduction

*Haor* region of Bangladesh, characterised as large bowl shaped floodplain depression, is located in the north-eastern part of the country and spread over seven districts namely, Sunamganj, Sylhet, Habiganj, Moulvibazar, Netrokona, Kishoreganj and Brahmanbaria. The *haors* are considered as one of the most productive wetland resources of Bangladesh contributing around 6-8 per cent to national GDP of the country.[1] The basin supports a large variety of wetland bio-diversity and works as natural reservoir as it plays a key role in basin water resources by regulating water flows of the Meghna river system.[2] It is the habitat of around 19.37 million people that makes 12 per cent of the country's total population. Out of 10.57 million hectare

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[1] Bangladesh Haor and Wetland Development Board, *Master Plan of Haor Area*, Volume I, Summary Report, April 2012, Ministry of Water Resources, Government of the People's Republic of Bangladesh.
[2] Mohd. Shamsul Alam and Md. Sazzad Hossain, "Haor", Banglapedia, available at http://en.banglapedia.org/index.php?title=Haor, accessed on 02 July 2017.

rice cultivation area of Bangladesh, *haor* region covers 1.74 million hectare which is 16 per cent of grand total. Besides, approximately 22 per cent of country's total cattle population and more than 24 per cent of country's total duck production come from that region.[3] It plays a vital role in the country's rice production *vis-à-vis* food security and is a major source of livelihood for a huge number of people.

In spite of its vital contribution in country's economy and food production, the region is afflicted by multitude of challenges. Owing to its unique geo-physical location and hydro-ecological characteristics, the *haor* region is one of the disaster hot-spots of the country, among which floods and flash floods are the most common one. In addition, prevalence of extreme poverty and lack of education coupled with limited livelihood options make people living in that area "backward section of citizens" of the country.[4] More than 28 per cent of the total *haor* population lives below the Lower Poverty Line (LPL).[5] The region has been suffering from unemployment and food insecurity, attributed to over dependency on mono crop production, frequent flash flood disaster, lack of communication infrastructure and other basic services.[6] Every year, the residents suffer from flash flood, which is a common and recurrent phenomenon of the region. The major threat of the flash flood is to crops, which are often destroyed by flood water just as they reach maturity. The flash flood also affects other livelihood options including fisheries, duck farming, animal husbandry, severely jeopardise the life and livelihood of the people living there.

Due to its recurrent nature, people, especially farmers living in *haor* are all familiar with flash floods. Nevertheless, the flash flood in 2017 caught everyone living there totally off-guard, which destroyed crops in over hundreds and thousands of hectares and killed huge number of livestock and damaged marine resources. Flash floods usually occur in the region in mid-April, but in case of 2017, crops went under water as early as 27 March due to incessant rain and onrush of flood water from the rivers of upstream. The flash flood caused havoc in the region by affecting every means of subsistence adversely. Due to its devastating impact, the flash flood in 2017 has been considered as one of the worst floods in the recent history of the region.

[3] General Economics Division (GED) and United Nations Development Programme (UNDP) Bangladesh, *Environment and Climate Change Policy Gap Analysis in Haor Area*, Workshop Outcome Report, September 2016, available at http://www.bd.undp.org/content/dam/bangladesh/docs/Projects/ssip/Haor%20Workshop%20Outcome%20Report_27.09.2016_optimized.pdf, accessed on 01 March 2018.

[4] Development Wheel, *Essential Services of Haor Areas and Way Forward*, Final Report, available at http://dewbd.org/dew/images/stories/dew_report/Final%20Report%20on%20Essential%20Services%20of%20Haor%20Areas%20and%20Way%20For.pdf, accessed on 28 February 2018.

[5] Bangladesh Haor and Wetland Development Board, *Master Plan of Haor Area*, Volume II, Main Report, April 2012, Ministry of Water Resources, Government of the People's Republic of Bangladesh.

[6] M. M. H. Kazal, C. C. Villinueva, Md. J. Hossain and T. K. Das, *Food Security Strategies of the People Living in Haor Areas: Status and Prospects*, Final Report, National Food Policy Capacity Strengthening Programme (NFPCSP), October 2010; Bangladesh Haor and Wetland Development Board, Main Report, *op. cit.*

Under this backdrop, based on the disaster of 2017, the study is an attempt to identify the underlying factors responsible for high disaster risk of flash flood in *haor* region. Conceptually, disaster risk is the consequence of the interaction between a hazard event and the factors that make people and the community vulnerable and exposed to disaster. Therefore, an effective way to understand the disaster risk of a hazard is to identify the vulnerability factors of people and community exposed to that particular hazard. To discuss the disaster risk, the study will seek answer to the following research questions: What are the factors that make the *haor* region vulnerable to flash flood and how the factors are responsible for high disaster risk? The study is divided into five sections including introduction and conclusion. Followed by an introduction, section two discusses the conceptual issues. Section three presents an overview of the flash flood that affected the *haor* region of Bangladesh in 2017. Section four analyses the factors responsible for high disaster risk of flash flood. Finally, a conclusion has been drawn.

The study will follow qualitative research method which is exploratory and descriptive in nature. It will explore the vulnerability factors and describe how the factors are responsible for high disaster risk. It is based on both primary and secondary data. Primary data has been collected from expert interviews. Collection of secondary data has been conducted from reviewing official documents, reports, newspapers, and academic literature including books, journals, thesis papers and internet based articles.

## 2. Flash Flood Disaster Risk in the *Haor* Region: A Conceptual Framework

The *haor* region in north-eastern Bangladesh is a wetland ecosystem characterised by the presence of large bowl-shaped floodplain depressions which are seasonally inundated.[7] It is also known as back swamp.[8] *Haors* receive surface runoff water by rivers and khals and become large extensive water body in monsoon but dry up mostly in the post-monsoon period. Due to its location below hilly regions of the states of Assam, Meghalaya and Tripura of India, haor areas have some of the most severe hydrological conditions like extreme precipitation and rainfall.[9] Therefore, they are vulnerable to multitude of natural hazards. Among all hazards, flash flood is the most common and recurrent one which often creates havoc in the *haor* region.

Though, among various natural hazards, flash floods rarely garner high level of attention, but according to the World Meteorological Organization (WMO), flash

[7] Sarah Gillingham, *Care Bangladesh Programme Strategy: Haor Region 2015-2020*, Bangladesh: Care Bangladesh, February 2016.

[8] A. W. Akonda, "Bangladesh", in A Directory of Asian Wetlands, available at https://portals.iucn.org/library/sites/library/files/documents/1989-Scott-001.pdf, accessed on 01 July 2017.

[9] S. Nowreen, S. B. Murshed, A. K. M. Saiful Islam and B. Bhaskaran, "Change of Future Climate Extremes for the Haor Basin Area of Bangladesh", 4th International Conference on Water and Flood Management, 2013, pp. 545-556.

floods are the most lethal form of natural hazard (based upon the ratio of fatalities to people affected), and cause massive damage in property every year. Flash floods defined as flood events of short duration with a relatively high peak discharge tend to occur frequently but at a very small scale.[10] Normally, flash flood begins within 3-6 hours of heavy rainfall. When rainfall within a catchment exceeds either the infiltration capacity or the storage capacity of the catchment, surface runoff occurs. When the surface runoff exceeds the discharge capacity of any point downstream of the catchment, flash flood will occur. The amount of rainfall that is required over a specified time frame to initiate a flash flood, *i.e.*, to exceed the infiltration (or storage) capacity of the catchment and cause more than bank full flow in the catchment outlet, depends on the catchment (slope, soil type, drainage capacity, shape and capacity of the discharge point).[11]

Flash flood in the *haor* region of Bangladesh occurs due to region's location just beneath the hilly region of the states of Assam, Meghalaya and Tripura of India and the rainfall pattern of the catchment area of the Surma-Kushiyara basin that receives water from the trans-boundary catchments of the Meghalaya, the Barak and the Tripura. However, flash flood becomes disaster for the region due to the vulnerable condition of the people and community living there. Flash flood might be a hazard attributed to external natural shock, but the disaster that creates results from the complex interaction between the hazard, the vulnerable condition of people and community as well as their coping capacity. Therefore, understanding disaster risk of flash flood requires clarity of the concepts hazard, vulnerability and disaster and how these terms are interlinked.

Disasters have long been recognised as arising from the juxtaposition of hazard events, vulnerable natural and built environment and vulnerable population.[12] Disaster is defined as a serious disruption of life or functioning of individual, community or society involving widespread human, material, economic or environmental losses, breakdown of infrastructure and service network, destruction of eco-system, etc., that exceeds the ability of the affected to cope with the situation using their own resources thus, require external assistance.[13] Disaster takes place when a hazard – which is defined as dangerous phenomenon, substance, human activity or condition that may cause harm[14] – occurs and severely impacts on affected community overwhelming

[10] World Meteorological Organization, cited in National Oceanic and Atmospheric Administration (NOAA), *Flash Flood Early Warning System Reference Guide*, US Department of Commerce, 2010.
[11] J. C. B. Hoedjes *et al.*, "A Conceptual Flash Flood Early Warning System for Africa, Based on Terrestrial Microwave Links and Flash Flood Guidance", *ISPRS International Journal of Geo-Information*, 2014, p. 586.
[12] Kathleen Tierney, "Social Inequality, Hazards, and Disasters", in Ronald J. Daniels, Donald F. Kettl and Howard Kunreuther (eds.), *On Risk and Disaster: Lessons from Hurricane Katrina*, Philadelphia: University of Pennsylvania Press, 2006.
[13] United Nations Office for Disaster Risk Reduction (UNISDR), *2009 UNISDR Terminology on Disaster Risk Reduction*, United Nations, 2009.
[14] *Ibid.*

its capacity to cope. Disaster will happen only when the hazard meets the vulnerable population. There would not be any disaster without exposure to hazard as well as conditions of vulnerability that are present. Here, vulnerability implies some risk combined with a level of social and economic liability, and the ability to cope with the resulting event. It can be defined as the degree to which a system, part of a system, individual, community or society may react adversely during the occurrence of a hazardous event.[15] It is the characteristics and circumstances of a community, system or asset that makes it susceptible to the damaging effects of a hazard.[16] Vulnerability is context specific and varies significantly within a community and over time. It could be determined by physical, social, economic, environmental, institutional and governance related factors. It should be noted that vulnerability is one of the defining components of disaster risk.

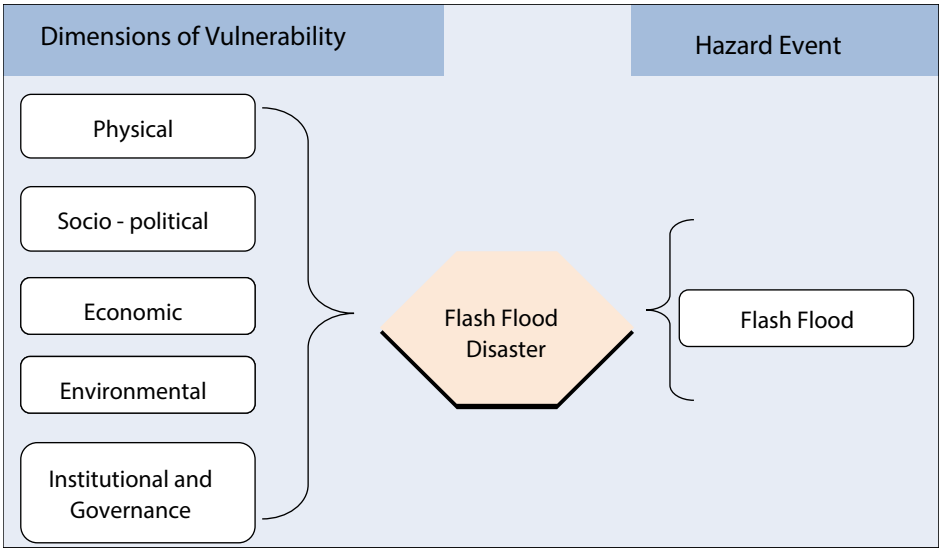
The concept of vulnerability has been a powerful analytical tool for describing states of susceptibility to harm and guiding actions to deal disaster risk.[17] Therefore, understanding different dimensions of vulnerability is crucial to understand disaster risk. Conceptually, disaster risk can be delineated as the potential disaster losses, in term of lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period. It comprises different types of potential losses which are often difficult to quantify. Nevertheless, with knowledge of the prevailing hazards and the patterns of population and socio-economic development and their vulnerabilities, disaster risks can be understood.[18] Here, the disaster risk faced by people is seen as a cross-cutting combination of vulnerability and hazard, which is a result of the interaction of both. There cannot be a disaster if there are hazards but vulnerability is (theoretically) nil, or if there is a vulnerable population but no hazard event.[19] Therefore, the risk of disaster is presented as a compound function of the natural hazard and the number of people, characterised by their varying degrees of vulnerability to that specific hazard, who occupy the space and time of exposure to the hazard event. There are three basic elements here: risk (disaster), vulnerability, and hazard, whose relations can be presented as:

$$\text{Disaster Risk} = \text{Hazard} \times \text{Vulnerability}^{20}$$

From the aforementioned equation, it is clear that when vulnerable community is exposed to specific hazard, their disaster risk increases. The study will

[15] Virendra Proag, "The Concept of Vulnerability and Resilience", *Procedia Economics and Finance*, Vol. 18, 2014, p. 370.
[16] United Nations Office for Disaster Risk Reduction (UNISDR), *op. cit.*
[17] W. Neil Adger, "Vulnerability", *Global Environmental Change*, Vol.16, 2006, pp. 268-281.
[18] United Nations Office for Disaster Risk Reduction (UNISDR), *op. cit*.
[19] Ben Wisner, Piers Blaikie, Terry Cannon and Ian Davis, *At Risk: Natural Hazards, People's Vulnerability and Disasters*, Second Edition, London: Routledge, 2004, p. 49.
[20] *Ibid.*

analyse five dimensions of vulnerability of the *haor* region and people living there who are exposed to flash flood, and will try to imply how the vulnerability factors are responsible for high disaster risk. Following framework can be useful to represent the aforementioned equation of disaster risk.




The physical vulnerability depends on the physical infrastructure present in the exposed area as well as its physical or geographical proximity to the source and origin of the disasters. Physical vulnerability can be determined by factors such as population density levels, remoteness of settlement, the site, design and materials used for critical infrastructure and housing.[21] Physical vulnerability can also be attributed to absence of physical infrastructure required for a specific hazard as well as weakness in their construction and design. Physical vulnerabilities are hazard specific.

Non-physical domain, spanning from social to governance related issues is also crucial in the parlance of vulnerability discussion. This domain involves but is not limited to various dimensions of vulnerability like socio-political, economic, environmental, institutional and governance. Socio-political vulnerability generally refers to the inability of people, communities or societies to withstand adverse impacts to hazards due to characteristics inherent in social interactions, institutions and systems of cultural values, and the political process and power structure. It is

[21] United Nations Office for Disaster Risk Reduction (UNISDR), cited in "Vulnerability and Risk", Office of Disaster Preparedness and Management, Government of Republic of Trinidad and Tobago, available at http://www.odpm.gov.tt/node/162, accessed on 07 April 2018.

basically linked to the level of well-being and living standard of individuals as well as the availability of social and utility services. It includes aspects related to levels of literacy and education, the existence of peace and security, access to basic human rights, systems of good governance, social equity, positive traditional values, customs and ideological beliefs, access to decision making, quality of leadership, level of discrimination in forms of racial, ethnic, linguistic or religious basis and overall collective organisational systems.[22] All these are factors crucial for an individual as well as for the community to prepare for any adverse situation, effectively respond when things go wrong, mitigate its impact and finally return to its normal situation.

The level of vulnerability is also highly dependent upon the economic condition. The poor are usually more vulnerable to disasters because they lack the resources to build sturdy structures and put other engineering measures in place to protect themselves from being negatively impacted by disasters.[23] Economic vulnerability of a community can be assessed by determining how varied its sources of income are, the ease of access and control over means of production (*e.g.*, farmland, livestock, irrigation, capital etc.), adequacy of economic fall back mechanisms and the availability of natural resources in the area.

Vulnerability also concerns the wider environmental conditions that restrict people and communities to cope with the impact of hazard.[24] There is a strong causal relationship between degraded environment and higher disaster risk.[25] Environmental causes that are responsible for increasing disaster risk can be enumerated as poor environmental management and declining risk regulating ecosystem services, adverse impact of climate change, natural resource depletion, loss of natural defences and environmental degradation etc.

Governance, spanning, pre, during and post-disaster period, is another important factor that regulates the smooth functioning of management procedure and is also a major source of vulnerability if hindered. Poor risk management, absence of transparency and accountability, lack of monitoring, supervision and feedback, bureaucratic bottlenecks, ineffective policies and non-implementation of rules and regulation are few among many governance related vulnerabilities. In addition, anthropogenic factors in the form of institutional vulnerability can also impede good governance and jeopardise the entire gamut of disaster management.

[22] *Ibid.*

[23] *Ibid.*

[24] "Vulnerability", Prevention Web, 12 November 2015, available at https://www.preventionweb.net/risk/vulnerability, accessed on 12 March 2018.

[25] United Nations Environment Programme, *Environment and Vulnerability: Emerging Perspectives*, United Nations International Strategy for Disaster Reduction, United Nations Environment Programme, available at https://www.gdrc.org/uem/disasters/disenvi/environment-vulnerability.pdf, accessed on 12 March 2018.

## 3. Flash Flood Disaster in Haor Region in 2017: At a Glance

Flash floods are not new for the people living in the *haor* region rather it is an expected and recurrent phenomena. Generally, water levels of the Surma river cross the 6.5 metre mark during April, causing flash floods. People of the region, especially the farmers are usually prepared for such an occurrence every year as they harvest a major portion of the Boro crops before mid-April when the flood water usually hit the region. They cultivate two kinds of Boro crop that they are supposed to harvest in the last week of *Chaitra* and the first week of *Baishakh* (second and third week of April). However, in 2017, people of *haor* region, especially the farmers were completely taken by surprise by the early floods that inundated their farmlands and large portion of the *haor* region on 27 March. According to the Flood Forecasting Warning Centre (FFWC) of Bangladesh Water Development Board (BWDB), water from most of the rivers in the region crossed the 6.5 metre mark nearly two weeks before the estimated time and caused large scale flooding. Due to the early arrival of flash flood, farmer got no chance to harvest their crops which were totally submerged and destroyed by the flood water. The following table will show the number of farmland submerged due to the early arrival of the flash flood in 2017.

**Table 1: Farmland Submerged Because of Flash Flood**

| District | Cultivated (hectares) | Damaged (hectares) | % of Damage |
|---|---|---|---|
| Sunamganj | 166,000 | 166,000 | 100 |
| Sylhet | 76,835 | 34,536 | 44.95 |
| Habiganj | 116,510 | 35,325 | 30.32 |
| Moulvibazar | 53,426 | 19,111 | 35.77 |
| Kishoreganj | 165,515 | 24,100 | 14.56 |
| Netrokona | 184,320 | 69,710 | 37.82 |

Source: Adapted from Pinaki Roy, Dwoha Chowdhury and Mintu Deshwara, "Havoc in Haor", *The Daily Star*, 14 April 2017; Haor Advocacy Platform, *Damaged by Flash Foods in North-eastern Haor Areas in Bangladesh* 2017,Situation Bulletin, 30 April 2017.

The flash flood killed 10 people and affected over 46 *lac* living in the *haor* region. Over 10 *lac* households were fully or partially affected due to this disaster.[26] According to Department of Agriculture Extension (DoAE), of 450 thousand hectares of farmland under Boro cultivation, more than 2 *lac* hectare completely destroyed due to flood water.[27] Crop loss has been estimated over 15.8 *lac* metric ton (MT), which is equivalent to 8.3 per cent of national average Boro production.[28] The flood

[26] Md. Zafar Sadique and Estiaque Bari, *Flood 2017: Assessing Damage and Post-flood Management*, Centre for Policy Dialogue, October 2017.
[27] "Onslaught of Flash Floods in Haors", *The Daily Star*, 28 April 2017.
[28] Md. Zafar Sadique and Estiaque Bari, *op. cit.*

affected approximately 250 thousand farmers.[29] The estimated loss in monetary term was in between BDT 3040 *crore* to 5300 *crore*.[30] It is very important to note that Boro crop makes up 55 per cent of the annual rice output and it is cultivated on 48 *lac* hectares of land. In 2016, the country saw production of 1 *crore* and 89 *lac* MT of Boro rice.[31] Crop loss was not the only problem that the people of *haor* region faced, rather a huge number of fish and ducks died due to the rotting of crops in the flood water which decreases oxygen and increases the acidity of the water. Approximately 1,246 MT of fish died.[32] In Netrokona district alone, 800 MT of fish died affecting more than 16,000 fishermen.[33] Moreover, the ducks also died because of cholera which spread due to consumption of dead fish floating in flood water. In addition, nearly 591 thousand MT fodder/straw was destroyed due to flood water. The Haor Advocacy Platform estimated that considering the destruction of crops, fishes and livestock, the loss due to flash flood was more than BDT 10,000 *crore*.[34]

There was also allegation that the flood water was contaminated by the radioactive material. Some residents claimed that Uranium was coming from the drilling pits in the Khasi Hills in Meghalaya bordering the region in Sunamganj, causing the death of ducks, fish and other aquatic resources. However, Bangladesh Atomic Energy Commission (BAEC) later confirmed that the radiation levels in the samples of water, dead fish and ducks collected from the flash flood-hit *haor* region were within the permissible limits and not alarming.

To mitigate the sufferings of the people affected by flash flood, the government distributed relief, introduced Open Market Sale (OMS) of rice and expanded social safety net programmes. However, success of these initiatives was severely questioned due to the allegation of corruption and nepotism. There was allegation that the affected farmers were deprived of the rice of the government's Vulnerable Group Feeding (VGF) programme and the VGF cards were being sold among the people. There was also allegation that some Union Parishad (UP) members were taking money to include names of affected people to the VGF list. There was also report that people were selling the rice allotted for OMS.[35] All these adversely impacted the disaster response and recovery of the flash flood disaster which ultimately affected the disaster risk of the community as a whole.

[29] Dwoha Chowdhury, "Embankments in Haors: Projects Turn Into Plights", *The Daily Star*, 19 April 2017.
[30] Shekh Farid, "Prioritising Haor Region for Inclusive Development", *The Financial Express*, 24 November 2017; Md. Zafar Sadique and Estiaque Bari, *op. cit.*
[31] Reaz Ahmad, "Growers Now Buyers", *The Daily Star*, 18 April 2017.
[32] "Onslaught of Flash Floods in Haors", *op. cit.*
[33] Reaz Ahmad and Pinaki Roy, "Havoc in Haors: Fish Dying Further Down", *The Daily Star*, 23 April 2017.
[34] Haor Advocacy Platform, cited in Shykh Seraj, "Nature Turns Her Back on Haor People", *The Daily Star*, 27 April 2017.
[35] Mintu Deshwara, "Rich Feasts on Rice for Poor", *The Daily Star*, 09 May 2017; Mintu Deshwara, "Flash Flood-Hit Sunamganj: OMS Programme Tainted by Graft", *The Daily Star*, 11 May 2017; Mintu Deshwara, "Many Denied VGF Cards, Nepotism Alleged", *The Daily Star*, 21 May 2017.

## 4. Explaining High Disaster Risk of Flash Flood

It has already been mentioned that a disaster happens only when a hazard affects vulnerable people. A disaster strikes when the two elements, *i.e.*, hazard and vulnerability come together. A natural phenomenon by itself is not a disaster; similarly, a population maybe vulnerable for many years, yet without the "trigger event", *i.e.*, the specific hazard, there would not be any disaster.[36] A flood hazard is the potential for inundation that involves risk to life, property, livelihood, ecosystem, service network and natural floodplain resources and functions. *Haor* region of Bangladesh is a remote setting, where due to complex hydro and geo-morphological dynamics, water borne hazards like floods and flash floods are very common. In addition, due to the physical, socio-political, economic, environmental, institutional and governance related vulnerability, those hazards turn into disasters, regularly devastate life and livelihood in the region. In this section, an attempt has been made to discuss how the exposure to flash flood hazard event and various vulnerability factors are responsible for high disaster.

### 4.1 *Flash Flood in the Haor Region: The Hazard Event*

The dangers of flash flood are associated with a number of parameters. By analysing the parameters, inference can be made on how the flash flood hazard event transforms into disaster and inflicts damage to the community. Some important parameters to analyse a flash flood event are:

- depth of flood water
- rate of rise of flood water
- duration of flooding
- flow velocity of flood water
- frequency of occurrence of flood, and
- seasonality[37]

The main triggering factor behind the flash flood disaster in *haor* region in 2017 can be attributed to the incessant rain at the beginning of March which was responsible for pouring down of massive amount of water from upstream. Prior to 29 March, Cherrapunji in Meghalaya of India received 1,100mm of rainfall in nine days, while Sylhet and Sunamganj each received about 450mm and 500mm of rainfall respectively. That excessive rain is one of the reasons for the untimely flood which increased the depth of water within a very short span of time. According to government report, when the water level of the Surma river at Sunamganj station of

[36] Vu Minh Hai and Ines Smyth, *The Disaster Crunch Model: Guidelines for a Gendered Approach*, Oxfam GB, May 2012.

[37] Office of the Disaster Relief Co-Ordinator (UNDRO), *Mitigating Natural Disasters: Phenomena, Effects and Options: A Manual for Policy Makers and Planners*, New York, UN: UNDRO, March 1991.

BWDB crosses the 6.5 metre-mark during the month of March/April, it is considered as the beginning of flash flood. Every event of flash flood since 2000 hit the *haor* was in mid-April. However, in case of 2017, the flash flood came on 27 March and caused severe damage in the region.

In addition, depth is a major characteristic of flood water on a standing crop that impacts the yield. It is generally considered a primary factor in crop losses due to flood during harvest periods. Crop losses are related to inundation depth of floodwater when the flood depth is beyond the tolerance limit of the crop occur.[38] Duration is also a critical parameter in the determination of flood damage to crops. The impact of duration of flood typically varies throughout the cultivation, growing and harvest periods. A few days of flooding in the initial phase of plant development may not result in damage (loss of production costs) while a few hours of inundation at crop maturity may result in total loss.[39] In case of 2017 flash flood, the depth and duration of flood water severely affected the crop production and caused massive damage. The rate of rise of flood water was also very high restricting the ability of the disaster management authority to issue flood warning. For flash flood disaster, flood water velocity is also important for the representation of crop and livelihood damage. It was also reported that the velocity of the flood water in 2017 was also very high compared to other years which resulted in breaching of flood protection embankments built to protect the life and livelihood of people living in *haor* region.

### 4.2 *Flash Flood Vulnerabilities of the Haor Region*

Vulnerability is understood as the conditions determined by many factors, such as physical, social, economic, environmental, institutional, governance etc., that increase the susceptibility of a person or community to the impact of hazards. The progression of vulnerability leads to a disaster from any hazards. People in *haor* basins are vulnerable due to their location, physical infrastructure, socio-political conditions, economic situation, poverty, unemployment, lack of education, agriculture practices, and health services etc. The region is also considered to be extremely vulnerable to climate change impacts due to its physical and hydrological setting.[40] Changing weather patterns in the region, including a rise in temperatures, reduction in rainfall and occurrence of untimely rainfall are having negative impacts on agricultural production and other livelihood options and thus, increasing the disaster risk. It is important to understand how different vulnerability factors are affecting the disaster

[38] Md. Sabbir Hossain, *Flood Damage and Risk Assessment Model in the Haor Basin of Bangladesh*, Thesis Paper, Bangladesh University of Engineering and Technology (BUET), September 2013, available at http://lib.buet.ac.bd:8080/xmlui/bitstream/handle/123456789/4165/Full%20Thesis.pdf?sequence=1, accessed on 01 April 2018.

[39] Y. Hattori, K. Nagai and M. Ashikari, "Rice Growth Adapting to Deepwater", *Plant Biology*, Elsevier: Japan, 2011

[40] Sarah Gillingham, *op. cit.*, p. 6.

risk of the region as well as the coping capacity of the people living there. The vulnerability factors are discussed here under five board dimensions.

4.2.1 *Physical Vulnerability*

The physical location coupled with the hydrological characteristics of the *haor* region has made the inhabitants vulnerable to flash floods. Most of the rivers in these areas originated in from the nearby hilly area of neighbouring country India. These rivers are extremely flashy that is characterised by sudden and wide variation in flow as a result of excessive rainfall. The region receives water from the catchment slopes of the Shillong Plateau across the borders in India to the north and the Tripura Hills in India to the south-east. The region lies in the Meghna basin which is part of the Ganges-Brahmaputra-Meghna (GBM) basins. Flow from about 66,640 square km of the Meghna basin is drained ultimately into the Bay of Bengal through the Kalni-Kushiyara and Surma-Baulai river system. Of this area, only 35 per cent, that is 23,137 square km, lies in Bangladesh. The estimated outflow of water from this region into the Bay amounts on average is 162,619 million cubic metres per year. About 57 per cent of this flow is generated at the upstream of Bangladesh while 43 per cent is generated within the country. Trans-boundary flow from India is 70 per cent, 60 per cent, 37 per cent and 80 per cent of total flow in pre-monsoon, monsoon, post-monsoon and dry season respectively. This inflow (mainly pre-monsoon flow) from India into Bangladesh is highly responsible for flash flood in the *haor* area.[41] In addition, India is planning to build a hydroelectric dam project in Tipaimukh, Manipur, just 100 km off the Bangladesh border. If implemented, this will have severe short and long term impact on Bangladesh, especially on the water flow of the Surma and Kushiyara river system.[42] Along with reduced water flow in dry season, the project will result in an increase of water in the wet season which will in turn increase flood vulnerability.

The *haor* region requires special physical infrastructure due to its unique geo-physical location and hydro-morphological setting. Most of the critical infrastructure and housing in that area should be flood resilient, absence of which can severely increase flash flood disaster risk. But, in reality, most of the physical infrastructure and households are not flash flood proof and collapse easily during the time of disaster. In addition, communication system of *haor* region is itself a source of vulnerability. Road alignments transverse to the primary drainage path, lack of sluice gates, opening and waterways in the road network, blockage drainage channels due to siltation and lack of maintenance have severely increased disaster risk in the region.

Physical isolation is another reason for high disaster risk. The *haor* area has one of the poorest road communication networks in terms of connectivity with the

[41] Bangladesh Haor and Wetland Development Board, Main Report, *op. cit.*

[42] M. Asaduzzaman and Md. Moshiur Rahman, "Impacts of Tipaimukh Dam on the Down-stream Region in Bangladesh: A Study on Probable EIA", *Journal of Science Foundation*, Vol. 13, No.1, January 2015.

main land, 11 *haor* upazillas are totally not connected with roads network.[43] The region remains under water for 4-7 months during the pre-monsoon and monsoon seasons. The roads are submerged during this period making it impossible to move from one place to another without boats. Therefore, waterway is the main route of transportation of the people in *haor* region. The situation gets worse when *afal* – a type of high wave – takes place during monsoon flooding making the boat transportation a risky communication option. In the lean period, boats waterways cannot be availed for communication making it extremely difficult for the people living there to move from one place to another. The poor transportation network limits the incentives for increasing production, discourages rural growth, limits access to markets and off-farm employment opportunities and limits access to existing social services particularly health and education.

High disaster risk is also attributed to inadequate number of flood shelter and *killas*, absence of which caused death of people as well as large number of animals during the flash flood in 2017. In addition, unplanned development work and increasing growth of industries in fertile land near rivers and wetlands is also taking a toll in the region in term of increased casualty and damage during flash floods which is at the same time affecting the ecosystem of the area. It is clear from the aforementioned discussion how physical vulnerability is responsible for high disaster risk. However, there are other vulnerability factors that work as catalyst for high disaster risk in the region.

#### 4.2.2 *Socio-political Vulnerability*

Despite having diverse resource systems that support the livelihoods of local communities, *haor* is lagging far behind in many development indicators and ranks high in case of exposure to multiple natural hazards due to various socio-political factors.[44] The people in the *haor* areas have no or little access to the basic services compared to those of the people in other parts of the country.[45] Living standard of majority of areas is one of the lowest in Bangladesh. Population density is also high in the region which limits the livelihood options of people living there. It should be noted that poorest are the most vulnerable to disasters and people living in the *haor* region are considered as one of the most backward citizens of the country. Five *haor* districts are considered the worst performers in the Millennium Development Goals (MDGs) composite index while two other *haor* districts present below average performance. According to *Master Plan of Haor Area*, 29.56 per cent of population in the area lives below lower poverty line and around 28.5 per cent of haor population are completely unemployed. Therefore, in most of the social indicators, the living standard and other facilities are extremely

[43] Bangladesh Haor and Wetland Development Board, Summary Report, *op. cit.*
[44] General Economics Division (GED) and United Nations Development Programme (UNDP) Bangladesh, *op. cit.*
[45] Development Wheel, *op. cit.*

low in the *haor* region, which implies high level of social vulnerability that results in high disaster risk.

The state of education, which is a very important indicator of coping capacity of a community, is also very disappointing in *haor* area. Sylhet district, which has the largest concentration of *haors*, has low proportion of people attending primary and secondary education compared to other divisions. The problems of education in *haor* areas are: lack of schools, poor physical condition of the existing schools, high tutor-pupil ratio, lack of teaching instruments and hygienic latrines, absence of playgrounds, inadequate textbooks, and other necessary conditions which are very important for ensuring quality education. School dropout rate is also higher in Sylhet division compared to the national average.[46] The illiteracy level is 38 per cent on average. The rate of primary school enrolment is 71 per cent but the school dropout rate is very high, which is around 44 per cent.[47] These numbers indicate the dire state of education in the *haor* region. In addition, most of the educational institutions and their connecting roads have not taken into consideration the regular inundation due to flash flood. There are no alternative places where children can continue their education during the time of flash flood. As a result, the education totally halts at the time of flood inundation. Due to lack of education, people living in the area are not fully aware of flash flood disaster risk and necessary mechanism to cope with it. They are also unaware of issues such as climate change which is now responsible for increasing disaster risk in the area. Due to lack of education and training, they also miss out on local developments and do not know about the programmes or projects that have been implemented by the government within the area. Therefore, due to lack of local knowledge, most of the projects fail to take into consideration the local dynamics and compulsion as well as the need of the community people. As such, many of the projects, including those taken for flash flood disaster preparedness and mitigation, fall short to produce expected result and, in many cases, increases disaster risk.

*Haor* region also stands at the bottom compared to other areas of Bangladesh as far as various social services are concerned. *Haor* districts have a very low coverage of safe drinking water sources. In the remote areas, the sources of safe drinking water are the tube wells. Unfortunately, the government sponsored tube wells are not enough in numbers and due to proper maintenance and monitoring, most of the tube wells are out of order. In addition, most of the tube wells go under water either in rainy season or during the time of flood and flash flood. Therefore, people in the region are vulnerable to many water-borne diseases due to their patterns of the use of water. Most of the people have limited knowledge about health risk associated with the use of unsafe and unclean

[46] Monitoring and Evaluation Division and Directorate of Primary Education, *Annual Primary School Census – 2015*, Ministry of Primary and Mass Education, Government of the People's Republic of Bangladesh, December 2015, p. 80.

[47] General Economics Division (GED) and United Nations Development Programme (UNDP) Bangladesh, *op. cit.*

water.[48] Moreover, most of the households do not have sanitary latrines. They only use hanging latrines. These latrines pose serious threat to public health and safety, especially during the time of flood. The government's initiatives in this regard are very minimal. The entire *haor* region has less than 50 per cent sanitation coverage. On an average, 44.25 per cent people use sanitary latrines, having the poorest coverage in Netrokona (35 per cent). In addition to that flooding, high water table, excessive rainfall and loose soil formation are the causes of overflow and collapse of the latrines. Every year most of the areas remain under water for about 4 to 7 months and it wipes out all existing sanitation system. Therefore, it becomes almost impossible for ultra-poor people to reconstruct toilets on a regular basis which in turn increases the water borne diseases risk in the area.

The health services in *haor* areas are another concern and a major source of social vulnerability. The status of health service is believed to be lower than other parts of Bangladesh. An overwhelming majority in *haor* areas depends on traditional healers. There exists extreme shortage of modern medical facilities which becomes acute during the time of flash flood. Government hospitals are inadequate and are in dire conditions. In the health policy of the government, *haor* and *char* do not get any special policy consideration, which they require desperately.[49] Therefore, in absence of that, the central health policy seems to be ineffective due to its special geographical location and socio-economic compulsions which is another prime reason for high disaster risk. Outbreak of disease is very common in the region. The paucity of human resources in health facilities is also responsible for that. In the *haor* region, population coverage per doctor is 23,304, which is nearly ten times higher than the national average of 2,785. The lowest coverage is observed in Habiganj (44,000 per doctor) followed by Sunamganj (37,000 per cent) district. The number of population per nurse is 11,729 compared to that of 5,782 at national level. The nurse-doctor ratio in the *haor* districts is 1.83:1 on average compared to the national ratio of 2.07:1.[50] This dire health situation restricts the ability of the inhabitants of the region to effectively cope with any adverse situation and respond to any flash flood disaster event, which increases their flash flood disaster risk. Outbreak of water-borne diseases and skin diseases is very common in the region after any flash flood incident.

The existing political structure is also a major impediment for people living in *haor* area to cope with disasters. They have very limited access to power structure and resources. Local elites control the key formal and informal institutions that determine poor people's access to resources and services, including local forums for dispute arbitration *(salish)*, employment opportunities, water bodies and agricultural land, and moneylender loans. They tend to exercise control of these resources to ensure their political advantage, sometimes by use of violence, which severely undermines local people's ability to utilise natural resources thus, affecting their disaster preparedness

[48] Development Wheel, *op. cit.*
[49] *Ibid.*
[50] Bangladesh Haor and Wetland Development Board, Main Report, *op. cit.*

and risk reduction ability for any adverse situation. This absence of enabling customs, rules, regulations, and others institutions and their enforcement coupled with limited and declining access, control, ownership and use of natural resources by majority of vulnerable *haor* population increase the disaster risk manifold. Furthermore, the inequitable management of the valuable in the *haor* area is a key constraint for people living there. Women and girls in *haor* communities experience multiple forms of gender inequity and discrimination. In particular, they face higher rates of malnutrition and maternal mortality, have limited mobility, lack of engagement in economic activities and participation in groups and networks. Women and girls also have limited access to basic services of healthcare and education due to the difficulties of transport during the flood season.[51] In addition to that, women, including Union Parishad female members, are particularly marginalised from decision-making processes at the community level and beyond. The weakness of citizen participation in local decision-making processes and the limited transparency and accountability of local governance processes undermines the effective and equitable delivery of services, including social safety nets, to assist poor and marginalised groups which increase their vulnerability to disasters, especially flash flood.

### 4.2.3 *Economic Vulnerability*

Poverty is considered as a crucial driver of disaster risk in the *haor* region. A number of studies with their findings identifies *haor* basin as 'hot-spots' of poverty of Bangladesh.[52] Around 29.56 per cent of the population in the area lives below the Lower Poverty Level (LPL), that is slightly higher than the national average of 29.26 per cent. Out of the seven *haor* districts, poverty incidence is the worst in Netrokona (39.5 per cent) and Kishoreganj (34 per cent). The region has long been lagging behind mainstream national development due to its physical exclusion and special hydrological dynamics. Geographical isolation, exposure to various natural shocks and socio-political dynamics are to be blamed for the underdevelopment which limits the economic capacity of the people of the region to cope with adverse situation, especially with flash flood. Economic marginalisation is also the outcome of limited livelihood opportunities in the region, which is highly seasonal, as they are focussed predominantly on agricultural labour associated with the single annual rice cropping cycle. Therefore, crop failure, due to flash flood has serious implication on livelihood of poor and extreme poor. Fishing, which was traditionally an important occupation for the region, has declined in recent years due to various faulty structural interventions and leasing arrangements which are often controlled by local elites that restricted the access of poor to open water fisheries. The incidence of livestock husbandry as a livelihood activity has also declined, due to a combination of factors including the

[51] Sarah Gillingham, *op. cit.*, p. 7.
[52] Shekh Farid, "In Search of a Development Model for Haor Dwellers", *The Daily Observer*, 10 November 2017.

conversion of grazing land to paddy cultivation, increasing population density, and increasing disease burden on animals due to rising temperatures associated with climate change. The extended lean season associated with the annual cycle of flooding and flash flood resulted in widespread and severe food insecurity and striking levels of indebtedness.[53] It is evident that when economic capacities are absent, individuals and communities are more vulnerable to disasters.

Furthermore, people living in the *haor* region possess very little homestead land. They are considered as resource poor in terms of agricultural resources.[54] Their earning capacity is very low which shrink further during wet season. In addition, high transaction costs, resulting from the remoteness of many *haor* communities, especially during the flood season, is a significant constraint on the effectiveness of both supply and demand side governance processes. Absence of economic instruments, incentive structures and enabling community institutions increase economic vulnerability *vis-à-vis* disaster risk, especially for flash flood in the region.

In addition, the level of industrial development is also very low in the *haor* region compared to other parts of the country. Industrialisation has not taken place to a great extent and consequently the number of industries and people engaged in this sector has been low (1.33 per cent of the total population only). Lack of energy resources and logistic support is mainly responsible for the little progress. Out of total number of 15,374 villages in the *haor* area, 6,740 villages have been brought under electrification which is only about 44 per cent compared to the nationwide coverage of about 72 per cent. Compared to the nationwide average consumption of about 200 kWh per capita, the *haor* area has consumed only 47 kWh per capita in 2010.[55] Sunamganj has the lowest use of electricity utility with only 17 kWh per capita followed by Kishoreganj and Netrokona.[56] Lack of energy resources has hampered the progress of industrialisation in the area, which in turn restricted the ability of the people to become economically solvent. Their limited capacity coupled with inadequate economic resources is therefore can be blamed for high disaster risk in the region.

### 4.2.4 *Environmental Vulnerability*

Environmental factors, which include, poor environmental management, destruction of natural defence as well as environmental degradation is also responsible

[53] Sarah Gillingham, *op. cit.*, p. 62

[54] S. M. K. Sarif, M. H. Kabir, S. Sultana, M. Showkat Mahmud and S. Mahjabun, "Socioeconomic Conditions, Agricultural Practices and Communication Status of the Vulnerable Haor People in Bangladesh", *American Journal of Rural Development*, Vol. 4, No. 5, 2016, p. 102.

[55] Bangladesh Haor and Wetland Development Board, Summary Report, *op. cit.*

[56] General Economics Division (GED) and United Nations Development Programme (UNDP) Bangladesh, *op. cit.*

for flash flood vulnerability. It should be noted that the floodwater during flash flood not only carries water but also a huge amount of sediment originate mainly from the hill. Over the time this sediment has deposited on the rivers and canal bed and has reduced the conveyance capacity more or less all of the water resources system within the *haor* area. Internal canals have lost their carrying capacity due to deposition of sediment on the bed of rivers and in some cases created drainage problem. Without proper river management and dredging, flash flood due to sudden heavy rainfall creates extreme pressure on the water resources system, and water easily overtopped and creates breaching at several locations on the submersible embankment. Therefore, water quickly enters into the *haor* and wreaks havoc in the entire region. In addition, reducing vegetation coverage and increasing establishment of new settlement in hilly region is also responsible for increasing siltation during flooding. Moreover, sand carpeting of fertile crop land due to flash floods is another environmental hazard, which makes land unsuitable for crop production, thus increasing disaster risk in term of crop failure *vis-à-vis* food insecurity.

*Haor* basin is anticipated to be under additional stress that climate change will certainly bring to its temperature and rainfall pattern. Variability in both rainfall and temperature during the pre-monsoon season when flash floods normally occur is now evident in the region. Though, there is no specific or comprehensive study on climate change impact on the *haor* area but projections made by the IPCC (4$^{th}$Assessment Report) for South Asia as well as other projections could be considered for the *haor* region for insight into climate change impact, adaptation and mitigation.[57] According to Kamruzzaman and Shaw, who have referred the PRECIS ensemble model outputs, the rainfall volume and runoff in the region and its upstream catchment will be increased by at least 40mm, 90mm and 150mm during peak monsoons of 2020s, 2050s and 2080s respectively. Cloud cover is more likely to concentrate over the Meghna catchment, especially over Meghalaya, indicating perhaps higher levels of rainfall and runoff in the *haor* influence region. The additional water in the eastern Himalayan rivers is likely to create drainage congestion, which in turn will aggravate flooding. According to the same model outputs, there will be a shift in peak rainfall towards May (away from mid-July to mid-August), with a decrease in rainfall in August. As a consequence, there will be sharp and short-duration high intensity rainfall events in the neighbourhood of *haors*, especially during pre-monsoon (*i.e.*, March-April-May period).[58] That will result in increasing and ill-timed flash flood in the area. Variability of climatic elements has already started affecting the agricultural productivity, land use practices, life styles and livelihoods in the *haor* area.[59]

[57] Bangladesh Haor and Wetland Development Board, Summary Report, *op. cit*.
[58] Md. Kamruzzaman and Rajib Shaw, "Flood and Sustainable Agriculture in the Haor Basin of Bangladesh: A Review Paper", *Universal Journal of Agricultural Research*, Vol. 6, No.1, 2018, pp. 40-49.
[59] P. K. Sarma, "Scenario of Haor Vulnerabilities and Other Obstacles for Sustainable Livelihood Development in Nikli Upazila", *Journal of Bangladesh Agricultural University*, Vol. 8, No. 2, 2010, pp. 283–290; Shekh Farid, "Empowering the Haor people", *The Daily Star*, 02 February 2018.

Environmental conditions not only modify the frequency and magnitude of hazard events, but also affect natural barriers that can moderate the impacts of a disaster and protect communities. Deforestation is often blamed for worsening the effects of flooding.[60] The *haor* basin is under threat of deforestation which is responsible for declining of risk regulating ecosystem services as well as loss of natural defense from disasters. *Haor* was previously full of numerous natural bushes and water tolerant trees which served as fence to protect the homestead from huge flash flood wave and erosion. Forest plays crucial role in the flooding equation as trees prevent sediment runoffs and forests hold more water than farms or grasslands. Therefore, the impact of deforestation on flash flood disaster risk is enormous. The release of sediment due to deforestation has also an impact on floods. The eroded sediment not only chokes rivers but also cause mudflow that is much more destructive than normal flood water.

In most of the cases, flash flood is associated with river bank erosion. Without proper river bank protection, the erosion caused by the flash flood results in massive damage and hampers the life and livelihood of the community. Faulty structural intervention, inadequate river bank management and absence of flood plain management are responsible for river bank erosion which in turn increases disaster risk by manifold.

#### 4.2.5 *Institutional and Governance Related Vulnerability*

Governance always remains a priority but a daunting task, as governance regulates all other activities. Flash flood in *haor* region is not only a matter of natural hazard but also a governance issue. The area is subject to various institutional and governance related challenges which are important factors for high disaster risk. Various flood control and mitigation projects taken in the region have been severely criticised for not being able to produce expected result due to faulty construction procedure, lack of transparency and accountability in the maintenance process and presence of wide spread anomalies. Lack of good governance can be blamed for increasing disaster risk and was responsible for extensive damage in the flash flood incident of 2017. In spite of government's initiative to implement several projects of re-sectioning submersible embankments and repairing the damaged ones through the BWDB, the contractors who got the work allegedly did not deliver. For instance, 76 projects had been taken up for re-sectioning of submersible embankments in different *haors* of Sunamganj, while another 238 projects were approved for Project Implementation Committees (PICs). Both types of projects were supposed to be completed by February 2017.[61] But none of the projects were completed on time. Locals of *haor* areas allege that the embankments, which were supposed to protect

[60] United Nations Environment Programme, *op. cit*.
[61] Dwoha Chowdhury, "Embankments in Haors: Projects Turn into Plights", *The Daily Star*, 19 April 2017.

the area from flash flood disasters, were faulty.[62] Therefore, much of the 2017 flash flood catastrophe has been blamed on negligence and corruption by the BWDB, its contractors and the PIC responsible for the construction and maintenance of embankments. Due to that allegation, 61 individuals associated with BWDB were sued by the Anti-corruption Commission of Bangladesh for corruption and mismanagement in the construction of dams in the *haor* area.[63] It is believed that the disaster of 2017 could be avoided or, the disaster risk could be at least minimised by manifolds if the repair and construction of the embankments in the *haor* areas were completed in time.

Corruption and irregularities were evident in the recovery phase of the flash flood disaster in 2017. There were several reports that OMS dealers were appointed based on political consideration that caused the food assistance programme to be less effective in alleviating the misery of flood victims. There were also serious allegations of nepotism and irregularities in relief distribution.[64] Corruption and lack of good governance aggravated the disaster situation in the flash flood affected areas and makes various government responses less effective.

Lack of monitoring and maintenance in the *haor* region also increases disaster risk. There is no Monitoring, Evaluation and Learning (MEL) strategy for flash flood management in the region that might mitigate the disaster risk. There are allegations that people cut embankments in many places to facilitate cross *haor* navigation and fishing which destabilises the entire embankment and results in breaching of embankment during flash flood. The crop protection submersible embankments are made of mud and go under water every year and have suffered a lot due to wave erosion. So, those embankments need regular maintenance, absence of which severely increases the vulnerability of flash flood, thus increasing the flash flood disaster risk. In addition, government rules stipulate that no soil should be excavated from within 50 metres of an embankment under construction. After construction, the earth of each embankment is supposed to be compacted and planted with grass. But it has been reported that construction is going on with sourcing earth from as close as 10 metres, which is a clear violation of the rules.[65] There are serious allegations that most embankments are being constructed in such a fashion. Therefore, in time of any flash flood, most of the embankments give up miserably failing to provide any protection.

Limited and inadequate public investment in flood and water resources management in *haor* area is another administrative drawback that restricts the

[62] Upashana Salam, "Prelude to a Spreading Nightmare", *The Daily Star*, 22 April 2017.
[63] Badiuzzaman Bay, "Of Rats and Rains", *The Daily Star*, 07 July 2017.
[64] Zyma Islam, "Lost to Corruption: Flash Floods in Haor", *The Daily Star*, 05 May 2017; Mintu Deshwara, "Many Denied VGF Cards, Nepotism Alleged", *The Daily Star*, 21 May 2017.
[65] Dwoha Chowdhury and Andrew Eagle, "Embankment Woes in Haor, *The Daily Star*, 03 April 2018.

capacity of the local community to cope with disasters like flash flood. *Haor* needs large investment to restore, sustain and manage water resources for food production, navigation and natural resources including biodiversity, which is currently absent. In addition, the *haor* area needs long term and integrated planning. Although the government has formulated *Master Plan of Haor Area* in 2012, comprising a set of development activities for specific areas and issues for the next 20 years (up to FY 2031-32) and in the final stage of developing Delta Plan of Bangladesh 2100; slow progress in the implementation of the long term plans and policies are increasing vulnerability *vis-à-vis* disaster risk in the region. Furthermore, lack of up to date information of *haor* and wetland is a major stumbling block for effective policy making. It is observed that literature on the development issues of *haor* areas is inadequate and so is the availability of quality data.[66] Due to non-involvement of local level disaster management committees in the national decision making process, there exist paucity of credible data and robust analysis which hampers the formulation of effective policy for *haor* region, lack of which place the disaster management process of the region in deep peril that ultimately increases disaster risk.

## 5. Conclusion

The life and livelihood of people living in Bangladesh largely depend on the wetlands. They are the source of fisheries, aquatic vegetation and other biodiversity, irrigation, navigation as well as provide natural barriers against floods and other hydrological disasters. The *haor*, *baors* and *beels* play an important role in the ecology, economy and livelihood of the country.[67] Among wetlands, *haors* are one of the most productive resources supporting a large variety of wetland bio-diversity and playing a key role in basin water management. The food security of the country also largely depends on the protection of the *haor* ecosystem. Therefore, any disruption of that ecosystem or any disaster in the area severely hinders every means of subsistence depending on it. Any slowdown of the economy of the *haor* region also adversely affects the national growth of the country as well.

In spite of having high prospects and resources as well as tremendous importance on country's economy and food security, *haor* region is country's one of the disaster hot-spots afflicted by multitude of natural as well as man-made disasters. The area is geographically isolated where floods and flash floods regularly disrupt the life and livelihood of people. The natural and physical settings of the area pose a serious threat to the development potentials of the region. In addition to that, a range of vulnerability factors like, socio-political, economic, environmental, institutional and

[66] General Economics Division (GED) and United Nations Development Programme (UNDP) Bangladesh, *op. cit.*
[67] Tapas Ranjan Chakraborty, "Management of Haors, Baors, and Beels in Bangladesh: Lessons for Lake Basin Management", International Lake Environment Committee Foundation, available at http://www.ilec.or.jp/ILBMTrainingMaterials/resources/Bangladesh.pdf, accessed on 18 March 2018.

governance related challenges work as catalyst for high disaster risk in the region. Apart from region's geographical location, the foremost reasons behind other vulnerability factors, especially, the physical and socio-political factors are its poor communication networks and limited livelihood opportunities in comparison to the other parts of Bangladesh. The area severely lacks flood proof sustainable physical infrastructure and has inadequate number of flood shelter and *killas* which are crucial for protecting life of people and livestock during the time of disaster. The area also stands at the bottom compared to other regions in respect to various social services and safety net coverage. The condition of basic services like health, education, safe drinking water, hygiene and sanitation is also in dire stage. The situation is deteriorating due to community people's limited access to the power structure and resources and their lack of participation in the decision making process. In addition, the vulnerable economic condition of people living in the region has severely curtailed their ability to cope with any adverse situation, especially with flash floods. Disaster risk of flash flood in the region also concerns the wider environmental conditions, and poor environmental management, declining of risk regulating ecosystem services, adverse impact of climate change, and depletion of natural resources are some of the vulnerability factors behind the high disaster risk. Not only that, there exist various institutional and governance related challenges like corruption, lack of transparency and accountability, lack of monitoring and maintenance, inadequate public investment, unplanned development work etc., which are also accountable for high disaster risk of flash flood. All these vulnerability factors discussed interact with each other in a complex ways and when these factors come together and collides with the hazard event, *e.g.*, flash flood, disaster occurs in the *haor* region.

Considering the importance and contribution of *haor* region in national economy and food security, it is important for the government as well as other concerned stakeholders to address the vulnerability factors in order to reduce disaster risk. The flash flood in 2017 brought to fore the need for strong policy initiatives to ensure better management of *haor* region and wetland ecosystem. Formulating appropriate plans and policies taking into considerations the dynamics of *haor* region is crucial to make community people resilient. In spite of having *Master Plan for Haor Area* which was formulated by the government in 2012, there remains a big gap in its implementation. Therefore, proper emphasis is needed to reduce the gaps between policy formulation and implementation. Damage of flash flood can be reduced by manifold if flood forecast and early warning can be issued with adequate lead time. Wireless Sensor Network can be used to issue warning which will help the residents to respond to imminent flash floods. In this regard, Bangladesh needs to work with its regional partners by establishing catchment based river basin management and joint flood forecasting and early warning system. Floodplain management incorporating flood hazard mapping, flood zoning etc., is also important to reduce flash flood vulnerability. The *haor* region should get special attention in various development plans and special funding should be allotted for the region in order to improve the basic utility services.

Economic backwardness has been identified as a prime factor of flash flood vulnerability that severely curtails the coping capacity of community people to disasters. Economic vulnerability of the region can be attributed to geographic isolation, dilapidated communication, limited livelihood options, and dependency of mono-crop harvesting etc. Therefore, initiatives need to be taken for improving connectivity and creating alternative livelihood opportunities. To get rid of mono-crop dependency, climate-smart agriculture and conservative agriculture practices can be devised so that farmers can continue their farming during the time of inundation. In addition, scientific research for flood tolerant rice varieties needs to be prioritised. Efforts should be made to develop submergible rice varieties which can be harvested from the beginning of March instead of the end of the month, as the year 2017 witnessed arrival of flash flood as early as 27 March. Farmers need to be provided with a short-term variety of rice so that they can harvest the crops early.

The success of any flood management project largely depends on effective supervision, monitoring and maintenance. Transparency and accountability of the people concerned are also important in this regard. Therefore, appropriate mechanism need to be devised to ensure constant supervision and effective monitoring in every flood management project in *haor* area. Regular maintenance of flood control measures, like embankments, dykes etc., need to be ensured. Good governance need to be established to ensure transparency and accountability. There should be system of collecting feedback from the local community regarding flood management projects to identify any faults or loopholes. Local people's participation in every phase of disaster management, ranging from preparedness to rehabilitation need to be ensured. Locals need to know every details of construction of structural interventions, timing of implementation and the monitoring mechanism after the construction. The local level disaster management committees need to be equipped with adequate authority, resources and funding so that they can play an effective role in policy formulation as well as implementation process.

Onrush of water from upstream is a major concern for *haor* area. The region has to drain huge volume of water from upstream, especially during monsoon period due to location in the downstream. Therefore, extensive river management with preservation of natural flow of river is needed to cope with that situation. Regular excavating and dredging of rivers are needed to increase the water carrying capacity which will help to reduce intensity of floods. In addition, prioritising afforestation programme can be an effective way to ensure rivers' water carrying capacity by protecting top soil of floodplain, which is normally washed away by rain water and deposited on the river bed. Due to high infiltration capacity of forest soils and vegetation water use, they can also store, temporally retain precipitation and reduce runoff rates which in turn can reduce the velocity of flood water. Moreover, most of the rivers in the region have their origin in the outside of the country. As a result, bilateral and regional cooperation is very important to avert any sort of hydrological disasters

which include flash floods also. Bangladesh needs to pursue catchment-based river basin management to strengthen cooperation with co-riparian countries and ensure exchange of information regarding precipitation, rainfall and water flow in the rivers.

The flash flood in 2017 demonstrates the threat of climate change that looms large over Bangladesh. It also highlights people's lack of awareness of climate change and its adverse impact on *haors* and other disaster prone areas. Therefore, initiatives, which might include education and training, need to be taken to increase knowledge and awareness in this regard. Bangladesh needs to pursue climate diplomacy vigorously to ensure climate funding from developed countries for various climate change mitigation and adaptation projects. Without regional and international cooperation, it would not be possible for the country to cope with the adverse impact of climate change, which, if remain, unaddressed will have serious consequence for the country, especially for the *haor* region.