

Assessing the Socio-Environmental Challenges by Floods in 2017: A Case from a Upazila of Northern Bangladesh

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Abstract

Flood in Bangladesh is a very common issue regarding crossing many rivers, and raining a lot caused by monsoon wind are subject to inundation by overflow. This paper mainly focuses on the challenges associated with 2017 flood disaster in northern Bangladesh, impacts and how affected victim Households (HHs) survive with this disaster. This study is based on mixed methods, and entirely primary data are collected from seventy-three sample survey, six Focus Group Discussion (FGD) and observation. For instance, secondary data are obtained from various authorized sources. Northern Bangladesh is more vulnerable to climatic variability, flash flood, upstream heavy rainfall, early flood during pre-monsoon period, two or three times flooding at a certain year and poverty as well. The socio-economic conditions of the 2017 flood victim HHs in northern Bangladesh are sub-standard compare to other regions of Bangladesh. In addition, the 2017 flood damaged different infrastructures, institutions, properties, crops, homestead vegetation, livestock and poultry and etc. Therefore, social and economic security, and proper guidance has to be ensured, damaged infrastructures and institutions have to be rebuilt, public awareness must be increased, regional planning and delta planning have to maintained regarding the flood management for the vulnerable groups.

Introduction

Bangladesh, a country of natural disasters, witnesses numerous catastrophic events in terms of climate change, unique geographical characteristics, natural formation. In regard, this country encounters huge recurrent hydro-geological/metrological disasters with disastrous consequences at every year (Ghosh, 2022; Ghosh and Mahbub, 2014; Keya and Harun, 2007), located in South Asia, ranging from 20°34' to 26°38', and 88°01' to 92°41' north latitudes and east longitudes, respectively (BBS, 2012). Bangladesh belongs to 147570 sq. km, and 6.7% area is water bodies (Rasheed, 2008). The land of country consists of largest delta, forms by the sedimentation of mighty rivers (the Ganges, the Brahmaputra and the Meghna) and their distributaries and tributaries. In addition, this delta is morphologically flat throughout and stretches from near the piedmont of the Himalayan to the Bay of Bengal (BBS, 2012).

Flood is unwanted inundation on flat or low-lying areas, when extreme rainfall and snowmelt supplies water rapidly more than infiltration (Jones and Myrtle, 2000). Bangladesh is experiencing flood in every year. As a result of monsoon rain, the rivers in the country became overflowing as well as the upstream hilly regions of neighboring countries, this land faced an abnormal flooding in 2017, and especially the northern Bangladesh became more vulnerable by overflowing the Brahmaputra- Jamuna River basin (BDRCS, 2017). The common after-effect of severe flood is economic hardship in relation to rehabilitation expenditure, rebuilding cost, temporary hamper of tourism sector, shortages of food leading to price hike (Ghosh an Mahbub, 2014; Brammer, 1990). Therefore, these affected issues make mental-health damage and particularly deaths, serious physical injuries and loss of property (Brammer, 1990). On the other hand, the effect of every year's flood is not likely same, where the 1999 flood was not as serious as the 1998 flood. The flood affected households (HHs) had to be paid for with local, national and foreign assistance as well due to causing deaths, homeless, and other associated complex issues (Priyangika, 1999).

Generally, the low-lying and densely-populated area of Bangladesh has been submerged by resulting of flash floods or riverine floods (Mahmood, 2014). Consequently, flood waters overflow the rivers, inundate villages in northern Bangladesh, make people homeless, damage roads and crops. Therefore, most vulnerable groups (e.g. women and children) become helpless during this disaster. Recent research documented that during the period of 1998 floods, mostly the women experienced different complexities regarding in accessing to basic sanitation due to submerge as most of latrines by the flood water (Rashid, 2000; World Bank, 1998). Flood is a reoccurring hazard in Bangladesh, and has dual impacts and frequently within tolerable limits (Ghosh and Sarker, 2021; Milliman et al, 1989). Most cases, the effects of floods are between moderate to large events, happening by stream flow following expected range. Moreover, floods are becoming dynamic through time by the nexus between the physical exposure and human intervention (Smith and Ward, 1998).

Nearly 20-22 percent of Bangladesh is flooded even in a year of normal precipitation; while around 80 percent land is considered flood prone for having same percentage of floodplain land (Rasheed, 2008; Brammer, 1990) and the nearly half is getting in severe floods (Chowdhury, 2000). The poor are predominately vulnerable to the effects of catastrophic floods (World Bank, 1998). On September 2017, a report by International Federation of Red Cross and Red Crescent Societies (IFRCRCS) claimed that flood in 2017 inundated almost one-third land of Bangladesh, particularly the regions of northern, north-eastern and central Bangladesh. In regard, UNICEF document revealed that more than six million people have been invaded by 2017 flood (*George, 2017*). As a result of flood in 2017, nearly 700,000 homes destroyed, 4,680,000 hectares farmland submerged, and thousand miles of roads worsened in Bangladesh (*UNICEF, 2017*). And almost fifty thousand people in Bangladesh became displaced internally due to the effects of that disaster (*George, 2017*). An explanatory statement has been asserted by the International Centre for Climate Change and Development (ICCCD) that this flood has been increased by the consequences of climate change (*Jonathan, 2017*).

The 2017 flood situation of northern Bangladesh became worsened due to continuous downpours of the tributary rivers into the Brahmaputra and Jamuna River. By the report of the Flood Forecasting and Warning Center (FFWC), the upstream rivers of Bangladesh were overflowing at different points of northern Bangladesh (e.g. Kurigram, Gaibandha, Jamalpur, Bogura, Sirajgonj), and Tangail and Netrokona. (BDRCS, 2017). As a result of flood, people loss life and property. Flood-prone areas' villagers become more vulnerable due to lack of their consciousness and government steps. Flood victim HHs are not satisfied with overall flood management process (Rashid, 2000). And the flood management strategies of government in root level in different phases of disaster are investigated (Elahi, 1991).

A dangerous scenario reported by FFWC on 14 August 2017 at afternoon that mighty Jamuna River's water level raises at 20.78 metres. As a consequences of huge volume water pressure during flood in 217, the northern Bangladesh, a vast area has been submerged due to breach the flood-protection embankments of different districts of this region (The Daily Star, 2017a). In regard, a report reveals on 30 August 2017 that more than 41 million people were oppressed by the floods 2017 in South Asia (e.g.

Bangladesh, India, and other countries) (The Independent, 2017). The northern part of Bangladesh was extremely affected by floods in 2017 (Ghosh and Sarker, 2021; Nirapad, 2017).

Aim and Objectives of the Study

The paper mainly focuses on the socio-environmental challenges and issues by the devastating flood in 2017 of the country's most flood amenable area in Rangpur District.

The specific objectives of the study are:

- To investigate the socio-demographic characteristics of the victim HHs due to the impact of flood 2017; and finally
- To assess the environmental challenges of Kaunia Upazila caused by the effects of flood in 2017.

Selection of the Study Area

Kaunia Upazila (Figure 1), Rangpur District is flood minded area of northern region of Bangladesh, has been chosen for the purpose of study. Kaunia Upazila's area is 147.6 square kilometre, and located in ranging 25°42' to 25°50' and 89°18' to 89°30' north latitudes east longitudes, respectively. This is the northern upazila of Bangladesh, and bounded by Lalmonirhat and Kurigram District. 214317 inhabitants are living in this upazila (BBS, 2012). Kaunia Upazila is the most vulnerable Upazilas in Bangladesh for flooding by the overflow of Teesta River. Teesta, one of the longest and transboundary rivers, is an active river of northern region, Bangladesh (Hanif, 1995).

Materials and methods

Data Collection

This research is based on mixed method. Almost primary data were selected by questionnaire survey, Focus Group Discussion (FGD) and observation. Firstly, a pre-designed semi-structured questionnaire was customized to conduct sample survey at household level in order to extract almost primary data (qualitative and quantitative data). The respondents are considered as the head of the households (HHs). Homemaker has been chosen as respondent by following de-facto method. The pre-designed questionnaire consisted of 21 questions in relation to the purposes of the study. Seventy-three HHs victimized by 2017 floods in Kaunia Upazila, Rangpur District were selected purposively to conduct this study.

Secondly, another method of gathering qualitative data named Focus Group Discussion (FGD) In regards, FGD was composed of 9 open-ended question in respect to the requirement of the study. Six FGDs from different groups of people regarding local teachers, farmers, businessmen, Non-government employee, day labour, house wife, and almost of them are flood victim people were selected to collect information in respect to carry on this study. Thirdly, observation is one of them a good method to understand the

scenario and reality of the 2017 flood effects on the inhabitants in Kaunia, a northern Upazila of Bangladesh.

With a view to use secondary data regarding this study's purpose, Bangladesh Water Development Board, Centre for Environmental and Geographic Information Services, Kaunia Upazila Parishad, Union Parishad of Kaunia Upazila and different local institutes of Kaunia Upazila, different websites, research papers different daily newspapers have been nominated as sources of data availability.

Sample Size and Sample Technique Determination

Sampling design, is the systematic method of selecting sample from the total flood oppressed population in the flood vulnerable areas of Kaunia Upazila, Rangpur. In this area, the total victim HHs caused by 2017 flood in Kaunia Upazila, Rangpur was 2661 (UP, 2022). Kothari and Garg (1999) postulated a formula for the number of sample determination. The sampling size has been confirmed by following statistical expression in accordance with 95% confidence level and 5% precision level. The study was completed with total sample of 73 HHs (Table 1) by applying simple random cluster sampling that was determined to conduct questionnaire survey at household level.

$$n = \frac{z^2 pq N}{e^2 (N-1) + z^2 p q}$$
 Here,
N = Total number of 2017 flood victim HHs

$$n = \frac{(1.96)^2 \times 0.05 \times (1-0.05) \times 2661}{(0.05)^2 \times (2661-1) + 3.8416 \times 0.05 \times (1-0.05)}$$
n = Sample size
e = 0.05 (Level of error)

$$n = \frac{3.8416 \times 0.05 \times 0.95 \times 2661}{0.0025 \times 2660 + 3.8416 \times 0.05 \times 0.95}$$
z = 1.96 (Defined table of area under normal curve, for the given confidence level of 95%)

$$n = 498.21$$
p = 0.05 (5% precision level)

$$n = 72.84$$
q = (1-e)

Data Processing and Analyzing

Statistical Package for Social Sciences (SPSS) 20.0 and ArcGIS 10.6 software are deployed to analyzing the collected data and producing maps, respectively. SPSS 20.0 software is deployed to descriptive statistical analysis and ArcGIS 10.6 software used to prepare study area map by geo-referencing, editing and digitizing and also delineating and the base map collected from Banglapeedia.

Results and Discussion

Demographic and Socio-economic Status of the Respondents at Household Level

Demographic data (Table 2) demonstrates that the maximum respondents of Kaunia Upazila (study area) are male (i.e. 93.2%) and middle aged (i.e. 49.3%). Moreover, almost all the respondents are married

(i.e. 95.9%). Socio-demographic situation of the respondents are including education, occupation, income, expenditure, type of house, family types and so on.

Table 2 shows the education level of the respondents, where only 10% have completed their secondary school certificate (SSC). Unfortunately, approximately 19% are illiterate and 33% are able to sign or went school for few days. It is clearly identified that two-thirds of the flood vulnerable people are belong to illiterate or went school for few days or passed grade five. Consequently, they do not have more strategies to cope with the environmental challenges. They are failing to get back the previous socio-economic conditions. On the other hand, more than 50% (i.e. 53.4%) flood victims have monthly income near about 10,000 BDT. Besides, nearly 69% families have only one earning member. Surprisingly their monthly income and expenditure are more or less equal.

Nearly 47% people are belonging to extended family. Moreover, present study also found that on an average of 4 to 6 family members depended only on one or two persons of the family. As a result, it is very challenging to maintain their livelihood expenditure with the current income. They have no savings or deposits to confront with disasters (e.g. floods) as their income and expenditure are more or less equal. Therefore, they have to face difficulties to keep momentum into their live during and after disasters. Again, one-third respondents (i.e. 35.6%) are involving with the primary activities including farming and fishing. Alongside, about 40% vulnerable people are working as a day laborer.

More than two-thirds (i.e. 91.8%) of the vulnerable people live in Kutcha houses (i.e. made by mud and straw or Tin). Most of the times, these types of houses are affected by the incurred flood. As a result, about 54.8% families need to repair or construct new houses after flood 2017. Alongside, these poor people have very little amount of homestead and agricultural lands after 2017 flood. Approximately 62% HHs have more than 5 decimal homestead lands. Moreover, only 20% people of the study area have more than 10 decimal agricultural lands. These socio-demographic conditions clearly expose the ability of the respondents' considering adaptive mechanisms and mitigation processes with the flood.

Access to drinking water, light, and sanitation

Rural poor people have access to the drinking water, light, and sanitation. Before and after flood almost all the respondents use deep tube well for drinking water whereas during flood about 50.7% people use deep tube well and 37% people use boiled water for drinking as their livelihood management (Table 3). In addition, marginal people have more or less similar access to the electricity before and after flood. However, during flood they do not have the access to electricity since electricity disrupted by the flood water. Therefore, they need to use kerosene (84.9%) and candle (15.1%) for the light or energy during flood (Table 4). Surprisingly, access to sanitation of the respondents at household level before and after flood is more or less similar. On the other hand, as their livelihood management and survival strategies they practiced open types of sanitation predominantly (e.g. about 98.6%) since their sanitation affected by flood (Table 5).

Environmental Challenges of Flood 2017 in Northern Bangladesh

Flood is a recurrent phenomenon, and become disastrous disaster that affects physical environment, lives and property and etc. Flood 2017 causes different challenges that hamper normal lives. This flood hits 32 districts of Bangladesh particularly in the northern, north eastern and central region, affecting over than 11 million inhabitants. The Ministry of Disaster Management and Relief (MoDMR) mentioned this flood as the worst in the last four decades (Nirapad, 2017). Moreover, the devastating 2017 flood inundated Rangpur region (e.g. low-lying areas) resulting of extreme rain, in the upper stream of the Brahmaputra River, and causes catastrophic floods in the Indian State of Assam (The Daily Star, 2017b). Kaunia, a subdistrict (Upazila) of Rangpur and northern Bangladesh as well, is located Teesta's right bank, tributary river of the mighty Brahmaputra. The Teesta River, is a transboundary river, originated from Teesta Khangtse Gracier in the north of Sikkim (Meetei et al, 2007). In Rangpur District, the floods in eight upazilas of the region deteriorated in terms of extreme rain and overflow of Teesta River (Table 6). The more affected upazilas are Kaunia, Pirgachha, Gangachara, Mithapukur, Badarganj, Taraganj, Pirganj, Rangpur Sadar and other low-lying areas of Rangpur City (The Independent, 2017). The most inundated villages of Kaunia Upazila in 2017 flood are Talukshabaz, Panjorvanga, Char Gonai, Hoyborkha, Azamkha, Bishwnath, Nijpara. The perception of the HHs regarding the causes of flooding in Kaunia Upazila, beside the Tista River are recorded (Table 7), in where upstream flow of river (64.38%) is main causes of flooding. The 2017 flood damaged different infrastructures, flooding agricultural and homestead lands and damages different property those are shown in Table 8. Another study estimated that in Bangladesh, 55,400 and 641,000 houses were damaged and destroyed, respectively by the 2017 flood. In addition, almost 714 km of embankments had been damaged fully (Nirapad, 2017). During and after flood, the flood victim HHs' member faced different physiological complexities especially water borne diseases. Table 9 shows the diseases, by whose flood affected HH in the Kaunia Upazila are affected, which is very common as a result of flood. In regard, the flood promotes the possibility to occur various types of water-borne diseases. It is more vulnerable in case of child and women and also for old people (Sinclair and Peg Ran, 2003). These HHs' member took treatment from different sources, shown (Table 10), which as their convenient in terms of short distance and low cost. The rural people Bangladesh take healthcare facilities from nearby hospitals and rural practitioners.

Estimation of Loss by Flood 2017

Many households suffered from loses of their belongings and valuable properties during floods. The flood 2017 victim HHs' in Kaunia Upazila lost their crops (23.3%), cattle (26%), poultry (34.2%), houses (11%) shown in Figure 2. The main source of valuable food as well as protein of the natural disaster (i.e. flood) victim HHs come from their livestock, hens and ducks (milk, eggs, and meat) (Ghosh, 2016). Rearing these livestock was a cumbersome job during the food in 2017. In some cases, food-affected HHs become bound to sell their cattle at steeply cheap prices for their livelihood management and to mitigate the effects of food and (Rahman, 2017). And 19.2% victim HHs lost their properties by value Tk. 20000 (Figure 3) regarding the 2017 flood effects. Figure 3 presents the loss value of the victim HHs by Bangladeshi currency (BDT). The lowest lost and highest loss value of the victimized HHs by flood 2017 in Kaunia Upazila are 500 BDT and 100000 BDT, respectively.

Recommendations of the study

1. The people of flood-prone areas in Kaunia Upazila are to be more literate, educated with the effective preparations regarding upcoming floods in terms of mitigate the negative of the floods.
2. Social and economic safety need to be ensured for the vulnerable groups; i.e, Local Government body and NGOs have to list the pure victim HHs caused by frequent floods regarding proving different supports in terms of comeback to their standard livelihood pattern.
3. Repairing embankments, roads, bridges and culverts should be taken first choice as recovery of disaster; need to be adopted proper plan for longevity of these infrastructures.

Conclusion

This flood causes the colossal damage to all sectors of the economy. These not only adversely effect on food security, people became more vulnerable to disease and other social crises. Many of them became helpless and workless by losing their properties, cattle and crops. The flood made a worsen environment, particularly in the northern region of Bangladesh where thousands of inhabitants are passing a miserable life without reliefs' material. The environmental challenges are arisen by the devastating 2017 flood. Government bodies especially Ministry of Disaster Management and Relief and NGOs are concerned to mitigate the impacts of this mega disaster. The disaster is extremely responsible for extensive damage to public facilities, agricultural crops, property, loss of human and animal lives, damages to roads, bridges, culverts, homestead and disruption of social and economic activities and breakdown of essential services. Every flood begets pauperization among people and 2017 flood's impacts prevailed longer. This flood affected people are vulnerable in socially and economically. They are leading their lives and livelihood through pauperization. These affected people are taken initiatives to adapt this disaster through indigenous knowledge.

Declarations

This study is funded by Begum Rokeya University, Rangpur Under University Grants Commission of Bangladesh. And the appropriate study area and concerning issues are approved by Ethics Committee of the Department of Geography and Environmental Science, Begum Rokeya University, Rangpur.

Human responses are the part of methodological section of the research. To conduct households survey, a consent form has to been filled up by the respondent as a consent regarding taking human responses in terms of conducting the research.

Consent to publish: Not applicable

Dataset and materials: The dataset of this study is preferable from field study and identified recognized institutions.

Completing Interest: There is no completing interest.

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Tables

Table 1: Selected Sample HH

Name of Union	Name of Village	Respondent HH	Total HH	Percentage (%)	Total (%)
Balapara	Taluksahabaj	15	28	20.50	38.30
	Panjonvanga	6		8.20	
	Godai	7		9.60	
Tepamadhupur	Gonai	18	35	24.70	48.00
	Hoyborkha	9		12.30	
	Bishwanath	8		11.00	
Kaunia	Nijpara	10	10	13.70	13.70
Total		73		100.00	100.00

Source: Field Survey

Table 2: Socio-demographic status of the respondents at household level

Characteristics		Number of respondents (in percent)
Gender	Male	68 (93.2%)
	Female	05 (6.8 %)
Age-group	21-30	11 (15.1%)
	31- 40	25 (34.2%)
	41-50	11 (15.1%)
	Above 50	26 (35.6%)
Marital Status	Married	70 (95.9%)
	Widow	3 (4.1%)
Education	Illiterate	14 (19.1%)
	Able to sign	24 (32.9%)
	Primary	25 (34.2%)
	Secondary	07 (9.6%)
	HSC	1 (1.4%)
	Honours	1 (1.4%)
	Post Graduate	1 (1.4%)
Occupation	Farming	19 (26.0%)
	Fishing	07 (9.6%)
	Business	09 (12.3%)
	Day laborer	29 (39.7%)
	Service	09 (12.3%)
Place of occupation	Surveyed mouza/village	65 (89.0%)
	Rangpur City	3 (4.1%)
	Kurigram Town	1 (1.4%)
	DhakaCity	4 (5.5%)
Income per month (BDT)[1]	1-10000	39 (53.4%)
	10001-15000	20 (27.4%)
	15001-20000	07 (9.6%)
	20001-25000	07 (9.6%)
Expenditure per month (BDT)	1-10000	46 (63.0%)

	10001-15000	15 (20.5%)
	15001-20000	09 (12.3%)
	20001-25000	03 (4.1%)
Type of house	Kutchra	67 (91.8%)
	Semi-pucca	05 (6.8%)
	Pucca	01 (1.4%)
Number of family members	1-3 person	39 (53.4%)
	4-6 person	34 (46.6%)

Source: Field Survey

[1] 106.46 BDT= 1 USD (as of January 2023)

Table 3: Access to drinking water of the respondents at household level

Period	Sources of water (in percent)			
	Deep tube well	Rain water	Boiled water	Mineral water
Before flood	100	0	0	0
During flood	50.7	5.5	37.0	6.8
After flood	100	0	0	0

Source: Field Survey

Table 4: Access to electricity of the respondents at household level

Period	Sources of light (in percent)			
	Electricity	Kerosene	Candle	Solar
Before flood	93.2	6.8	0	0
During flood	0	84.9	15.1	0
After flood	78.1	20.5	0	1.4

Source: Field Survey

Table 5: Access to sanitation of the respondents at household level

Period	Types of sanitation (in percent)			
	Kutcha	Semi-pucca	Pucca	Open
Before flood	45.2	31.5	6.8	16.4
During flood	0	0	1.4	98.6
After flood	41.1	30.1	9.6	19.2

Source: Field Survey

Table 6: Impacts of flood 2017 in Rangpur District

Particlurs	August 2017
No. of Affected Upazilas	9
No. of Affected Unions	61
No. of AZfected Villages	502
Partially Affected People (% of total population of Rangpur District)	62.97
Affected Crop lands (h)	38815
No. of Death	6
No. of Affected Institutions	200
Partially Affected Roads (km)	165
Partially Affected Embankments (km)	5
No. of Affected Bridge	29
No. of Affected Tube-well	1815

Source: DDM Report on Damage Information and Relief Distribution on Monsoon Flood, August 30, 2017 cited in Nirapad 2017, p.4

Table 7: Causes of Flood 2017

Main Causes	Respondents (n=73)	Percentage
Upstream flow of river	47	64.38
Bank erosion	26	35.62
Over rain	34	46.58
Will of almighty	12	16.44

**Multiple responses considered*

Source: Field Survey

Table 8: Damaged by flood 2017

Type of damage	Respondents (n=73)	Percentage
House	20	27.40
Poultry	35	47.95
Cattle	10	13.70
Tree	21	28.76
Crop	52	71.23
Agricultural land	37	50.68
Homestead land	2	2.74
Roads	5	6.85
Bridge	3	4.10

** Multiple responses considered*

Source: Field Survey

Table 9: Diseases affected by victim HHS' member

Name of Diseases	Respondents (n=73)	Percentage
Insomnia	4	6.50
Diarrhea	33	45.20
Fever	16	21.98
Hepatitis B Virus	8	10.96
Skin disease	13	17.80
Weakness	1	1.37

**Multiple responses considered*

Source: Field Survey

Table 10: Treatment sources of respondents

Sources of treatment	Respondents (n=73)	Percentage
Hospital	52	71.23
Homeopathic	34	46.58
Local	10	13.70

**Multiple responses considered*

Source: Field Survey

Figures

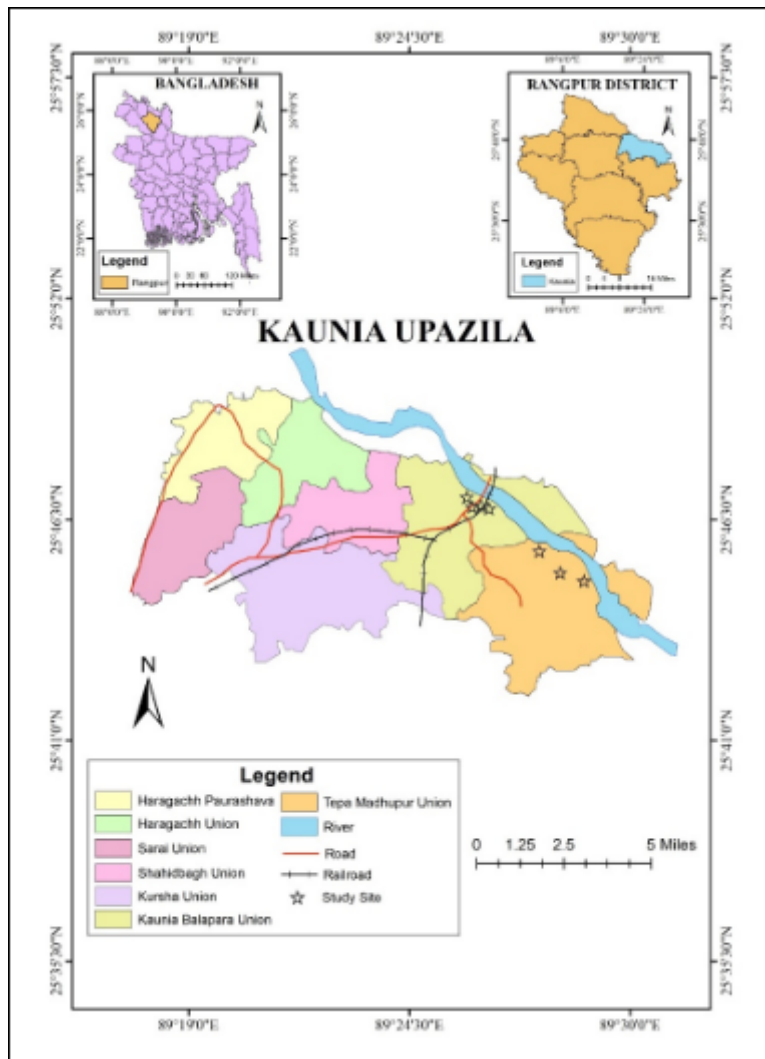


Figure 1

Study Area

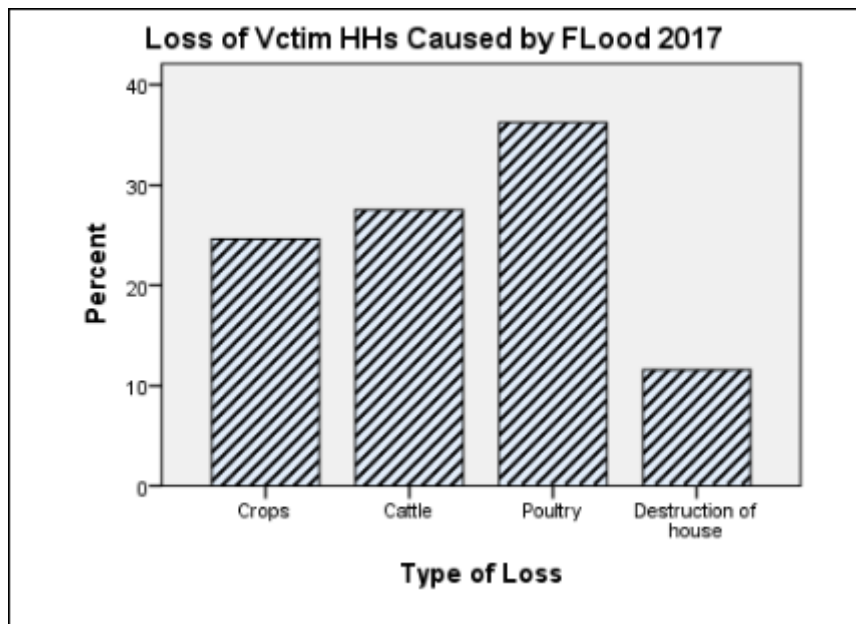


Figure 2

Loss of Victim HHs

source: Field Survey

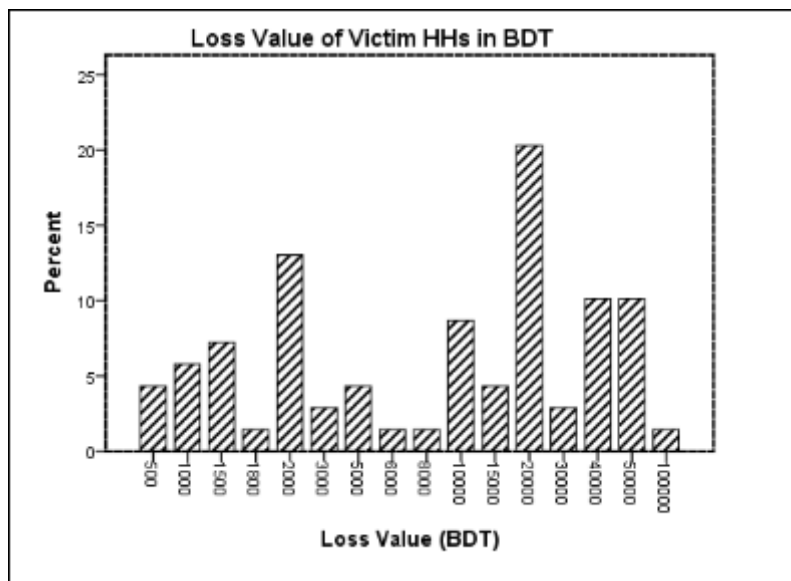


Figure 3

Loss Value of Victim HHs

Source: Field Survey

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Questionnaire.docx](#)