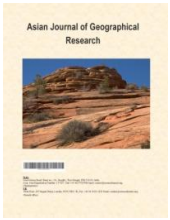

Asian Journal of Geographical Research

4(2): 55-64, 2021; Article no.AJGR.67982
ISSN: 2582-2985

Sectoral Impacts of Flash Flood in *Tanguar Haor* in Sunamganj of Bangladesh

Md. Shohel Khan[1], Mizanur Rahman Apu[1], Sameena Begum[2] and Mohammad Maruf Billah[3*]

[1]Department of Environmental Science and Disaster Management, Noakhali Science and Technology University, Noakhali, Bangladesh.
[2]Department of Geography and Environment, Jagannath University, Dhaka, Bangladesh.
[3]Department of Environmental Science and Management, North South University, Dhaka, Bangladesh.

Authors' contributions

This work was carried out in collaboration among all authors. Author MSK was mainly responsible for conceptualization, investigation, methodology, supervision, validation, visualization, writing – review and editing and critically revised the manuscript. Author MRA was responsible for data curation, analysis, editing of the manuscript. Authors SB and MMB were responsible for editing and revision of the manuscript. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJGR/2021/v4i230131
Editor(s):
(1) Prof. Armando García Chiang, Universidad Autónoma Metropolitana, México.
Reviewers:
(1) Peeyush Gupta, India.
(2) Saeed Khosrobeigi Bozcheloei, University of Tehran, Iran.
(3) Kartono, Universitas Diponegoro, Indonesia.
Complete Peer review History: http://www.sdiarticle4.com/review-history/67982

Original Research Article

Received 17 April 2021
Accepted 13 May 2021
Published 18 May 2021

ABSTRACT

Sunamganj is a north-eastern district of Bangladesh is considered a highly flood-prone *haor* area. Uttar Shreepur Union of Taherpur Upazila of Sunamganj District was selected to conduct the study to find out the causes behind the flash flood, situation analysis during and post-flood and different sectoral impacts of flash flood because these areas were flooded almost every year. Six focus group discussions (FGD) along with a total of 162 households were evenly targeted from six selected villages and a semi-structured self-explorative questionnaire was used to collect primary data. The study revealed that heavy rainfall (92.5%) and low land (53.13%) were the main causes of flood. The study also showed that transportation (84.37%) and agricultural (82.5%) sectors were the most affected, followed by water and sanitation (60%), housing (51.25%), and health (36.62%), respectively; among these, crops (89.37%) and animal husbandry (33.13%) were the most affected part of agriculture, followed by health sector, children (89.37%) and aged people (69.23%) were the

**Corresponding author: E-mail: maruf.geo.du@gmail.com;*

most affected and the people were mainly suffered from cold and fever (98.13%), diarrhoea (80.63%), typhoid (27.5%), and dysentery (33.13%), respectively because of the crisis of pure drinking water and poor sanitation system. About 85% respondents stored normal food, followed by dry food (30%), medicine (25%) and water (0.63%), respectively to meet up post-flood food crisis. 62% respondents received flood warning signals by mobile phone (54.37%) followed by, radio/TV (41.87%), relatives (41.25%) and Upazila/Union Parisad (13.75%), respectively. However, various initiatives were taken by GOs and NGOs to build back a better immediate post-flood period. Finally, it is suggested that proper long-term steps should be taken to strengthen resilience and coping capacity for hydrological disasters in the study area.

Keywords: Flash flood; sectoral impacts; coping capacity; build back better.

1. INTRODUCTION

The riverine floodplain (almost 80%) Bangladesh is one of the largest deltas in the world [1] encompasses sub-tropical monsoon rainstorm climate. The main river system is the Ganges-Brahmaputra-Meghna (GBM) alongside in excess of 210 tributaries and distributaries convey an immense volume of downpour runoff [2] and thus 20.5% areas of Bangladesh affected by flood [3]. The north-eastern part of Bangladesh is a low-laying bowl-shaped depression containing many wetland areas, locally known as *haor.* The district of Sunamganj, also located in this part, has unique physiography. A total of 461 wetlands are available in Bangladesh [4,5] among them the Tanguar *Haor* (Ramsar Site) is the largest one that situated in the Sunamganj district [6]. This *haor* supports 56000 to 60000 inhabitant's livelihoods from 46 to 88 villages which contribute to national food security [4,7,8,9,10]. This *haor* is extremely rich fisheries resources with a total of 200/140 [10] wetland plants and 141 fish species [9,11]. Community people living in this *haor* area rely upon a single pattern crop (boro rice) yearly that contributes significantly to the national rice production [1] and 80% agricultural land covered with *boro* rice [4]. However, the people of the *haor* areas of Sunamganj District are most vulnerable to early flooding also to extreme monsoon and post-monsoon flash floods. Flash flood is considered as the main disaster in the *haor* area which inundates the primary production sector and threatens the lives and livelihoods of the people [12]. Globally, hydro-meteorological hazards e.g., flash flood pose a direct threat to human lives and it has severe impacts on livelihoods e.g., homestead property, water infrastructure and sanitation facilities, damages to crops, and the socio-economic condition as well [13].

There are several factors mainly influence to occur flash flood e.g., excess rainfall in the upstream hilly areas and subsequent runoff, sedimentation in the rivers, deforestation and hill cuts, landslide, improper drainage, unplanned road and water management infrastructure and the effect of climate variability [12]. When the sudden rise of water level in the upstream reaches of rivers ultimately causes flash flood in their downstream branches and tributaries since these narrow meandering rivers fail to contain the billowing flow from upper reaches. However, the flood management work is done by the Bangladesh Water Development Board (BWDB). The government has also decided not to allow any developmental or commercial activity within the *haor* area, which is harmful to *haor* environment. Besides, the government has banned the digging of wells for gas or oil within the 10 km area of the *haor* [10]. The objectives of this study were to find out the causes behind the flash flood and impacts on transportation, agriculture, housing, health and sanitation sectors.

2. MATERIALS AND METHODS

2.1 Study Area

Tanguar *haor* (Fig. 1) located in Dharmapasha and Tahirpur Upazilas of Sunamganj District covering 46 villages about 100 km^2 [10] of land with 58,000 inhabitants [9]. The geographical position of Tanguar *haor* is between 25°06' to 25°11' N latitude and 91°01' to 91°06' E longitude [2]. Uttar Shreepur Union of Taherpur Upazila was selected purposively.

2.2 Data Source

The data was collected from six randomly selected villages of this union named Golabari, Joypur, Islampur, Silan, Tahirpur, and Torong. This study used the secondary data were collected from journals, books, and organizations such as Bangladesh Water Development Board (BWDB), Upazila Agriculture Office (UAO), Bangladesh Bureau of Statistics (BBS), etc.

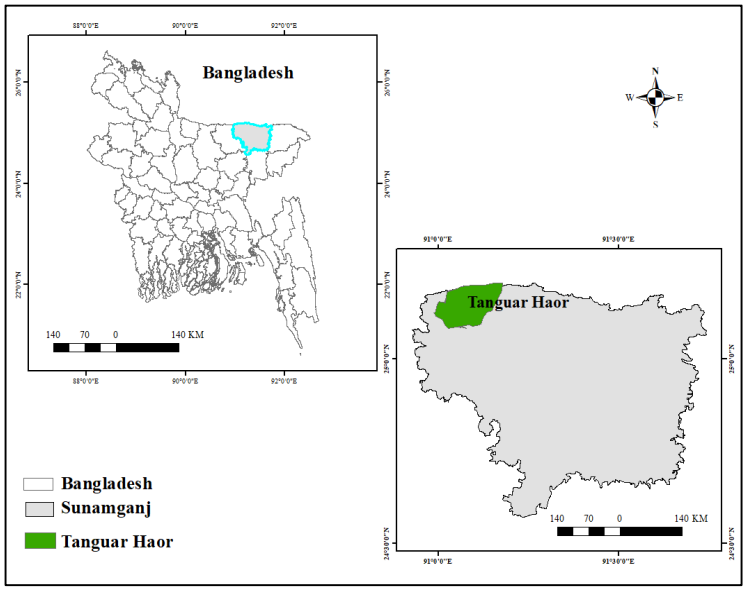

Fig. 1. Study area: Tanguar Haor, Sunamganj, Bangladesh

2.3 Sample Size and Data Collection

A total of 162 households were evenly targeted and a semi-structured self-explorative questionnaire was used to collect primary data from six selected villages. Households were selected randomly, and heads of households were interviewed for the study. Another six focus group discussions (FGD) were performed from six villages in the study area. The questionnaire was developed based on research objectives and agricultural, transportation, health, housing, water, and sanitation sectors. The duration of the primary data collection was June-August 2019.

3. RESULTS AND DISCUSSION

3.1 Demographic Characteristics of the Respondents

3.1.1 Age-sex distribution

The survey result showed that 84% of respondents were male and 16% of respondents were female. The respondents were categorized into five types based on their ages such as 18-30 (30.63%), 31-40 (28.75%), 41-50 (15%), 51-60 (8.75%) and >60 (16.87%) years, respectively.

3.1.2 Occupation

Agriculture (82.5%) is the main occupation in the study area, followed by, fishing (8.13%), business (6.87%), poultry farming (2.5%), respectively. They grew only *robi* crops in their cultivable lands and *boro* was the staple crop. It was also cleared from the study area that community people did not rely on the single occupation for their livelihood but many of them were involved in multi-occupational activities. The result also showed that 41% of people migrated for their livelihood. Usually, in the wetland areas, occupational change, and deterioration of the quality of life are identified as key the impacts [14]. Due to season-based occupation and lack of availability of capital, poor and landless people migrated to Dhaka (capital city) or Chattagram (commercial city) in monsoon to find alternative jobs in construction works, brickfields, a rickshaw puller, day labor, etc.

3.1.3 Educational qualification

The study revealed that the literacy rate was 29.38% and the rest of the respondents were illiterate. Among the literate respondents, 18.75% passed the primary school certificate (PSC), followed by 6.25% junior school certificate (JSC), 2.5% secondary school certificate (SSC) and only 1.88% higher secondary certificate (HSC) examination, respectively.

3.1.4 Family size

The family size of each household was 6.28 and the district average family size was 5.58 [15].

3.2 Agricultural Land Ownership

Land is usually categorized into five types [16,17]. These are landless (<0.5 acre), marginal

(0.51-1.0 acres), small (1.01-2.5 acres), medium (2.51-5.0 acres) and large (>5.0 acres). The study result showed the distribution of the land of the households' that the majority (71.88%) was functionally landless, followed by marginal (16.87%), small (8.75%) and medium (2.5%), respectively (Fig. 2).

3.3 Microcredit Provided by Local NGOs

Women in *haor* area have access to microcredit provided by local NGOs. They took loans for mainly three reasons to rebuild their houses; to feed family members just after disasters, and to repay loans taken from other sources. Households in these community plunged into the vicious cycle (poverty cycle) of asset loss and money lending or microcredit due to income instability. In the study area, the majority (74%) respondents took microcredit and 26% did not take it. The result showed that annually 55.08% respondents took BDT10000-20000, followed by BDT21000-30000 (23.73%), BDT31000-40000 (7.63%), BDT41000-50000 (5.93%) and above BDT50000 (7.63%), respectively (Fig. 3).

3.4 Causes of Flash Flood

Flooding in any area varies regarding the changing the base level of river elevation [13] and 80% of respondents' [2] of the study area was the victim of flash flood 1-2 times in a year. The survey resulted that there were many factors responsible for causing a flash flood in the study area. The study results indicated that heavy rainfall (92.5%) and low land (53.13%) were the main causes of flood, followed by an increase of river water (36.25%), lack of management (34.38%), upstream water (34.38%), and sedimentation on riverbeds (19.38%), respectively (Fig. 4). It is showed in a study [2] of 28 years rainfall analysis that 80% of total annual rainfall occurred during May-October.

3.5 Sectoral Impacts of Flood in the Study Area

Flood deteriorates the usual activities of life, affecting housing, infrastructure, agricultural land, transportation, water supply and sanitation system and these are severely affected. The study revealed that transportation (84.37%) and agricultural (82.5%) sectors were most affected by a flash flood, followed by water and sanitation (60%), housing (51.25%) and health (36.62%), respectively (Fig. 5).

The study revealed that during flood all the sectors had been damaged but agricultural land may be fertile because of sediment deposition. The result also cleared that the transportation and agricultural sector were severely damaged due to the flash flood.

3.5.1 Agricultural sector

The respondents of the study area grew crops once a year. The study showed that *boro* (82.5%) is the main *robi* crop, followed by vegetables (44.38%) jute (5%) and potato (1.25%), respectively. After *robi* crops, cultivable land became fallow round the year. In the study area, most of the lands were low land and flooded every year especially in the monsoon season. The study showed that 94% of respondents told agricultural land was affected/flooded most during the flood and only 6% of respondents' land were not flooded because these were homestead area. The result also revealed that 90.23% of respondents totally lost their agricultural crops and 9.77% of respondents partially lost their agricultural crops. After the flood, a lot of problems had risen. Most respondents (83.75%) told that they faced seed problem, followed by the increased price of seed (63.75%), increased labor cost (52.5%), shortage of money (35%), lack of tractor (2.25%), lack of fertilizer (1.25%) and unusable agricultural land (1.25%), respectively (Fig. 6).

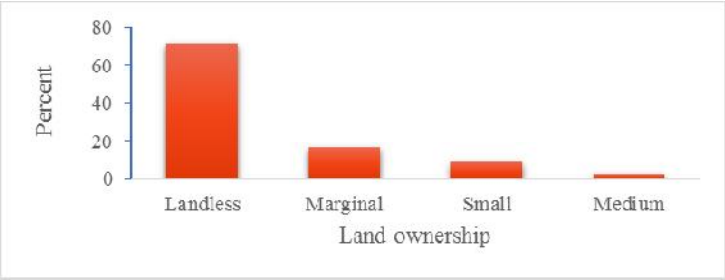

Fig. 2. Agricultural land ownership status of the respondents

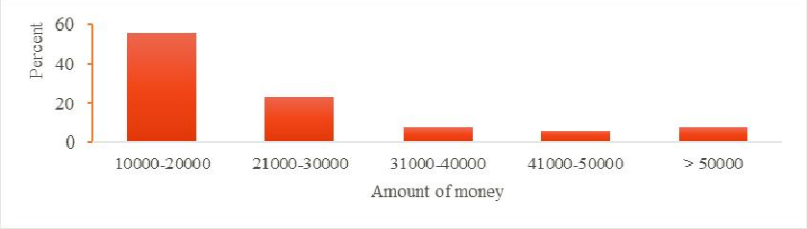

Fig. 3. Microcredit provided by local NGOs

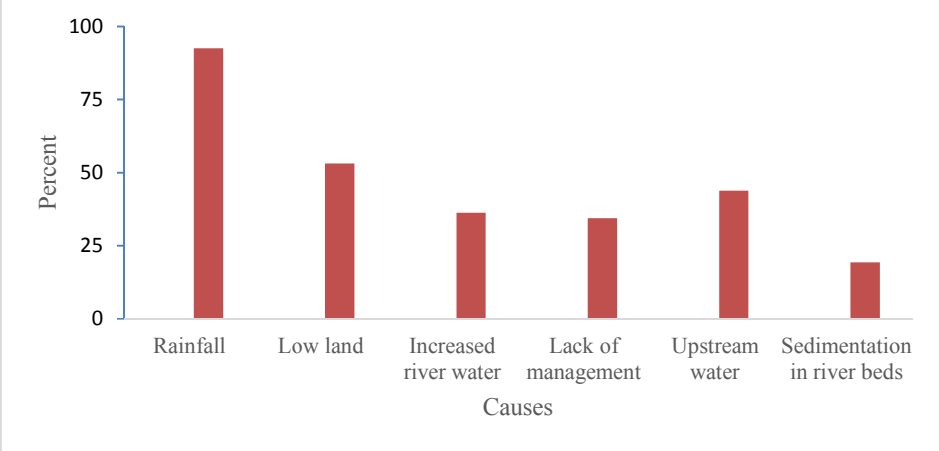

Fig. 4. People's perception of causes of the flood

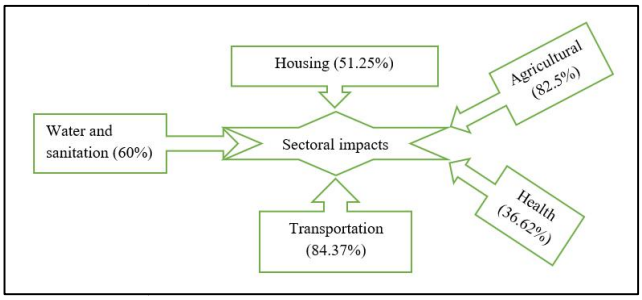

Fig. 5. Respondents opinion on different sectoral impacts in the study area

3.5.2 Annual financial agricultural losses

Most of the households (HHs) have annual financial losses during the flood. It depends on the frequency and duration of the flood. Agricultural land is inundated severely which may vary depending on the intensity and duration of the flood. The study found that annually 21.25% HHs had no losses because they might not involve in agricultural activities or their land may higher elevation than others, followed by 20.63% lost <BDT10000, 16.84% lost BDT11000-20000, 16.21% lost BDT21000-30000, 10% lost BDT31000-40000 and 15% lost >BDT41000, respectively (Fig. 7).

3.5.3 Transportation sector

In every year, the transportation sector was severely affected by the flash flood. The result revealed that 84.37% of respondents told this sector was fully damaged and the rest of the respondents told this sector was partially damaged. Among these, 47.49% opined that village roads were submerged through floodwater, followed by roads were unsuitable to communicate (23.66%), unavailability of vehicles (28.85%), respectively. In contrast, 78.26% of respondents used boats to transport different goods, passengers and other necessary things followed by cart (15.39%) and van (6.35%), respectively.

3.5.4 Housing sector

Flooding affects people in a multitude of ways. The survey showed that majority of the respondents (74.44%) said that homestead area was damaged by the flood period every year, followed by the respondents said that animal husbandry (33.13%) and homestead garden (23.13%) were also damaged by the flood time in the study area.

3.5.5 Health sector

The flood-affected people suffered from different communicable diseases like diarrhoea, dysentery, skin problem, cold and fever, etc. In the study area, acute shortage of pure drinking water and lack of sanitation arrangements were responsible for waterborne diseases because most of the households used floodwater without proper purification or treatment. The study result showed that 98.13% respondents told cold, and fever was the most common disease during the flood, followed by diarrhoea (80.63%), typhoid (27.5%), dysentery (33.13%), and others (3.75%, such as pneumonia, malaria, etc. (Fig. 8).

3.5.6 Water and sanitation sectors

Most of the tube-well was submerged either partially or fully, river and pond water were polluted; as a result, safe water became scarce in rural Bangladesh during flood time. The survey found that most of the people used deep tube-well (88.13%) water before the flood as a source of drinking purposes. They also used river water (74.37%), rainwater (1.87%), and pond sand filter water (3.13%), respectively (Fig. 9). So, the drinking water crisis was increased post-flood period. The sanitation system also hampered during this time and increased water-borne diseases. The study also revealed that 73.56% of respondents were told, their sanitation system was destructed completely, followed by partially (21.44%) and not destructed (5%).

3.6 Coping Techniques to Flood

3.6.1 Capturing flood forecasting and warning system

Bangladesh Water Development Board (BWDB) is liable for flood management through structural and non-structural measures and provides hydrological services in Bangladesh. It has been providing flood forecasting and warning services through its Flood Forecasting and Warning Centre (FFWC). Each administrative level committee is ready to monitor it [1]. The result revealed 62% of people received warning before the flood and 38% did not receive it. The study found that among the warning received people 54.37% of respondents received the warning by mobile phone, followed by 41.87% from radio/TV, 41.25% from relatives and 13.75% from Upazila/Union Office, respectively (Fig. 10a).

3.7 Food Storing Status during the Flood Period

The prices of food increased during the flood and it deteriorated food consumption, especially for the rural poor both in quality and quantity, and eventually leads them to malnutrition and health problem. So, storing food is essential for the local people to adapt during the flood period. According to the survey result, 86% of respondents stored food and 14% of respondents did not store food during flood periods because they had no ability to adapt them for facing food scarcity. Among them, 85% of respondents claimed that they did not store any dry food, but they stored normal food (daily necessary foods), 30% stored dry food (chira, muri, gur etc.), 25% stored medicine and only 0.63% stored water for emergency need (Fig. 10b).

3.8 Post Water Purification Status

The study survey resulted that 34.55% of respondents drank water without purification during and after the flood, followed by 55.78% purified by boiling and 4.76% purified by using medicine or potash alum (Fig. 11). As a significant percentage of the respondents consumed water without purification process so, they suffered from various water-borne diseases.

3.9 Government and NGOs Initiatives for the Restoration of Flood-affected People

Government and NGOs play a vital role in the restoration of the flood-affected people in *haor* areas. Every year government provides recovery incentives for farmers, such as providing subsidized or free fertilizer and high yield seeds. They provide varieties of types of relief and commodities. The study result revealed that 76.87% of respondents said that the Government and NGOs took initiative immediately after the flood for the restoration of affected people and they received at least any one type of relief. The perception about sector wise initiatives is taken by the government and NGOs were tabulated below in the study area (Table 1).

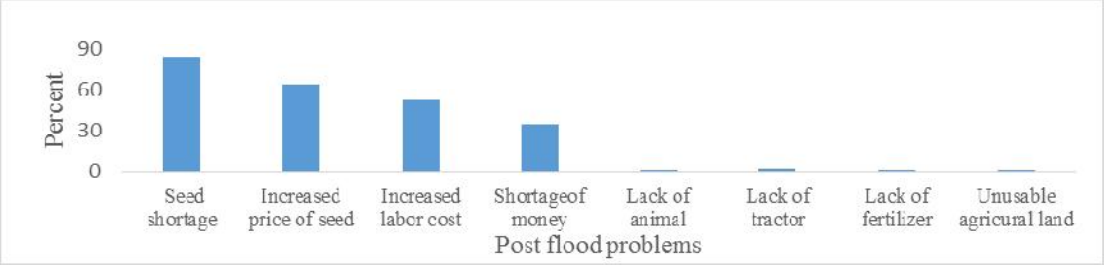

Fig. 6. Post-flood agricultural problems

Fig. 7. Annual financial losses due to flood

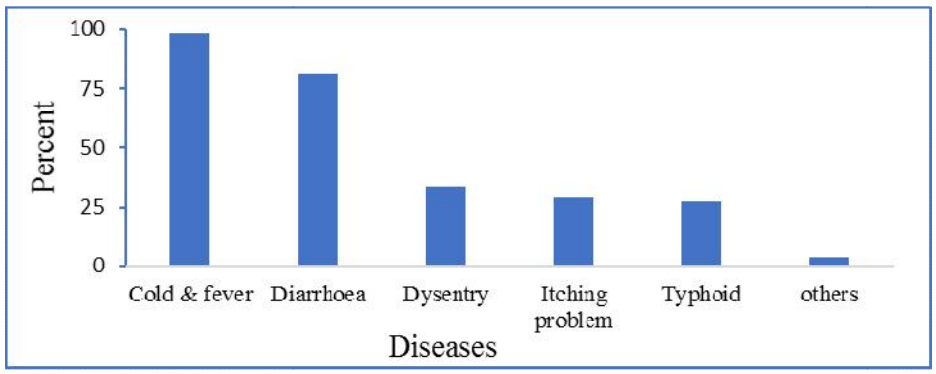

Fig. 8. Disease experienced during the flood

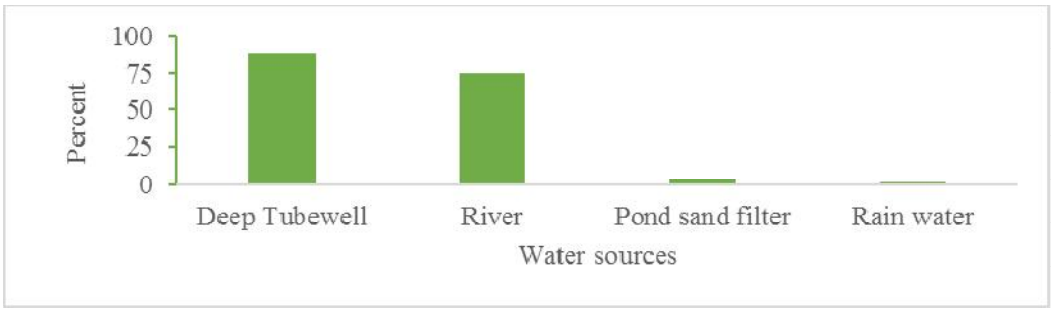

Fig. 9. Common water sources for household

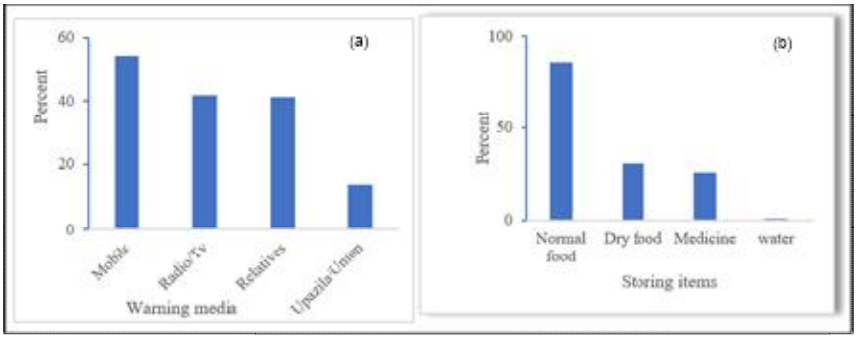

Fig. 10. Warning media for flood forecasting and food storing status

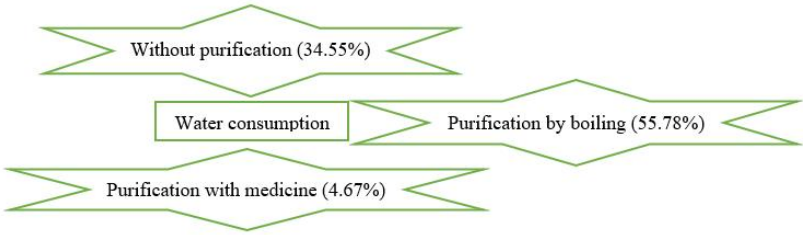

Fig. 11. Post-flood water purification system for consumption

Table 1. Government and NGOs initiatives for the restoration of flood-affected people

Government initiatives	Percent	NGO initiatives	Percent
Flood forecasting warning system	3.05	Introducing high yield crops	8.39
Low cost of food materials	5.34	Creating awareness	9.03
Distribution of relief	38.93	Introducing short duration hybrid rice	7.10
Increasing flood shelter	6.87	Homestead vegetable and species cultivation	1.94
Creating public awareness	3.44	Provide training	15.48
Provide loan at a low interest rate	3.05	Tube-well setup	17.42
Plan for long term development	3.05	Offering money as a loan	12.90
Tube-well setup	3.44	Embankment development	20.00
Embankment development	26.72	Offer domestic animals	7.74
Giving relief card	6.11		

4. CONCLUSION

The streams in the Tanguar *haor* are naturally flashy, low-lying topography with high annual rainfall and a flash flood occurs pre-monsoon period that is vulnerable to different sectoral impacts. The vast extent of water bodies and prolong the duration of submergence has made the area difficult for human settlement. Due to flash flood, a thousand hectors of agricultural land were destroyed, and the food crisis occurred around the *haor* basin area every year which led to negative impacts on national food security.

The study results showed that children and women were most affected during the flood time. So, proper health care and sanitation facilities should be ensured by installing sanitary latrines and tube wells. Moreover, this research demonstrated that about 90.23% of respondents totally and 9.77% of respondents partially lost their agricultural crops. About 83.75% of respondents faced seed problem and 63.75% of respondents faced the increased price of seed in the post period of the flood. Most importantly, about 84.37% of respondents told the transportation sector was destroyed and the communication was not possible without the boat and it was the largest sectoral impacts of floods. Therefore, it is essential to maintain transport system through the year and act carefully to minimize the lost. Hence, flood forecasting and

early warning were very important to reduce livelihood vulnerability. Long term record of impacts in different sectors can project the loss of future. So, this study can be helpful for the research of long-term flood impacts in different sectors. The flood cannot be fully controlled, prevented or eliminated, but damages should be reduced by taking preventive measures and co-ordination among different agencies or organizations. As climate change will have acute negative impacts on different sectors, short, medium and long-term initiatives would be taken to consider better livelihood and well-being for humans.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

ACKNOWLEDGEMENT

The authors acknowledge the anonymous reviewers for their valuable suggestions and comments that improved the quality of this research article. We are also in-depth with our gratitude to the local respondents as well as local leader and Department of Environmental Science and Disaster Management, Noakhali Science and Technology University, Bangladesh, to supply the necessary supports to accomplish the study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Choudhury MUI. Wetland-community Resilience to Flash Flood Hazards (Bonna) in Sunamganj District, Bangladesh, A Masters Thesis Submitted to University of Manitoba, Canada; 2015.
Accessed 22 January 2020.
Available:https://umanitoba.ca/institutes/natural_resources/pdf/theses/Choudhury,%20Mahed. MNRM%202015.pdf
2. Rahman MM, Sajib KI, Alam I. Impacts of Climate Change on the Livihoods of the People in Tanguar Haor, Bangladesh. Journal of Water Resource Engineering and Management; 2016. Accessed 3 February 2020;3(1):1-9.
Available:https://www.researchgate.net/publication/294909060_Impacts_of_Climate_Change_on_the_Livelihoods_of_The_People_in_Tanguar_Haor_Bangladesh
3. Paul SK, Routray JK. Flood Proneness and Coping Strategies: The Experiences of two Villages in Bangladesh. Disasters. 2010;34(2):489-508.
DOI: 10.1111/j.0361- 3666.2009.01139x
4. Hossain MS, Nayeem AA, Mazumder AK. Impact of Flash Flood on Agriculture Land in Tanguar Haor Basin. International Journal of Research in Environmental Science. 2017;3(4):42-45.
Accessed on 22 September 2019
Available: http://dx.doi.org/10.20431/2454-9444.0304007
5. Chakraborty TR, Adrika A, Hussain MB. Fish and Wildlife of the Chanda Beel Area. IUCN Bangladesh Country Office, Dhaka, Bangladesh. 2005;viii+:44.
Available:https://www.ilec.or.jp/ILBMTrainingMaterials/resources/Bangladesh.pdf
(Accessed on 22 December 2019)
6. GOB. Tanguar Haor Wetland. Biodiversity Conservation Project, Ministry of Environment and Forests. Government of the People's Republic of Bangladesh, Dhaka; 2004.
7. Alam ABMS, Badhon MK, Sarker MW. Biodiversity of Tanguar Haor: A Ramsar Site of Bangladesh Volume III: Fish. IUCN, International Union for Conservation of Nature, Bangladesh Country Office, Dhaka, Bangladesh. 2015;xii+216.
8. Albertsen JO. Biodiversity of Tanguar Haor: A Ramsar Site of Bangladesh, Waterbirds; 2012.
9. Alam A, Chowdhury M, Sobhan I. Biodiversity of Tanguar Haor: A Ramsar Site of Bangladesh Volume I: Wildlife. IUCN Bangladesh, Dhaka, Bangladesh. 2012;xi:234.
10. Banglapedia. The National Encyclopedia of Bangladesh. Asiatic Society of Bangladesh, Dhaka; 2012.
Accessed on 22 September 2019
Available:http://en.banglapedia.org
11. Gieson W, Rashid SMA. Management Plan for Tanguar Haor, Bangaldesh. NCSIP-1. Ministry of Environment and Forests. Bangladesh; 1997.
12. MOWR (Ministry of Water Resources). Master Plan of Haor Area. Bangladesh Haor and Wetland Development Board, Government of the People's

Republic of Bangladesh. Summary Report. 2012;1.
Accessed on 22 December 2020.
Available on https://dbhwd.portal.gov.bd

13. Salam MA, Khan MS, Sarker MAH. Impacts and Coping Techniques to Flood: A Case Study on Two Adjacent Char Land of Jamuna River in Sirajganj District, Bangladesh. International Research Journal of Environmental Sciences. 2019; 8(3):53-61.
Accessed on 10 February 2020
Available:http://www.isca.in/IJENS/Archive/v8/i3/7.ISCA-IRJEvS-2018-095.php
14. Khan MS, Abdullah S, Salam MA, Mandal TR, Hossain MR. Review Assessment of Biodiversity Loss of Sundarban. Indonesian Journal of Forestry Research. 2021;8(1):85-97.
15. BBS (Bangladesh Bureau of Statistics). Bangladesh Population and Housing Census, District Sunamganj. Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka; 2011. Accessed on 10 February 2020. Available:http://203.112.218.65:8008/WebTestApplication/userfiles/Image/District%20Statistics/Sunamganj.pdf.
16. Quasem MA. Conversion of Agricultural Land to Non-agricultural Uses in Bangladesh: Extent and Determinants Bangladesh Development Studies. 2011; XXXIV(1):59-85.
Accessed on 10 February 2020
Available:https://bids.org.bd/uploads/publication/BDS/34/34-1/04quasem.pdf
17. BBS (Bangladesh Bureau of Statistics). Bangladesh Household Income and Expenditure Survey. Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka; 2014. Accessed on 10 February 2020. Available:http://203.112.218.65:8008/WebTestApplication/userfiles/Image/District%20Statistics/Sunamganj.pdf.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/67982