engineering proceedings

MDPI

Proceeding Paper

A Study on the Effect of Flood Disaster That Occurred in 2022 on the People of North-East Part of Bangladesh †

Asraf Ibna Helal

Department of Statistics, Shahjalal University of Science & Technology, Sylhet 3114, Bangladesh; asraf16@student.sust.edu

† Presented at the 4th International Electronic Conference on Applied Sciences, 27 October–10 November 2023; Available online: https://asec2023.sciforum.net/.

Abstract: Bangladesh is characterized by its tropical climate and low elevation. Every year, this region is affected by flooding. The proximity of India adds another significant layer of complexity to this issue. Because India opens its switch gate during the rainy season, Bangladesh sees an increase in the amount of water that flows through the country. The area often has issues with flooding. In the year 2022, the residents of the north-east part of Bangladesh were put in a terrible position due to flooding. Therefore, one of our goals is to find factors associated with this flood disaster. In addition to this, one of our goals is to mitigate the negative impact that the flood had on the physical and emotional health of the people living in the north-east part of Bangladesh. This study also includes some demographic and socio-economic factors associated with this environmental disaster.

Keywords: environment; flood; disaster; physical health; mental health

Citation: Helal, A.I. A Study on the Effect of Flood Disaster That Occurred in 2022 on the People of North-East Part of Bangladesh. *Eng. Proc.* **2023**, *56*, 217. https://doi.org/10.3390/ASEC2023-16605

Academic Editor: Simeone Chianese

Published: 6 December 2023

1. Introduction

In South Asia, floods occur frequently, particularly in Bangladesh, where these cause a variety of losses [1]. Bangladesh is ranked sixth in the world as the nation most susceptible to flooding due to its topography and the negative effects of climate change [2]. Bangladesh has already experienced bad floods during the floods of 1988, 1998, 2004, and 2007 and is gradually becoming more susceptible to floods, not only due to changes in the environment but also due to the high-speed increase in residents in the coastal plains and the prevalent poverty that forces individuals to live in floodplains [3]. The tropical climate and low elevation of Bangladesh are its defining features [4]. The proximity of India contributes to the region's annual floods [5]. The north-east part of Bangladesh, which includes Sylhet, Sunamganj, and Netrokona Districts, is the main sufferer of flood disasters [6]. The amount of water flowing through Bangladesh increases during the rainy season as a result of India opening its switch gate [7]. Floods in 2022 put the people of Sylhet in a difficult situation. Poverty is a major factor in people's susceptibility to flooding, and frequent flood impacts contribute to an increase in poverty and, consequently, susceptibility [8]. In Bangladesh, floods in 1974, 1988, 1998, and 2017 killed approximately 4000 people and destroyed approximately 18 million kilograms of crops, according to previous research [9]. This overall condition highlights the vulnerability of Bangladesh's human sector to flooding. In densely populated regions with compact urban structures, flooding can also have devastating effects [10]. Bangladesh, a country with a low per capita income, suffers severe economic damage from floods. Human vulnerability refers to the physical, economic, social, and natural circumstances that make those who are exposed to hazards more vulnerable [11]. The process of identifying human vulnerability to flooding is not a novel topic of discussion due to the close relationship between location and people. Bangladesh is susceptible to four kinds of destructive flooding: river floods, precipitation floods, flash floods, and cyclone floods [12]. Heavy monsoon precipitation and thawing snow in the upper catchment areas of Bangladesh's main rivers cause river inundation [13]. Heavy precipitation in the

eastern and northern hill streams is the primary cause of flash flooding [14]. In April and May, when climatic shocks in the region are the most frequent, flash floods devastate the region and cause the collapse of flood protection infrastructures such as earthen dams and embankments, as well as inundating and destroying the developing paddy [15]. Bari et al., the quantity of rain that falls in the Sylhet region during the months of March and April (i.e., during the time of early flash flooding) is approximately three times the national average for the same time period. Geomorphologically, the region is situated between the northern Indian state of Meghalaya and the eastern Indian states of Assam and Tripura [16]. The terrain of the Haor region is significantly lower than that of the adjacent Indian region [17]. Thus, the haor belt not only obtains its own rainfall but also the runoff water from the aforementioned Indian catchments upstream [18]. Cherrapunji, a region of Indian Meghalaya, is one of the highest rainfall regions in the globe and is situated directly above the Haor region of Bangladesh that is only 30 km from the nearest Bangladeshi frontier, as seen from the air [19]. The temporal and spatial variability as well as the total rainfall that occur in the northeastern part of Bangladesh and its upstream Indian areas are crucial for analyzing the flood characteristics in the Haor region, but this issue has received no attention whatsoever [20]. The northeastern region of Bangladesh is prone to excessive rainfall. This region in Bangladesh is separate from others due to its hilly terrain and propensity for inundation [21]. Agriculture, fisheries, and the local economy were adversely affected by the floods caused by sudden rainstorms [22]. The objectives of this study are to lessen the harm that the floods do to the mental and physical health of the residents of this area and to understand the current economic environment and the parameters of the damage rate. The goals of this study are to determine the impact of the recent flood tragedy on the residents of the north-east and the economic loss experienced by locals.

2. Materials and Methods

Information was collected from various districts in the north-east of Bangladesh that were affected by the 2022 disaster. Approximately 416 data points were collected for this study. We used a Google Form and a manual document to collect the data.

Then the data were cleaned and processed for analysis using SPSS version 25. Descriptive statistics were performed to view the actual scenario of flood-affected people. Exploratory data analysis and a cross-sectional study were performed to find factors that are associated with flood disasters. The chi-square test from a cross-sectional study was used to fulfill our aims. This study also executed binary logistic regression to determine the factors that affected the flood disaster.

3. Result and Discussion

Table 1 shows the descriptive study of flood-effected people in the north-east part of Bangladesh. It gives an overview of the area affected by the flood in 2022. It shows that 81.5% of respondent's ages are less than 42, and 18.5% of respondents ages are greater than or equal to 42. The gender-wise percentages of male and female respondents are 76.9 and 23.1%, respectively. The study results show that 39.9% of respondents live in rural areas, and the rest live in urban areas. The percentage of people who live in urban areas is 60.1%, which means a huge portion of people live in urban societies. Additionally, it has been seen that floods affect 86.1% of people and cause 77.9% of property damage. Approximately half of the respondents could move to safe places during the flood. The percentage of people who suffered from hunger and received relief assistance is 58.7 and 34.6%, respectively. There are various diseases that affect about 30.3% of people, and the proportions of people who have watery diarrhea and those who do not are 4.8% and 25.5%, respectively. This flood disaster put a lot of respondents under mental strain. The percentage of people who suffered from lack of pure drinking water was 62.5%, and 25% of people got a water purification tablet.

Table 1. Descriptive analysis of variables related to flood-affected people.

Variables	Category	Frequency	Percentage
Age of respondents	Less than 42	339	81.5
	Greater than or equal to 42	77	18.5
Gender	Male	320	76.9
	Female	96	23.1
Marital Status	Married	238	57.2
	Unmarried	174	41.8
	Others	4	1.0
Area of Resident	Rural	166	39.9
	Urban	250	60.1
Monthly Family Income	0–10,000	84	20.2
	10,000–15,000	104	25
	15,000–20,000	68	16.3
	20,000–30,000	58	13.9
	30,000–50,000	70	16.8
	50,000+	32	7.7
Flood-affected/not	Yes	358	86.1
	No	58	13.9
Damaged by flood	Yes	324	77.9
	No	92	22.1
Moved to safe place/shelter	Yes	202	48.6
	No	214	51.4
Suffered from lack of food	Yes	244	58.7
	No	172	41.3
Received relief assistance	Yes	144	34.6
	No	272	65.4
Got any disease	Yes	126	30.3
	No	290	69.7
Type of disease	No disease	290	69.7
	Watery Diarrhea	20	4.8
	Others (fever, cough, cold etc.)	106	25.5
Mentally pressured	Yes	384	92.3
	No	32	7.7
Having children in family	Yes	204	49
	No	212	51
Got children disease	Yes	82	19.7
	No	334	80.3
Type of child disease	No disease	334	80.3
	Watery Diarrhea	20	4.8
	Others (fever, cough, cold etc.)	62	14.9
Suffered from lack of pure drinking water	Yes	260	62.5
	No	156	3705
Got water purification tablet	Yes	104	25
	No	312	75

Table 2 shows the cross-sectional study result, which is the chi-square test result. This interprets the associated factors with the flood disaster. The chi-square test revealed

that eight variables have p-values that are less than 0.05. The variables are damaged by flood, moved to safe places or shelters, suffered from lack of food, received relief assistance, experienced mental pressure, had children with diseases, suffered from lack of pure drinking water, and got a water purification tablet. These variables have a significant association with flood disasters. This means that these variables have a significant effect on flooding. Unfortunately, any disease has no association with flooding because the p-value (0.084) of the variable is greater than 0.05. Further, a binary logistic regression model with these associated variables was performed. The result is given in the below tables.

Table 2. Chi-square test result.

Factors		Flood Affected/Not		Chi-Square Value	*p*-Value
		Yes	No		
Damaged by flood	Yes	320	38	197.180	0.000
	No	4	54		
Moved to safe places/shelter	Yes	194	164	32.609	0.000
	No	8	50		
Suffered from lack of food	Yes	234	124	47.662	0.000
	No	10	48		
Received relief assistance	Yes	138	220	17.541	0.000
	No	6	52		
Got any disease	Yes	114	244	2.941	0.086
	No	12	46		
Mental pressure	Yes	350	8	107.713	0.000
	No	34	24		
Got children disease	Yes	80	278	11.264	0.001
	No	2	56		
Suffer from lack of pure drinking water	Yes	260	98	112.328	0.000
	No	0	58		
Got water purification tablet	Yes	96	264	4.514	0.034
	No	8	50		

Tables 3 and 4 show the results of the binary logistic regression model. Table 3 demonstrates the omnibus test results. Omnibus tests of the model coefficient are used to test the model fit. If the model is significant, this shows that there is a significant improvement in fit as compared to the null model. Hence, the model shows good fit.

Table 3. Omnibus test results of binary logistic regression model.

Omnibus Tests of Model Coefficient				
		Chi-Square	**df**	**Sig.**
Step 1	Step	236.444	8	0.000
	Block	236.444	8	0.000
	Model	236.444	8	0.000

Table 4. Hosmer and Lemeshow test result of binary logistic regression model.

Hosmer and Lemeshow Test			
Step	**Chi-Square**	**df**	**Sig.**
1	6.402	8	0.602

Table 4 reveals the Hosmer and Lemeshow results for a test of model fit. The Hosmer and Lemeshow statistics indicate a poor fit if the significance value is less than 0.05. The model adequately fits the data. There is no difference between the observed and predicted models. Finally, the model interprets that these associated variables have an impact on flood-affected people.

Then, the study conducted one-way ANOVA to find area-wise variation of flood-affected people. The result is given below.

Tables 5 and 6 show the results of a one-way ANOVA between flood-affected and non-flood-affected areas of residence, which is used to find the area-based variation in living of flood-affected people. ANOVA (Table 5) shows that the test is statistically significant (p-value=0.05). Table 6 reveals there is a significant mean difference between rural and urban flood disasters; the mean of rural areas' flood disasters (0.06) is greater than the mean of urban areas' flood disasters (0.19). This means that urban areas are most affected by flooding.

Table 5. ANOVA table for one-way ANOVA.

ANOVA					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig**
Between groups	1.732	1	1.732	14.881	0.000
Within groups	48.182	414	0.116		
Total	49.913	415			

Table 6. Descriptive analysis table for one-way ANOVA.

	N	**Mean**	**Std. Deviation**	**Std. Error**	**95% CI for Mean**	
					Lower Bound	**Upper Bound**
Rural	166	0.06	0.239	0.019	0.02	0.10
Urban	250	0.19	0.395	0.025	0.14	0.24
Total	416	0.14	0.347	0.017	0.11	0.17

4. Conclusions

In the conclusion, the findings show precise descriptive studies about the peoples of the north-east part of Bangladesh who were affected by the flood in 2022. They have given an overview of the flood disaster and flood-affected people. Most of the flood-affected people lived in urban areas in those districts of Bangladesh. The study includes eight significant variables associated with the flood disaster. Those who were damaged by floods moved to safe places or shelters, suffered from lack of food, received relief assistance, suffered from mental pressure, got children's diseases, suffered from lack of pure drinking water, and got water purification tablets. The outcome of this research has shown that these variables have a significant impact on flood-affected people and that the urban area is more affected by flooding than the rural area.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data sharing is not applicable due to privacy.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Douglas, I. Climate change, flooding and food security in South Asia. *Food Secur.* **2009**, *1*, 127–136. [CrossRef]
2. Agrawala, S.; Ota, T.; Ahmed, A.U.; Smith, J.; Van Aalst, M. *Environment Directorate Development Co-Operation Directorate Working Party On Global And Structural Policies Working Party On Development Co-Operation And Environment Development And Climate Change In Bangladesh: Focus On Coastal Flooding And The Sundarbans*; OECD: Paris, France, 2023.
3. Alam, M.; Rabbani, G. Vulnerabilities and responses to climate change for Dhaka. *Environ. Urban.* **2007**, *19*, 81–97. [CrossRef]
4. McGranahan, G.; Balk, D.; Anderson, B. The rising tide: Assessing the risks of climate change and human settlements in low elevation coastal zones. *Environ. Urban.* **2007**, *19*, 17–37. [CrossRef]
5. Marmulla, G. *Dams, Fish and Fisheries: Opportunities, Challenges and Conflict Resolution*; FAO: Roma, Italy, 2001.
6. Hossain, S. Flood Damage and Risk Assessment Model in the Haor Basin of Bangladesh. Master Thesis, Bangladesh University of Engineering & Technology, Dhaka, Bangladesh, 2013.
7. Mainuddin, M.; Karim, F.; Gaydon, D.S.; Kirby, J.M. Impact of climate change and management strategies on water and salt balance of the polders and islands in the Ganges delta. *Sci. Rep.* **2021**, *11*, 7041. [CrossRef] [PubMed]
8. Philip, D.; Rayhan, M.I. *Vulnerability and Poverty: What Are the Causes and How Are They Related?* Center for Development Research (ZEF), University of Bonn: Bonn, Germany, 2004.
9. Masum, J.H. *Climatic Hazards in Bangladesh—A Literature Review*; Coastal Development Partnership (CDP): Dhaka, Bangladesh, 2019.
10. Kreimer, A.; Arnold, M.; Carlin, A. *Bank, Building Safer Cities The Future of Disaster Risk*; World Bank Publications: Washington, DC, USA, 2003.
11. Brooks, N. Vulnerability, risk and adaptation: A conceptual framework. *Tyndall Cent. Clim. Chang. Res. Work. Pap.* **2003**, *38*, 1–6.
12. Simonović, S.P. *Floods in a Changing Climate: Risk Management*; Cambridge University Press: Cambridge, UK, 2012. [CrossRef]
13. Ghazi, T.W.; Muniruzzaman, A.N.M.; Singh, A.K. *Climate Change & Security in South Asia Cooperating for Peace*; Institute for Environmental Security: The Hague, The Netherlands, 2016.
14. El Afandi, G.; Morsy, M.; El Hussieny, F. Heavy Rainfall Simulation over Sinai Peninsula Using the Weather Research and Forecasting Model. *Int. J. Atmos. Sci.* **2013**, *2013*, 11. [CrossRef]
15. Islam, T. Performance of Ecological Revetment in Haor Areas of Bangladesh. Master's Thesis, Department of Civil Engineering, Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh, 2021.
16. Al-Hussain, S.J. Identification of Drought and Flood Induced Critical Moments and Coping Strategies in Hazard Prone Lower Teesta River Basin. Master's Thesis, Rajshahi University, Rajshahi, Bangladesh, 2017.
17. Sikder, M.T.; Elahi, K.M. Environmental Degradation and Global Warming-Consequences of Himalayan Mega Dams: A Review. *Am. J. Environ. Prot.* **2013**, *2*, 1–9. [CrossRef]
18. Rahman, M.; Ningsheng, C.; Mahmud, G.I.; Islam, M.; Pourghasemi, H.R.; Ahmad, H.; Habumugisha, J.M.; Washakh, R.M.A.; Alam, M.; Liu, E.; et al. Flooding and its relationship with land cover change, population growth, and road density. *Geosci. Front.* **2021**, *12*, 101224. [CrossRef]
19. Sinha, V.R.; Golan, M.M. *Benefit Sharing Opportunities in the Meghna Basin: Profile and Preliminary Scoping Study Bangladesh and India*; IUCN: Bangkok, Thailand, 2018.
20. Dey, N.C.; Parvez, M.; Islam, M.R. A study on the impact of the 2017 early monsoon flash flood: Potential measures to safeguard livelihoods from extreme climate events in the haor area of Bangladesh. *Int. J. Disaster Risk Reduct.* **2021**, *59*, 102247. [CrossRef]
21. Khalequzzaman, M. Recent floods in Bangladesh: Possible causes and solutions. *Nat. Hazards* **1994**, *9*, 65–80. [CrossRef]
22. Poncelet, A.; Gemenne, F.; Martiniello, M.; Bousetta, H. A country made for disasters: Environmental vulnerability and forced migration in Bangladesh. In *Environment, Forced Migration and Social Vulnerability*; Afifi, T., Jäger, J., Eds.; Springer: Berlin/Heidelberg, Germany, 2010; pp. 211–222. [CrossRef]