BILINGUAL PUBLISHING GROUP

Journal of Geographical Research

https://journals.bilpubgroup.com/index.php/jgr

ARTICLE

Coping Measures and Social Capital in Offsetting Effects of an Estuary Flash Flood in Bangladesh: A Case Study

***Munshi Khaledur Rahman*[1*], *Bimal Kanti Paul*[2], *Mohammad Farhad Hossain*[3]**

[1] *Department of Geosciences, Georgia Southern University, Statesboro, GA 30458, USA*

[2] *Department of Geography and Geospatial Sciences Kansas State University, Manhattan, KS 66506, USA*

[3] *Noakhali Govt. Mohila College Noakhali, Maijdee 31 3800, Bangladesh*

ABSTRACT

The northern, northeastern, and southeastern parts of Bangladesh are highly susceptible to the impacts of flash flooding. Beyond these typical areas, flash floods also occur in the coastal areas of the country. The objective of this paper is to examine the ways residents of a coastal area have coped with the impacts of the flash flood event that took place on 5 August 2020 in 26 villages of Kamalnagar and Ramgati upazilas in the Lakshmipur district, Bangladesh. A household survey conducted in these villages revealed that nearly 83% of the respondents adopted two of the six broad groups of coping measures to recover from the impacts of the 2020 flash flood event. Unlike flash floods in typical areas, the survivors in the study area did not receive any emergency assistance either from local/national governments or NGOs, creating a cause of anger among the flash flood survivors. They offset the event effects largely by social capital through social networks and social relations. This study concludes that the government of Bangladesh should have effective policies to reduce the impacts of coastal flash flooding.

Keywords: Flash flood; Coping measures; Social capital; Riverbank erosion; Coastal Bangladesh

1. Introduction

Flash flooding is a recurrent natural hazard during pre-monsoon (April–May) and monsoon (June–September) seasons in Bangladesh. They are particularly prevalent in the northern transboundary foothills

*CORRESPONDING AUTHOR:
Munshi Khaledur Rahman, Department of Geosciences, Georgia Southern University, Statesboro, GA 30458, USA; Email: mkrahman@georgiasouthern.edu

ARTICLE INFO
Received: 6 February 2024 | Revised: 24 February 2024 | Accepted: 27 February 2024 | Published Online: 13 March 2024
DOI: https://doi.org/10.30564/jgr.v7i1.6249

CITATION
Rahman, M.K., Paul, B.K., Hossain, M.F., 2024. Coping Measures and Social Capital in Offsetting Effects of an Estuary Flash Flood in Bangladesh: A Case Study. Journal of Geographical Research Research. 7(1): 1–17. DOI: https://doi.org/10.30564/jgr.v7i1.6249

as well as in the hilly areas of the northeastern and southeastern parts of the country [1,2]. Among the 64 districts, at least 15 comprise the traditional or typical areas of flash flooding.① Although flash floods are generally short-lived and localized events, roads, houses, shops, and schools are inundated overnight and the flooding often causes massive damage to private property. Flash floods also breach embankments, particularly offshore islands in Coastal Bangladesh [3,4]. In the traditional areas of flash floods, they can cause loss of flood attenuation capacity of major rivers, which further intensifies if the events are associated with landslides and mudflows [5].

Although various aspects of flash flooding in the traditional areas of Bangladesh have been widely studied [1,3,6–11], little or no attempt has been made to deal with such events in coastal (non-traditional) areas. The present study addresses this research gap with the main purpose of investigating the ways in which residents of the selected coastal area have coped with the impacts of the August 2020 flash flood event, which occurred in 12 unions and covered 26 villages of Kamalnagar and Ramgati upzillas in Lakshmipur district, Bangladesh.② We expect that the residents of traditional and coastal/estuary areas will respond differently to offset the damage and loss caused by such events. Flash floods in the former areas, particularly in the low-lying haor (vast wetland) areas of northeastern Bangladesh, cover much larger surface areas compared to the latter areas [11].③ For example, Mahtab et al. [8] reported that 74.1 square miles (192 square km) of land were inundated in Tahirpur upazila, Sunamganj district due to a flash flooding event that occurred on May 4, 2017. In that year and date, parts of 11 upazilas of this district experienced this event [10]. Note that in 2017, three episodes of severe flash floods affected six districts (Sylhet, Moulavibazar, Sunnamganj, Habigang, Netrokona, and Kishorganj) of the haor areas of the country from June to September [2].

In the absence of empirical studies, an understanding of coping strategies would help in developing appropriate public policies toward providing emergency support and protecting the livelihoods of vulnerable people living in coastal and estuary areas in Bangladesh. Flash flood waters can also cause varied and substantial health impacts (e.g., diarrheal illnesses like cholera, typhoid fever, tetanus, skin diseases, or rashes). This understanding is also essential because the Intergovernmental Panel on Climate Change (IPCC) predicted that the frequency of flash floods in the coastal areas of the country will increase because of increased precipitation from global warming [12]. The study provides local insights for reducing the adverse impacts of future flash floods in the coastal areas in Bangladesh and beyond. Moreover, it helps to establish policies related to reducing flash flood vulnerability and thus improve individual and community resilience.

The paper is organized as follows. Section 2 reviews the literature on coping measures in general with components of social capital. Section 3 presents the justifications for why it is called a flash flooding event. Section 4 discusses the study area and data source. Section 5 presents the results of this study with three sub-sections: households' characteristics, damage caused by flash flooding, and coping measures adopted by respondents. This section is followed by a discussion section. The concluding section summarizes the results and provides recommendations.

2. Cope with natural disasters: Types and links to social capital

Coping with natural disasters generally means fully or partially overcoming the adverse consequences of extreme events. This includes short-term and immediate responses and measures of affected individual households [13,14]. By implementing these measures, they generally utilize their own resources and assets, and/or receive external financial assis-

① A district is the second largest administrative unit in the country, containing an average population of about 2.5 million.

② A union is the lowest tier of the local government structure in Bangladesh. It has an average population of 35,000. An upazila is the third largest administrative unit in Bangladesh with an average population of nearly 325,000.

③ Haors cover around 43% land area in the northeastern part of Bangladesh. This part of the country contains 414 haors with sizes varying between 1,804 and 60,027 acres [10]. They are located across seven districts: Sunamganj, Sylhet, Habiganj, Maulavibazard, Netrokona, Kishorganj, and Brahmanbari [2].

tance, including members of social networks. Coping measures are essential to prepare for quick recovery and return to pre-disaster conditions through access to resources within and beyond the disaster-stricken area [15]. These measures are broadly classified into two groups: ex-ante (proactive) and ex-post (reactive) [16]. The former includes risk reduction and risk mitigation strategies, which are enacted by the individuals or households before disaster strikes them (e.g., raising and maintaining the plinth of the house, building the home on a natural level, modifying the house with strong materials, clearing both sides of the hilly rivers so that the water can quickly recede without any barrier, or removing other hindrances from the bed of the river) [16–19].

Ex-post coping measures refer to recovering as quickly as possible from the negative impacts of a natural disaster during the post-event period. Kerr [20] claimed that these measures have also a strong linkage in building resilience at both household and community levels [15,21]. In essence, they help disaster survivors restore their livelihoods following calamity [22]. Like most coping studies, this paper deals with ex-post coping measures. Sultana and Rayhan [23] and Mondal et al. [19] classified ex-post measures into five broad groups: namely, money borrowing, asset disposal, consumption reduction, temporary migration, and essential assistance/aid from external sources. We also add one group—changing occupation (**Table 1**). As indicated, apart from disaster-affected households themselves, ex-post measures are also financed by members of traditional social networks, or nongovernmental organizations (NGOs) at various levels and government organizations (GOs). Note that social networks are made up of a set of social actors such as individuals (e.g., relatives, friends, and neighbors), and they can be thought of as potential sources of resources in times of need. In essence, social networks are relationships that develop between individuals and/or groups through familiar ties, friendship, similar interests and beliefs, organizational life, and/or other types of social connection [13,25].

When households become successful in ex-post coping measures, it is often considered a sustainable livelihood (SL) because these measures ensure subsistence levels of food consumption, the potential for

Table 1. Broad group coping measures with specific measures and remarks.

Group	Specific measure	Remark
Money Borrowing/ Taking Loan	Formal sources (banks, micro-credit organization and local co-operatives	With interest rates ranging from medium to high
	Informal sources (local money lenders)	Very high interest rate
	Members of social capital (e.g., relatives, friends, and neighbors)	Either interest free or nominal interest rate
Assets disposal	Selling crops in advance	To repair houses, boats, and fishing nets; and purchasing food, health expenses, and livestock fodder
	Purchasing food on credit	
	Selling livestock at liquidation price	
	Selling or leasing household assets (utensils, jewelry, lands, crops, agricultural tools, and trees) at liquidation price	
	Spending previous savings	
Consumption Reduction/Changing habits	Meal skipping (reducing food consumption) or fewer meals	To compensate reduction in crop production
	Relying on cheap foods (reducing expenditure)	
	Consuming wild plants and foods (reducing expenditure)	
Changing occupation	One or member change occupation	To survive
Migration	Both temporary and permanent	To diversify income
Emergency help from external sources	Support receiving from NGOs	
	Support receiving from GOs	
	Support receiving from social networks	

Source: Modified after Mondal et al. [19].

income-generating capacity through permanent employment, and opportunities for a diversified livelihood [16,26]. Developed by the British Department for International Development (BDFID) in 1997, central to the Sustainable Livelihood Framework (SLF) are various livelihood assets and access to these resources [27,28]. These assets consist of five capitals (human, financial, physical, natural, and social), which exist at the individual household and community levels [29]. Some of these capitals, particularly social capital, are realized as the social capability and capacity to cope with disasters or other stressful conditions.

In this paper, our interest is on individual households and our focus is primarily on social capital along with financial capital.④ In the context of disaster, social capital is generally defined "as social trust, networks, and relationships that people can draw upon." [30]. It reflects disaster-affected households' social networks and relationships with members of the community and beyond that they can use in times of need [31,24]. Robert Putnam, who popularized the concept, defined social capital broadly as the "features of social organizations, such as networks, norms, and trust that facilitate action and cooperation for mutual benefit" [32].

Components of social networks or social safety nets include strong social norms, social connections, emotional bonds, high levels of interpersonal trust, and social and religious organizations that help individual households in their efforts to cope and resiliency with extreme natural events quicker and more efficiently. Components of financial capital include cash, credit, remittance, pension, wage, or liquid assets (e.g., land, livestock, poultry, utensils, savings, and jewelry) [28]. It is worth mentioning that individual and household social capital are of three types: bonding, bridging, and linking networks [33,34]. Each type identifies variations in the strength of relationships and composition of social networks and thus different outcomes for individuals or households.

Bonding social capital describes the connections among individuals who are emotionally close, such as family members, kinship ties, and close relatives within the same community and beyond [34]. The strong connection makes this type of social capital a key source for providing social support and personal assistance during the post-disaster period or any other shock [35]. In contrast, a bridging network includes acquaintances or individuals loosely connected that span social groups, such as neighbors, colleagues, associates, and friends [36]. This network links various heterogeneous individuals and groups [34]. Members of both networks provide disaster emergency assistance (e.g., hot meals, clothing, utensils, furniture, and loans for constructing damaged houses), medical assistance, sanitation, shelter, and help in search and rescue (SAR) operations, debris removal, and childcare. Bonding and bridging social capital work in complementary ways but disaster-affected households regularly have more of one type than the other [37].

Linking networks, which are developed over time, describe individual or household vertical connections with various levels of NGOs and GOs, mass media, or can be friends/acquaintances with anyone with these organizations [36,38]. The term NGO is broadly defined here to include all religious, political, and nonprofit organizations as well as civil society organizations. Memberships with such organizations improve one's chance of receiving necessary emergency assistance promptly because these organizations often provide humanitarian assistance solely to individuals within their jurisdiction [33,36,39]. Therefore, membership in these organizations is essential for reducing the negative impacts of any type of natural disaster [40]. Linking networks provide vertical integration, while the other two components of social capital represent horizontal integration. Additionally, members of the linking networks are more likely to articulate their needs to authorities of such organizations and work together to overcome obstacles in efforts to return life to pre-disaster levels [41].

In contrast, individuals and households who are not members of any NGO are less likely to receive assistance from such organizations [40,42]. Thus, disasters can motivate survivors of extreme events to

④ Social capital was first proposed by Pierre Bourdieu (1985) [60] in the 1980s and claimed that an individual could have more accessibility to potential because of his/her social networks.

participate in civil society organizations. Whether or not members of these organizations, survivors expect to access government and nongovernment assistance immediately after a disaster [40]. This access is clearly a coping measure for a household in rural Bangladesh and elsewhere in developing countries [43]. In the absence of emergency assistance provided by NGOs and GOs, the other two group members of social capital/networks contribute to coping measures of disaster-affected households.

3. Was the 2020 August event considered a flash flood?

Bangladesh is subjected to different types of floods such as river (often called the monsoon) floods, tidal or coastal, flash, and tropical cyclones-induced storm-surge floods [44,45] ⑤ A precise definition of flash floods is problematic and frequently debated (e.g., [46–49]. Flash floods are caused by excessive rainfall in a short period of time with a small lead time and very limited warning time. They generally occur within two to six hours of heavy rain, and water levels can rise and fall rapidly and quickly, leading to extensive damage to properties [1,50].

In the traditional flash flood-prone areas of Bangladesh, the events also occur due to sudden enormous rainfall. Most of the rivers in these areas originate from nearby hilly regions of India and Myanmar, and when excessive rainfall takes place beyond the international border, flash floods can occur in the country's traditional areas with some lags of 8–20 hours.⑥ If heavy and continuous rain falls for 1 to 2 hours within the basin located in the country, flash floods can occur, particularly in southeastern hilly areas. Thus, an enormous amount of rainfall in a relatively short time beyond and within Bangladesh is the imminent cause of flash floods in traditional areas of the country [1,2,5,16].

Unlike typical flash flood-prone areas of Bangladesh, the coastal zones in the country are affected by diurnal high and low tides. Apart from storm surges associated with tropical cyclones, the study area frequently experienced sudden tidal surges, particularly when coincided with high tide with a full moon and strong wind. We, some respondents, and union and upazila officials considered tidal surge as a flash flood event. To make sure that August 2020 was a flash flood event, we explored the perceived causes of the event provided by the respondents of the study area. Field survey reveals that 98% and 51% of respondents provided primary (main or ultimate) and secondary reasons for the event, respectively.⑦ Primary reasons are listed in descending order: tidal surge, lack of embankment, upstream water, close to the river, heavy rainfall, and strong wind (**Figure 1**).⑧ Among the six primary reasons, three (upstream water, lack of embankment, and tidal surge) were also mentioned as a secondary reason for the event (**Figure 1**).

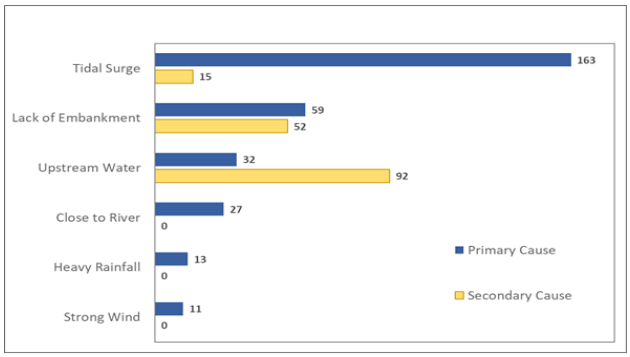

Figure 1. Respondents' perceived causes of flash flooding in the study area.

Five respondents did not provide a cause for the August 2020 flash flooding in the study area and nearly half of the respondents provided both primary and secondary causes of the event. The area has no embankment along the east bank of the Lower Meghna River, which has a long-time demand from the local people. The reason "close to the river" indirectly implies that demand. On rush of water from

⑤ The main source of river floods is the bank overflow from the major rivers, and their tributaries and distributaries during the rainy season [61].

⑥ Bangladesh is a riverine country. Among the major rivers of the country, 54 rivers flow directly from India and 3 from Myanmar [61].

⑦ In some cases, a secondary cause exacerbates the primary cause, but independently it is insufficient to lead to a catastrophic event by itself.

⑧ Two respondents mentioned full moon was the cause of the very high tide on August 5, 2020. Almost all major rivers in Bangladesh flow into the Bay of Bengal. The study area is located along the eastern (right) bank of the Lower Meghna River, the main outlet of the Ganges-Brahmaputra-Meghna (GBM) drainage basin, a transboundary river basin. By upstream water, the respondents referred to the water of this basin.

the upstream was also reported by a considerable number of respondents as both primary and secondary reasons for the flash flood in the study area.

However, only 13 (4%) out of 310 respondents reported that excessive rainfall was the primary cause of flash floods in the study area. No respondents mentioned it as a secondary reason for the event. Conversations with elected union officials informed that immediately before the flash flood event, continuous rainfall occurred for about two days in the local area. This excessive rainfall together with the synchronization of unusually high tides in the nearby river, strong wind, and onrush of water from the upstream were the major causes of flash floods in the study area. Local people said that the tide was abnormally high due to a full moon and/or was accompanied by strong wind.

Based on respondents' reported causes of flash flooding, no concluding evidence was found within the study area. That is why four key physical characteristics of the event (duration, areal extent, speed of onset, and spatial dispersion) along with their dichotomic scales are briefly discussed. These selected characteristics are presented in **Table 2** and compared (regular or monsoon) floods with flash flood events. The event in the study area suddenly occurred (speed of onset) and lasted between 2 to 5 days (duration) [1], claimed that flash floods in the villages in Cox's Bazar district, southeastern Bangladesh, typically remain inundated for 5–12 hours, although sometimes up to 2 to 4 days.

Table 2. (River) floods and flash floods are compared with four physical characteristics of natural disasters and a two-dimensional scale.

Physical characteristic	Two-dimension scale	(River) Flood	Flash flood
Speed of onset	Slow	X	
	Fast		X
Duration	Long	X	
	Short		X
Areal extent	Widespread	X	
	Limited		X
Spatial dispersion	Diffuse	X	
	Concentrated		X

Source: Modified after Burton et al. (1993) [51].

In contrast, other flooding, particularly river flooding, is a longer-term event and may last 15 to 20 days in Bangladesh. **Table 3** lists major (river) floods in the country with duration. Flash floods also differ from other type of floods in spatial scale (spatial extent). They inundate a small area, confining to less than 20 square miles (51.8 square km) of drainage area in the United States [52]. In the Mediterranean region, flash floods inundate up to 1,150 square miles (nearly 3,000 square km) [53]. Spatial extent reflects spatial dispersion (**Table 2**). Based on suddenness, duration, areal extent, and spatial dispersion, it is considered a flash flood event.

Table 3. Duration of major (river) floods in Bangladesh.

Year	Duration (in days)
1987	60
1988	53
1998	63
2004	28
2020	35
Average	15-25

4. Materials and methods

4.1 Study area

As indicated, the study area is located along the eastern bank of the Lower Meghna River in the central coastal zone of Bangladesh where rapid geomorphological changes have been taking place [54]. Note that Bangladesh's 447 miles (720 km) of coastline is broadly divided into three zones: the southwest, central, and eastern. These zones differ in geomorphological and ecological conditions [54]. This vast active delta zone is subject to recurrent erosion and deposition of sediments carried out by the combined flow of the three mighty rivers (Ganges or Padma, Brahmaputra or Jamuna, and Meghna) from upstream. The study area covers 30 square miles (78 square km) and had approximately 93,000 people in 2011 (**Figure 2**). As a part of the Meghna estuary, it is characterized by low elevation and rapid geomorphological changes.

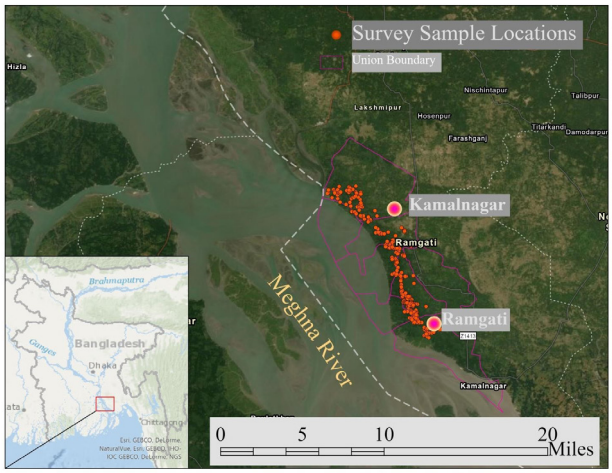

Figure 2. Study area.

This estuary is the most productive fishing ground in Bangladesh. Expectedly, fishing is one of the primary occupations of people living in the study area, and the secondary occupation of many more residents. Most people engaged in agriculture are marginal farmers [58]. Like in other coastal zones of Bangladesh, the poverty rate in the study area is at least 40% higher than the national average. Similarly, access to education, health, and other basic services in the study area is lower than the national average [53]. With a National Science Foundation (NSF) grant, we conducted a field survey in 2018 just south of the current study site to analyze migration patterns of people due to riverbank erosion. Familiarity with the general area and the occurrence of flash floods in 2020 were the two reasons for selecting this survey location.

The study area experiences multiple hazards such as tropical cyclones and associated storm surges, riverbank erosion, riverine floods, and tornadoes. Field survey reveals that flash flooding occurs more frequently and is often more destructive than other natural disasters. If conditions coincide to initiate flash flooding, water rapidly rushes from the estuary through canals and small rivers, causing erosion of riverbanks, and inundating adjacent settlements and croplands. The 2020 flash flood occurred in the study area on August 5 and lasted 2–5 days. In some waterlogged portions in the eastern part of the area, it stayed even longer. The study area also experienced tidal surged-induced flash floods in the first week of September and August 2021.

4.2 Sources of data

A total of 310 household heads participated in the questionnaire survey through spatial random selection using the ArcGIS Pro tool. Large-format field maps were produced to aid field navigation and household recruitment. Mainly household heads from selected sampling households were surveyed, but another adult member was interviewed when the household head was not available at the time of the survey. If a household head declined participation, enumerators approached the next nearest household. The survey was conducted in the selected villages by four experienced field investigators supervised by two project leaders during May and June 2021. They had participated in many household surveys in the past. For this survey, the authors provided training to the investigators through Zoom.

However, the questionnaire contained 66 questions—some were open-ended, and others were closed-ended. In addition to damage caused by the flash flood, emergency assistance received from different sources, and coping measures used to reduce the impact of the event, the survey collected data related to households' socio-economic and demographic characteristics. Household surveys were complemented by field observations and notes, and several informal discussions were arranged with respondents, village leaders, schoolteachers, other local professionals, and local NGO and GO officials.

Before conducting the surveys, the respondents were informed regarding the purpose of the study and asked whether they would like to participate. The interview was conducted after receiving the verbal consent from the respondents. The study was approved by the Institutional Review Board (IRB) of Southern Georgia University. The collected data were then coded and stored in an Excel file.

5. Results

5.1 Households' characteristics

Age

This sub-section discusses the household char-

acteristics. The ages of the household heads ranged from 20 to 90 years, with mean and median age of 48.76 and 47 years, respectively. Out of 310, 116 or 37% of all heads belonged to the age group 35–49 years of age (**Table 4**). Slightly over 95% of the sampled households were male-headed. The average household size was nearly 5.1 persons, which was higher than the national average (4.4 people).

Occupations

Agriculture and fishing were the dominant forms of livelihood options in the study area. Dependency on agriculture and fishing is not surprising in coastal areas in Bangladesh [31,54,55]. Fishing not only involves catching fish, but also includes people who are working as day laborers on others' boats, marketing fish, and making nets and boats. Another 8% are employed in both agriculture and fishing. That is, 64% of the heads of households are employed in these two sectors. Other primary occupations were service holders (14%), small business owners (9%), and agricultural laborers (6%). The rest were employed in other occupations, including homemakers (**Table 4**).

Landholding size

Sixty-one percent of households in the study area did not have any agricultural lands, which was not unusual because landlessness is much higher in the coastal areas compared to the country [54]. They made a living either as tenant farmers or entirely in the fishing sector. Usually, tenant farmers, after harvesting crops, give two-thirds of the produce to landowners. Some landless people also cultivated

Table 4. Selected background information of the respondents (N = 310).

Background information	Number	Percentage
Age (in years)		
20–34	48	14
35–49	116	37
50–64	96	31
> 64	50	16
Primary occupation		
Farmers	83	28
Fishing	83	28
Both farmers and fishers	23	8
Service holders	40	14
Small businesses	26	9
Laborers	18	6
Others, including home makers	20	7
Agricultural land owned (in decimal)		
Landless	190	61
< 100	81	26
100 and above	39	13
Annual household income (in BD Takas)		
< 100,000	199	64
100,000–250,000	105	34
> 250,000	6	2
Educational level (years of schooling)		
Illiterate	80	26
1–5	214	69
> 5	16	5

agricultural lands under the 'kot' system. The kot system provides money to needy landowners and allows their land to be cultivated by landless farmers until the money returns from the landowners to the farmers.

Of those who had agricultural land, most of them were under 100 decimals. The average farm size was nearly 45 decimals, which is not enough to support a household size of five members. Similar situations were reflected in terms of annual income.

Annual income

The average annual income of the surveyed households was 92,923 Bangladeshi Taka (Tk.) (US $1,080). More than two-thirds earned less than Tk. 100,000 (US $1,200) per year (**Table 4**). They were considered poor.

Level of education

Nearly 26% of heads were illiterate. The largest percentage of the respondents were educational attainment of 1–5 grade. Clearly, all indicators listed in **Table 4** reveal that socio-economically, residents of the study area were lower than the national average.

5.2 Damage caused by the 2020 flash flooding

Crops and dwelling damage

On August 5, 2020, suddenly saline water entered the study area, submerging homes, field crops (rice, soybean, peanut, pepper, maize, pulses, and summer vegetables) and roads (made of both earth and asphalt) and making a scarcity of drinking water. Three hundred and five respondents provided information about the damaged status of their main dwellings. Of the 305 respondents, 52 or 17% reported that their houses were completely damaged, including 15 respondents who lost their homes to Meghna River.[9] The remaining 37 respondents, who were not living close to the riverbank, had experienced complete damage of main dwellings because they could not stand strong wind and forces of water flow during the duration of flash flooding. However, 241 (79%) respondents experienced partial damage to their houses. The remaining 12 (4%) respondents did not experience any damage to their main dwellings. That is, the August flash flood in the study area caused extensive damage to the houses of the respondents. The event also damaged six shops, owned by six respondents (**Figure 3**).

Figure 3. Picture of flash flooding event in the study area. Photo taken on 5 August 2020, from the village of Sanaligram, Alexander Union by Junayed Al Habib.

Two hundred and six (67%) of the 310 respondents experienced crop and vegetable damage either partially or completely due to salt-water intrusion and rapid flow of water. Vegetable gardens are relatively abundant in the coastal area compared to inland. More than one-third of the households had small gardens around their homesteads. The produce of these gardens met domestic consumption as well and some were sold to market for additional income. Saline water made it difficult to grow vegetables and crops in subsequent agricultural seasons. Because the riverbank erosion intensified the flash flood event, croplands were also ceded to the nearby river.

Other damage

Apart from crops and vegetables, strong tides washed away many respondents' household items (e.g., beds, chairs, tables, clothes, and stored crops). Many roads were so damaged that they were not usable for weeks. Many perennial trees were uprooted. Because of saltwater inundation, fish left ponds and were killed, causing the loss of a considerable amount of earnings to the 77 respondents. Sixty-seven percent of households lost chickens and ducks. Since the study area had 195 small ponds attached to homesteads and a nearby large river, almost every

[9] Some respondents owned other houses, such as kitchens and cowsheds. We only asked the main dwellings about the damage status.

family raised ducks to earn extra income. Generally, ponds are ubiquitous in the coastal zone in Bangladesh because salt-free drinking water is scarce in such a zone, and therefore coastal residents store rainwater in some of these ponds and use pond water for drinking purposes. Also, these ponds are usually used for raising fish (aquaculture), and for bathing purposes, particularly by women and adolescent girls.[10] Lastly, there was no report of losing any cattle and small animals like goats and lambs.

Illnesses and COVID-19

The 2020 flash flooding caused no death or injury in the study area. A considerable number of respondents suffered from the skin, water-borne (e.g., diarrhea, dysentery, typhoid and malaria fever), and other diseases (e.g., fever, and cold) during the post-event period. People in the study area could not move because all places were inundated. Besides, roads were flooded with open latrines, causing faeces to float with flash flood water, creating a bad smell. Given such circumstances, during flash flooding time, the residents seem to be exiled or locked down in their own homes. By sitting at home, they lost income sources for a few days. Moreover, a small number of residents in the study area took this opportunity to commit petty crimes.

Note that the flash flood event in the study area overlapped with the COVID-19 pandemic. Schools were closed and a state of lockdown was imposed throughout Bangladesh, particularly in Dhaka City, the capital of the country. According to reports by the field investigators, COVID-19 safety measures and awareness were almost zero in the study area. Residents of the area were living quite normal lives as they always practised. Field investigators hardly saw anybody wearing a face mask. Nobody practised social distancing. As if nothing has happened across the country or the world.

5.3 Coping measures

The survey data show that respondent households adopted two (disposed assets and borrowed money) of the six broad groups of coping measures to respond to and recover from the impact of the 2020 flash flooding in the study area.

Disposed assets

Out of a total of 310 households, 126 (41%) used the first group of coping measures. Among them selected households adopted four coping measures (**Figure 4**). Seven households sold land, six households sold livestock, 10 households sold household assets, and 103 households spent their previous savings. Except for the last measure, those who opted to dispose of assets were primarily poor and marginal farmers/fishers. Households in the study area disposed of their assets in two phases, liquid assets (e.g., livestock and household goods, including jewelry) and productive assets, such as land. Distress selling of assets is common in overcoming hardships caused by natural disasters in rural Bangladesh [56,57].

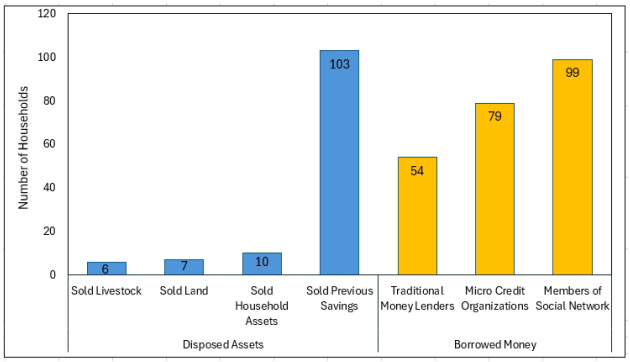

Figure 4. Coping measures by group implemented by the respondents.

Borrowed money

Two hundred thirty-two 232 (75%) of the 310 households borrowed money to cope with losses incurred by the 2020 flash flood from both formal and informal sources. Calculated chi-square values (2.31 and 3.52, respectively) clearly show that households' use of this coping measure (i.e., borrowed money) with their agricultural land owned, and annual income were not statistically significant at the level 0.05. This means that all socio-economic groups borrowed money to cope with the destruction of flash flooding events in the study area. They borrowed

[10] The social and religious custom of purdah (veil) is strictly practised in the study area.

from three sources: members of social networks, micro credit organizations, and traditional money lenders (**Figure 4**). Many NGOs, such as the Bangladesh Rural Advancement Committee (BRAC), Community Development Center (CODEC), and COAST Trust, provided loans to households that survived the flash flood. Apart from these NGOs, there are many other NGOs (e.g., Bureau of Bangladesh (BB), The Bridge, Hope, and Prism Bangladesh—PB) working in the study area during the survey time.

Respondent households badly needed to borrow money from the above sources to repair their houses, boats and fishing nets, cultivation of crops, and continuation of their livings. Micro-credit agencies and local money lenders charged relatively high-interest rates, while flash flood-affected people took interest-free loans from their friends, relatives, or neighbors. It appears that once their own savings were exhausted, then they borrowed from members of their social networks and/or micro-credit agencies. No household borrowed money by selling labor in advance, and selling crops and trees in advance, or both. Similarly, no member of respondent households changed their occupations (**Table 1**).

Apart from the above coping measures, a considerable number of villagers in the study area raised the house floor or built with concrete after the 2020 flash flooding. Their earthen floor was removed by the speed of flash flood water. These two are classified as ex-ante coping measures. However, people were really shocked and surprised when suddenly the flow of saltwater started flooding almost everything. Aged people mentioned that they had never seen or experienced this sort of flash flooding in their lifetime.

Figure 4 revealed that some households adopted multiple coping measures. The survey data revealed that 48 selected households chose multiple measures, ranging from 2 to 3 coping measures. No respondent households relied on inexpensive food and reduced the amount of food consumption per day during and after the flashing flooding. Only one household with three members migrated to another district. This household had decided to migrate before the flash flood event occurred. No flash flooding survivors received any emergency assistance from either NGOs or local and national GOs.

6. Discussion

Unlike flash flooding in traditional areas in Bangladesh [1,2], households in the study area failed to adopt a wide range of coping measures to reduce the impact of the August 2020 event. This might be related to the more frequent occurrence of (tidal induced) flash flooding in the study area. For example, the area experienced a tidal surge caused by flash floods in the first week of September 2020, and again in August 2021 amidst of COVID-19 pandemic crisis [58]. Prior to flash flooding in 2020, the study area was also affected by the powerful Cyclone Amphan, which made landfall in a low-lying deltaic region straddling the border between neighbouring West Bengal, India, and Bangladesh on May 20, 2020 [59]. Employing too frequent coping measures to reduce the impact of natural disasters was probably responsible for adopting a limited range of coping strategies immediately after the flash flooding in August 2020 in the study area. Other reasons why the residents of the area did not adopt a diversity of coping measures were the short duration of the event which affected relatively less of the geographic area and hence affected a small number of populations [57].[ⓘ] Flash-flood-affected coastal residents seem to reserve a wide range of coping mechanisms for larger disasters such as tropical cyclones and associated storm surges. Because of the short duration, the event did not create long-term food scarcity for the local community.

No local or national government initiated any emergency relief effort among the flash flood survivors in the study area. Among the local NGOs, some of them provided micro-credits for the event survivors. GOs and NGOs did not provide food, cash, and housing loans to help the flash flood-affected people in the study area, which created grief and an-

[ⓘ] In terms of physical dimensions (e.g., duration, areal extent of inundation, and number of people affected) of the event, some exceptions can be found in flash floods that occurred in the northeastern part of Bangladesh [1,2,11].

ger among the survivors. Many respondents believed that flash flooding events in northeastern and southeastern parts of Bangladesh often attract ample mass media attention due to longer duration and affect larger numbers of people [1,2,11]. Thus, flash flood survivors in these areas receive emergency assistance from elsewhere in the country and beyond. In contrast, flash flooding in the coastal areas is a localized event, unknown to many people of Bangladesh, and attracts limited interest among national mass media outlets due to distance. There is no denying the fact that receiving disaster assistance depends heavily upon the extent of media exposure [40].

The inaction of the GOs and NGOs distribution of relief aid among the flash flood survivors has possible consequences for disaster management and preparedness programs in coastal communities. If this continues, a considerable number of residents of the study area will leave from coastal areas to inland areas. The population density is one of the highest in Bangladesh. Domestic migration is not a solution for the government authorities and non-profit organizations. Like tropical cyclone survivors, they should prepare for flash flooding impacts, and provide ample emergency assistance for this event, which occurs quite frequently than other extreme events.

In the absence of external help, the survivors of flash flood-affected people in the study area tried to reduce the impact by adopting coping strategies by utilizing members of kinship and relying on social networks. Members of these groups offered immediate assistance (food, shelter, clothing, cash, loan, and labour) and other necessary emergency items to survivors. Additionally, they provided crucial psychological support. Some of them were also affected by the event. Either they were not incurring as much damage as the other affected people, or they were financially better off compared to other affected people.

Fifteen households lost their houses to riverbank erosion. Eleven of them built houses within the same village and four opted to relocate to other villages within the home union. Most of them built houses with the help of local people and relatives. They did not only provide free labour to construct houses, but they also supplied house materials such as poles, wood, and corrugated tin. Ten of them built houses rent-free on properties of neighbours, relatives, and friends. The reason for this enduring social bond is that many people in the study area originally came from the same source area. Due to massive riverbank erosion in the western bank of the Lower Meghna River in the early or mid-twentieth century, parents and grandparents of most current residents came from the neighbouring Bhola district to the study area in the Lakshmipur district [55]. These two districts are located opposite the two banks of the Lower Meghna River. No riverbank erosion was present along the eastern (right) bank of the river at the time of their ancestors' migration. Consequently, established lineage has created a strong feeling of community among the residents of the study area, and they consider themselves as belonging to the same clan. Additionally, their social bonds are very strong because they speak the same dialect, which is different from the accent of Lakshmipur [55].

In summary, people in the study area were heavily dependent on social networks and connections during the post-disaster event. Thus, bonding and bridging networks are very strong in the study area. In contrast, linking networks are not so strong, although, like other environmentally stressed areas in Bangladesh, many NGOs and GOs are present in the area affected by flash flooding. The inactiveness of these organizations in helping the flash flooding survivors is not a surprising finding because one study [55,57] done just south of the present study site also reported that victims of riverbank erosion did not receive any emergency assistance from these two entities.

7. Conclusions

Residents of the study area overcome the effects of the 2020 flash flooding by adopting a limited number of coping strategies. Assets disposal and borrowing money from different sources are common coping measures in the area. They did not rely on inexpensive wild food, reduce the amount of meal consumption, or sell labour, crops, and trees in

advance. Despite great suffering and constant threats of climate change-induced sea level rise (SLR), most of the respondents prefer to live in the study area for two reasons: social bonds and available natural resources. This may be changed in future depending on GOs and NGOs activities. Most of the residents believe that the most effective way to prevent flash flooding is the construction of an embankment along the eastern bank of the Lower Meghna River. This is also needed to make the study area resilient to SLR. Fortunately, the national government recently passed such a project for the study area.

Neither the government of Bangladesh nor local governments at the union or upazila level have a plan and policy to manage recovery from impacts of coastal flash flooding with adequate damage assessment and response to this event, but such policy is urgently needed for the benefit of the residents of the study area. One limitation of this study is that it represents a case study and is not therefore representative of all coastal areas of Bangladesh. Future work should continue to focus on flash flooding coping strategies employed by other coastal areas of Bangladesh.

Author Contributions

Conceptualization M.K.R., B.K.P. and M.F.H.; methodology, B.K.P. and M.K.R.; formal analysis, M.K.R., B.K.P. and M.F.H.; investigation, M.K.R.; data curation, M.K.R.; writing—original draft preparation, M.K.R., B.K.P. and M.F.H.; writing—review and editing, M.K.R and B.K.P.; supervision, M.K.R. and B.K.P.; project administration, M.K.R. All authors have read and agreed to the published version of the manuscript.

Conflict of Interest

We declare no conflict of interest.

References

[1] Ahmed, B., Kelman, I., Raja, D.R., et al., 2019. Livelihood impacts of flash floods in Cox's Bazar District, Bangladesh. International Journal of Mass Emergencies & Disasters. 37(3), 306–326.
DOI: https://doi.org/10.1177/028072701903700304

[2] Chakraborty, D., Mondal, K.P., Islam, S.K., et al., 2021. Chapter 26–2017 flash flood in Bangladesh: Lessons learnt. Disaster resilience and sustainability: Adaption for sustainable development. Elsevier: Amsterdam. pp. 591–610.
DOI: https://doi.org/10.1016/B978-0-323-85195-4.00007-X

[3] Choudhury, N.Y., Paul, A., Paul, B.K., 2004. Impact of costal embankment on the flash flood in Bangladesh: A case study. Applied Geography. 24(3), 241–258.
DOI: https://doi.org/10.1016/j.apgeog.2004.04.001

[4] Rahman, M.K., Paul, B.K., Curtis, A., et al., 2015. Linking coastal disasters and migration: A case study of Kutubdia Island, Bangladesh. The Professional Geographer. 67(2), 218–228.
DOI: https://doi.org/10.1080/00330124.2014.922020

[5] Adnan, M.S.G., Dewan, A., Zannat, K.E., et al., 2019. The use of watershed geomorphic data in flash flood susceptibility zoning: A case study of the Karnaphuli and Sangu river basins of Bangladesh. Natural Hazards. 99, 425–448.
DOI: https://doi.org/10.1007/s11069-019-03749-3

[6] Sarker, A.A., Rashid, A.K.M., 2013. Landslide and flashflood in Bangladesh. Disaster risk reduction approaches in Bangladesh. Springer: Tokyo. pp. 165–189.
DOI: https://doi.org/10.1007/978-4-431-54252-0_8

[7] Kamal, A.S.M., Shamsudduha, M., Ahmed, B., et al., 2018. Resilience to flash floods in wetland communities of northeastern Bangladesh. International Journal of Disaster Risk Reduction. 31, 478–488.
DOI: https://doi.org/10.1016/j.ijdrr.2018.06.011

[8] Mahtab, M.H., Ohara, M., Rasmy, M., 2018.

The impact of rainfall variations on flash flooding in haor areas in Bangladesh. Water Conservation & Management. 2(2), 6–10.
DOI: https://doi.org/10.26480/wcm.02.2018.06.10

[9] Ferdushi, K.F., Ismail, M.T., Kamil, A.A., 2019. Perceptions, knowledge and adaptation about climate change: A Study on farmers of Haor areas after a flash flood in Bangladesh. Climate. 7(7), 85.
DOI: https://doi.org/10.3390/cli7070085

[10] Mondal, S., Akter, L., Hiya, H.J., et al., 2019. Effects of 2017 early flash flooding on agriculture in Haor Areas of Sunamganj. Journal of Environmental Science and Natural Resources. 12(1–2), 117–125.

[11] United Nations, Bangladesh, Flash Floods: Humanitarian Response Plan 2022 [Internet]. United Nations. [cited 2023 Jul 24]. Available from: https://bangladesh.un.org/en/188010-flash-floods-humanitarian-response-plan-2022-united-nations-bangladesh-coordinated-appeal

[12] IPCC, Climate Change 2014: Synthesis Report [Internet]. IPCC. Available from: https://www.ipcc.ch/site/assets/uploads/2018/02/AR5_SYR_FINAL_Front_matters.pdf

[13] Oxfam, Climate Change Adaptation: Enabling People Living in Poverty to Adapt [Internet]. Oxfam International. [cited 2023 Jul 24]. Available from: https://policy-practice.oxfam.org/resources/climate-change-adaptation-enabling-people-living-in-poverty-to-adapt-111978/

[14] Van der Geest, K., Warner, K., 2015. Vulnerability, coping and loss and damage from climate events. Hazards, risks, and disasters in society. Elsevier: Amsterdam. pp. 121–144.

[15] Aldrich, D.P., 2012. Building resilience: Social capital in post-disaster recovery. University of Chicago Press: London.

[16] Endowed Wisdom: Knowledge of Nature and Coping with Disasters in Bangladesh [Internet]. Comprehensive Disaster Management Programme (CDMP). Available from: https://www.academia.edu/176780/ENDOWED_WISDOM_Knowledge_of_Nature_and_Coping_with_Disasters_in_Bangladesh

[17] Fakhruddin, S.H.M., Rahman, J., 2015. Coping with coastal risk and vulnerabilities in Bangladesh. International Journal of Disaster Risk Reduction. 12, 112–118.
DOI: http://dx.doi.org/10.1016/j.ijdrr.2014.12.008

[18] Paul, B.K., Rashid, H., 2017. Climatic hazards in coastal Bangladesh: Non-structural and structural solutions. Elsevier: Amsterdam.

[19] Mondal, M.S.H., Murayama, T., Nishikizawa, S., 2020. Determinants of household-level coping strategies and recoveries from riverine flood disasters: Empirical evidence from the right bank of Teesta River, Bangladesh. Climate. 9(1), 4.
DOI: https://doi.org/10.3390/cli9010004

[20] Kerr, S.E., 2018. Social capita as a determinant of resilience: Implications for adaption policy. Resilience: The science of adaptation to climate change. Elsevier: Cambridge, MA. pp. 267–275.

[21] Béné, C., Al-Hassan, R.M., Amarasinghe, O., et al., 2016. Is resilience socially constructed? Empirical evidence from Fiji, Ghana, Sri Lanka, and vietnam. Global Environmental Change. 38, 153–170.
DOI: http://doi.org/10.1016/j.gloenvcha.2016.03.005

[22] Daly, P., Mahdi, S., McCaughey, J., et al., 2020. Rethinking relief, reconstruction and development: Evaluating the effectiveness and sustainability of post-disaster livelihood aid. International Journal of Disaster Risk Reduction. 49, 101650.
DOI: http://doi.org/10.1016/j.ijdrr.2020.101650

[23] Sultana, N., Rayhan, M.I., 2012. Coping strategies with floods in Bangladesh: An empirical study. Natural Hazards. 64, 1209–1218.
DOI: https://doi.org/10.1007/s11069-012-0291-5

[24] Bradshaw, S., 2013. Gender, development and

disasters. Edward Elgar Publishing Ltd.: Cheltenham.

[25] Carpenter, A., 2013. Social ties, space, and resilience: Literature review of community resilience to disasters and constituent social and built environment factors. FRB Atlanta Community and Economic Development Discussion Paper, (2013-02). Available from: https://ideas.repec.org/p/fip/fedacd/2013-02.html

[26] Setini, M., Yasa, N.N.K., Supartha, I.W.G., et al., 2020. The passway of women entrepreneurship: Starting from social capital with open innovation, through to knowledge sharing and innovative performance. Journal of Open Innovation: Technology, Market, and Complexity. 6(2), 25.
DOI: https://doi.org/10.3390/joitmc6020025

[27] BDFID (British Department for International Development), 2008. BDFID's sustainable livelihoods approach and its framework. BDFID: London.

[28] Serrat, O., 2010. The sustainable livelihoods approach. Asian Development Bank: Washington, D.C.

[29] Flora, C.B., Flora, J.L., 2004. Rural communities: Legacy and change, 4th edition. Westview Press: Boulder.

[30] Karki, J., Matthewman, S., Grayman, J.H., 2022. From goods to goats: Examining post-disaster livelihood recovery in the aftermath of the Nepal earthquake 2015. Natural Hazards. 114(3), 3787–3809.
DOI: https://doi.org/10.1007/s11069-022-05543-0

[31] Paul, S.K., Routray, J.K., 2011. Household response to cyclone and induced surge in coastal Bangladesh: Coping strategies and explanatory variables. Natural Hazards. 57, 477–499.
DOI: https://doi.org/10.1007/s11069-010-9631-5

[32] Putnam, R., 1993. Making democracy work, civic traditions in modern Italy. Princeton University Press: Princeton.

[33] Aldrich, D.P., 2011. The power of people: Social capital's role in recovery from the 1995 Kobe earthquake. Natural Hazards. 56, 595–611.
DOI: https://doi.org/10.1007/s11069-010-9577-7

[34] Szreter, S., Woolcock, M., 2004. Health by association? Social capital, social theory, and the political economy of public health. International Journal of Epidemiology. 33(4), 650–667.
DOI: https://doi.org/10.1093/ije/dyh013

[35] Aldrich, D.P., Meyer, M.A., 2015. Social capital and community resilience. American Behavioral Scientist. 59(2), 254–269.
DOI: https://doi.org/10.1177/0002764214550299

[36] Panday, S., Rushton, S., Karki, J., et al., 2021. The role of social capital in disaster resilience in remote communities after the 2015 Nepal earthquake. International Journal of Disaster Risk Reduction. 55, 102112.
DOI: https://doi.org/10.1016/j.ijdrr.2021.102112

[37] Elliott, J.R., Haney, T.J., Sams-Abiodun, P., 2010. Limits to social capital: Comparing network assistance in two New Orleans neighborhoods devastated by Hurricane Katrina. The Sociological Quarterly. 51(4), 624–648.
DOI: https://doi.org/10.1111/j.1533-8525.2010.01186.x

[38] Woolcock, M., 2001. The place of social capital in understanding social and economic outcomes. Canadian Journal of Policy Research. 2(1), 11–17.

[39] Paul, B.K., 2006. Disaster relief efforts: An update. Progress in Development Studies. 6(3), 211–223.
DOI: https://doi.org/10.1191/1464993406ps139oa

[40] Paul, B.K., 2019. Disaster relief aid: Changes and challenges. Palgrave Macmillan: Gewerbestrassse.

[41] Tsukamoto-Yasui, M., Sasaki, T., Matsumoto, W., et al., 2007. Active hippocampal networks undergo spontaneous synaptic modification. PloS One. 2(11), e1250.
DOI: https://doi.org/10.1371/journal.pone.0001250

[42] Dynes, R., 2006. Social capital: Dealing with community emergencies. Homeland Security Affairs. 2(2).

[43] Khandker, S.R., 2007. Coping with flood: Role of institutions in Bangladesh. Agricultural Economics. 36(2), 169–180.
DOI: https://doi.org/10.1111/j.1574-0862.2007.00196.x

[44] Dewan, A.M., Nishigaki, M., Komatsu, M., 2003. Floods in Bangladesh: A comparative hydrological investigation on two catastrophic events. Journal of the Faculty of Environmental Science and Technology. 8(1), 53–62.

[45] Baten, A., González, P.A., Delgado, R.C., 2018. Natural disasters and management systems of Bangladesh from 1972 to 2017: Special focus on flood. OmniScience: A Multi-disciplinary Journal. 8(3), 35–47.

[46] Gruntfest, E., Handmer, J., 2001. Dealing with flash floods: Contemporary issues and future possibilities. Coping with flash floods. Springer: Dordrecht. pp. 3–10.
DOI: https://doi.org/10.1007/978-94-010-0918-8_1

[47] Handmer, J., Henson, R., Sneeringer, P., et al., 2001. Warning systems for flash floods: Research needs, opportunities and trends. Coping with flash floods. Springer: Dordrecht. pp. 77–89.
DOI: https://doi.org/10.1007/978-94-010-0918-8_10

[48] Kaiser, M., Günnemann, S., Disse, M., 2020. Providing guidance on efficient flash flood documentation: An application based approach. Journal of Hydrology. 581, 124466.
DOI: http://doi.org/10.1016/j.jhydrol.2019.124466

[49] Maqtan, R., Othman, F., Wan Jaafar, W.Z., et al., 2022. A scoping review of flash floods in Malaysia: Current status and the way forward. Natural Hazards. 114, 2387–2416.
DOI: https://doi.org/10.1007/s11069-022-05486-6

[50] Gourley, J.J., Flamig, Z.L., Hong, Y., et al., 2014. Evaluation of past, present and future tools for radar-based flash-flood prediction in the USA. Hydrological Sciences Journal. 59(7), 1377–1389.
DOI: http://doi.org/10.1080/02626667.2014.919391

[51] Burton, I., Kates, R.W., White, G.F., 1993. The environment as hazard. Oxford University Press: New York.

[52] Paul, B.K., 2021. Disaster deaths: Trends, causes and determinants. Routledge: London.

[53] Amponsah, W., Ayral, P.A., Boudevillain, B., et al., 2018. Integrated high-resolution dataset of high-intensity European and Mediterranean flash floods. Earth System Science Data. 10(4), 1783–1794.
DOI: https://doi.org/10.5194/essd-10-1783-2018

[54] Rashid, H., Paul, B.K., 2014. Climate change in Bangladesh: Confronting impending disasters. Lexington Books: Boulder, CO.

[55] Paul, B.K., Rahman, M.K., Crawford, T., et al., 2020. Explaining mobility using the community capital framework and place attachment concepts: A case study of riverbank erosion in the Lower Meghna Estuary, Bangladesh. Applied Geography. 125, 102199.
DOI: https://doi.org/10.1016/j.apgeog.2020.102199

[56] Alam, G.M., Alam, K., Mushtaq, S., et al., 2018. How do climate change and associated hazards impact on the resilience of riparian rural communities in Bangladesh? Policy implications for livelihood development. Environmental Science & Policy. 84, 7–18.
DOI: https://doi.org/10.1016/j.envsci.2018.02.012

[57] Paul, B.K., Rahman, M.K., Crawford, T., et al., 2021. Copying strategies of people displaced by riverbank erosion in the lower Meghna Estuary, Bangladesh. Living on the edge in Bangladesh. Springer: Cham. pp. 227–239.
DOI: https://doi.org/10.1007/978-3-030-73592-0_13

[58] Paul, B.K., Rahman, M.K., Lu, M., et al., 2022.

Household migration and intentions for future migration in the climate change vulnerable lower Meghna estuary of coastal Bangladesh. Sustainability. 14(8), 4686.
DOI: https://doi.org/10.3390/su14084686

[59] Hassan, M.M., Ash, K., Abedin, J., et al., 2020. A quantitative framework for analyzing spatial dynamics of flood events: A case study of super cyclone Amphan. Remote Sensing. 12(20), 3454.
DOI: http://doi.org/10.3390/rs12203454

[60] Bourdieu, P., 1985. The social space and the genesis of groups. Theory and Society. 14, 723–744.
DOI: http://doi.org/10.1007/BF00174048

[61] Ahmad, E., Choudhury, J.U., Hassan, K.M., et al., 2001. Floods in Bangladesh and their processes. Disaster in Bangladesh: Selected readings. DRTMC: Dhaka. pp. 9–28.