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Exploring the Socioeconomic Condition and Livelihood Vulnerability of Coastal People in Southwest Bangladesh

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Abstract: This research aims to investigate the socioeconomic condition and livelihood vulnerability of coastal communities in the Mongla Port Paurashava, Bangladesh. Data were collected from the respondents through household surveys, focus group discussions (FGD), and key informant interviews (KII). A total of 50 household responses, 2 FGD, and 5 KII were considered to address the socioeconomic and livelihood attributes. This study considered 9 basic criteria (e.g., income, livestock, reserve resources, ownership of land, frequency of natural disasters, the impact of natural disasters, impact on specific resources, economic loss, and hazard mitigation) to assess the socioeconomic condition and physical variables of human vulnerability. Community vulnerability enlightens the different stressors and shows the overall impact on coastal inhabitants. The results revealed that over fifty percent of respondents (54%) suffer from fresh water scarcity and salinity intrusion, mostly in the dry season, where climate change impact is comparatively high. The overall condition is intensified by various socioeconomic issues like low income, resource depletion, environmental degradation, and the absence of bottom-up approaches from the ground level. Lastly, hazard ranking and risk evaluation denote that Mongla Paurashava lies in the high-risk zone (Zone II), which demands immediate mitigation, resource optimization, and adaptive planning as emergency response.

Keywords: *Socio-economic Condition; Livelihood; Vulnerability; Coastal Community; Bangladesh.*

Introduction: Nature comprises dynamism and anthropogenic activities geared to the failure of the mechanism further. The livelihood of the coastal people is adversely affected by the impact of climate change while the growing demand contributes to the decline of natural resources such as forests, floodplain areas, wetlands, and local management system components [1]. Nations with middle and lower-income levels are affected most by natural disasters like cyclones, tidal floods, storm surges etc. located in the geographically vulnerable region [2]. Nowadays, one of the main causes of natural catastrophes worldwide is climate change. The hazard from climatic catastrophes will, however, increase due to their size and recurrence over the years. As a result, the interaction between people and the environment has increased, putting more people and property vulnerable to dangers and increasing the community's exposure to them. Social scientists introduced the idea of vulnerability initially, and in the 1970s it came to be acknowledged as a tool for understanding the risk perceptions of people [3].

Bangladesh is one of the countries which is extremely vulnerable in respect of climate. Few developing countries face climatic disasters and some of them are beyond comprehension in terms of losses. Salinity, river erosion, cyclone, and flood severely affect the local community and biodiversity of Bangladesh [4], that can be a potential threat in the near future [5, 6]. In Bangladesh's coastal area, cyclones are usually related to global warming. In the meanwhile, additional hydro-meteorological coastal catastrophes, such as storm surges, waterlogging, and saline intrusion in soil, as well as surface and groundwater, have intensified. The effect of climate change may be seen in rising average temperatures and the severity and frequency of weather-related changes [2].

According to the past record, a sum of 159 cyclones, among them 48 severe cyclonic storms, 43 cyclonic storms, and 68 tropical depressions hit people in the coastal area of Bangladesh [7]. The coastline and low-lying regions are severely susceptible to both sea level rise and natural catastrophes, especially in the southern portion of Bangladesh [8]. Frequent occurrences of any natural hazard do significant harm to the socioeconomic base of a community leading to impairment of livelihood. According to the United Nations International Plan for Disaster Reduction [9], disasters and climate change are connected and climate change might increase the frequency and severity of natural disasters by causing more severe weather occurrences. Hence, it's detrimental effects continually and indirectly compel coastal residents to alter their way of life and daily activities, while social and situational variables heighten their susceptibility.

Consequently, in the coastal districts of Bangladesh, salinity has emerged as a significant problem. It may be caused by the effects of climate change, such as cyclonic storm surges, the lack of fresh water flow from upstream, and the extended length of flooding in surface regions. During the dry season (November to March), salty water may impact parameters upstream as far as 240 kilometers from the shore [10] as well as It is capable of destroying the freshwater ecology. The extreme salinity restricts

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coastal agriculture and aquaculture, upon which the majority of populations rely. In reality, crop production in Bangladesh is dependent on surface water and groundwater, neither of which can be used for irrigation. Due to the impacts of excessive salinity and illnesses, the shrimp production rate in promising coastal regions has continuously fallen, but the crab production confronts several obstacles. During the dry season (November to March), salinity increases beyond the optimal levels for shrimp cultivation.

The high salinity and warmth, as well as variations in rainfall patterns, exacerbate the degradation of water quality and the change in the surrounding environment that is attributable to outbreaks of shrimp illnesses and mortality rates. Other natural resources have progressively been confronted with a variety of problematic variables whose hazards may result in an escalation of devastation. As a result, social anxieties have increased for all socioeconomic stratum components. Due to the geophysical features of the southern coast of Bangladesh, the socioeconomic level of the local population has deteriorated further as a result of cyclones and storm surges [11]. Social perceptions may be a good indicator of the involvement of environmental change on local development over the long run. Regarding climate change, however, people's opinions are entirely reliant on their own experience and geographical location, which is impacted by a number of variables [12, 13].

Mongla is a distant region in the district of Bagerhat. Nowadays, natural occurrences such as cyclonic storm surges and their attendant repercussions have rendered small settlements insecure. The inconsistency and unpredictability of coastal dangers impede local development initiatives. As a result, a number of issues regarding the changes in the regional environment and patterns of subsistence arise, such as the nature of the greatest threats, how the regional environment affects people's attitudes toward development activities, and how these perceptions make things unexpectedly worse than the past. The study regions are very much susceptible to climatic occurrences like cyclone, flood, salinity etc. that affected the livelihoods of the local community heavily. Moreover, climatic changes accelerating its frequency and magnitude of impact gradually and trapped them into a worsen circumstances. Hence, exploring the socioeconomic condition and livelihood vulnerability of community people could be a very realistic study to understand the relative comparison of different hazard phenomenon that will help to formulate future adaptation strategies at the community level to minimize the impact and improve the livelihood of coastal inhabitants.

Materials & Method

Study Area: This research was conducted in the Mongla Port Pourashava under Mongla upazila of Bagerhat districts situated in the southern Bangladesh coastline area (Fig. 1). The study area is very susceptible to natural coastal hazards such as cyclonic storm surges and salinity issues, which arise mostly in the southern portion of the Bay of Bengal. The entire area is 1,461.22 square kilometers and is situated between latitudes 21°49' and 22°33' north and longitudes 89°32' and 89°44' east. It is bordered on the north by Rampal upazila, on the south by the Bay of Bengal, on the east by Morrelganj and Sarankhola upazilas, and on the west by dacope upazila. Many individuals engage in agriculture, village transit, fishing, and other subsistence activities. The principal rivers include the Pasur, the Mongla, the Bhola, the Bangra, and the Chandpai [13].

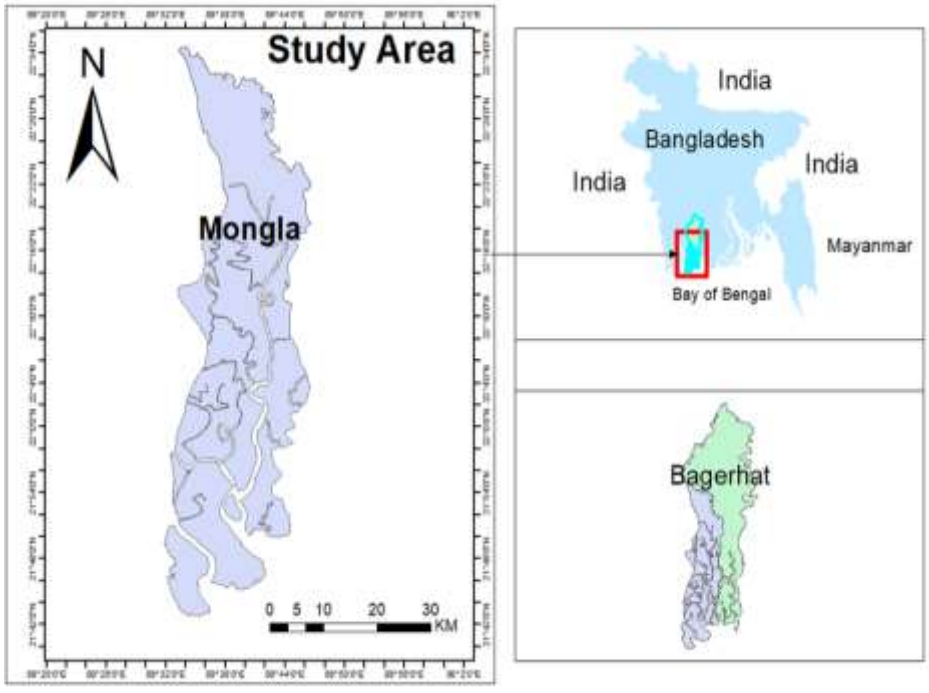

Fig. 1: Mongla Upazila under Bagerhat District in South-west Bangladesh.

Methodological Approaches: Two wards (Ward-2 & Ward-9) were selected as study site for the household survey from the insight of reconnaissance survey and literature review. These two wards were most vulnerable based on the criteria "Adaptation capacity to cope with hazards" and "Disaster management practice" respectively [14]. A total of 50 households were selected purposively (25 households from each area) for the survey. The questionnaire for the household survey was divided into two sections: (1) the socioeconomic condition of the local population; and (2) coastal hazards and livelihood vulnerability. Responses were collected from respondents willing to share their opinions. Respondents read all queries in their native language. Moreover, two focus group discussions (FGD) consist of 10 members, separately in two wards for overall data collection and validation. Also, five key informant interviews (KII) with knowledgeable persons, were carried out for deep insight. Observations from the field were conducted to comprehend social problems. These findings were useful for validating the survey results. To preserve the significance of the study findings and meet the research objectives, the entire strategy for data acquisition was rigorously executed. The summary of the methodological approach is clearly stated by the flow diagram (Fig. 2).

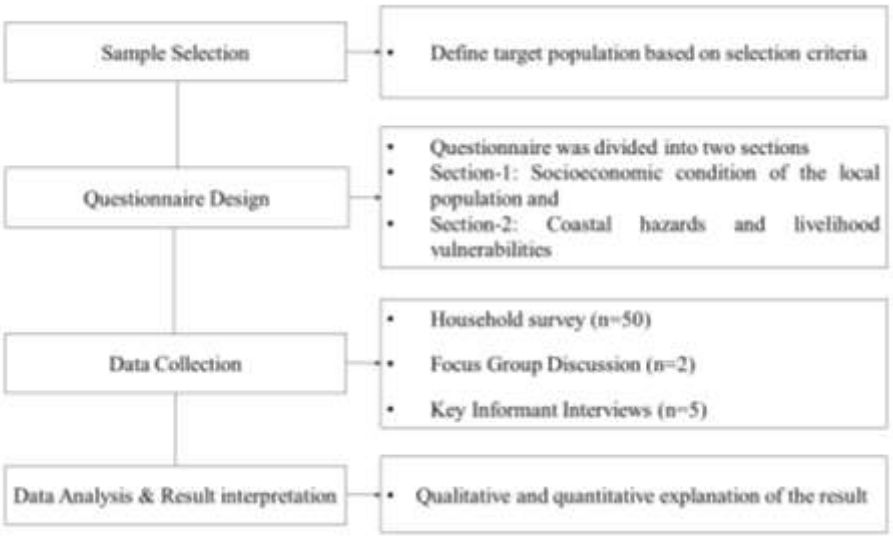

Fig. 2: The methodological steps followed in this research process.

Community level vulnerability indexing: Vulnerability was framed as a subset of risk for indexing community level vulnerability of the Mongla. Risk of any community under stressed environmental conditions are very much co-related with vulnerability. Risk is defined [15] by the following equation:

$$R = H \times V \qquad \text{eq. 1}$$

Where, R is risk, H is hazard and V is vulnerability

Later manageability or capacity of the community was added to the equation and thus it takes the following shape [16,17]:

$$R = \frac{H \times V}{C} \qquad \text{eq. 2}$$

Where, R is risk, H is hazard, V is vulnerability and C is manageability or capacity.

According to Heijmans and Victoria, 2001 [17] risk is expressed as a product of frequency time vulnerability time social evaluation. The first step in deciphering the probability of occurrence of an extreme event is the identification of hazards and is ranked here between 1 and 10 (Table 1).

Table 1. Community hazard intensity and frequency evaluation.

Occurrence criteria	*Score*
Occurrence of extreme event (that surpass threshold) in commonplace	10
Occurs at least once per month	9
Occurs at least once per year	8
Has occurred once in the past decade	7
Has occurred at least once in the past	6
Occurrence in commonplace	5
Occurs at least once per year	4
Has occurred at least once in the past	3
Has occurred at least once in the past	2
Has occurred somewhere in the world, has some potential for occurrence	1

Source: Ferrier and Haque, 2003 [18]

In the next phase of vulnerability assessment, the scoring - based on the characteristics of Vulnerability Evaluation Scheme (Table 2) - was followed. Vulnerability was assigned a score from one to ten where *ten* represents the most serious and far-reaching effects on the community and *one* being relatively benign.

Table 2. Community vulnerability assessment and impact evaluation.

Impact criteria	**Score**
Results in widespread or large-scale loss of life and injuries. Creates financial losses from which my community could not recover	10
Results in the loss of ten or more lives and some major injuries. Loss of large numbers of private homes, public infrastructure. Loss of public confidence in the government. Interruption of normal business across the community. Formal declaration of emergency required.	9
Results in the loss of 5-10 lives and some major injuries. Some loss of private property, public infrastructure. Substantial financial loss for the health care system. Localized interruption of normal business.	8
Results in the loss of less than 5 lives and some major injuries. Loss of private property. Damage to public infrastructure. Financial loss for the health care system beyond normal response costs.	7
Results in the loss of a single life and some major injuries. Widespread damage to private property. Major interruption of municipal service and utilities. Large number of private homes unfit for habitation.	6
Results in widespread major injuries. Large amount of damage to private property in individual neighborhoods and locales. Localized interruption of municipal services and utilities. Some homes in individual neighborhoods are unfit for habitation	5
Results in widespread minor injuries, some major injuries. Small number of private homes in a single neighborhood are seriously damaged. Interruption of municipal services and/or utilities in a single neighborhood.	4
Results in widespread minor injuries, no major injuries. Private homes are damaged but are not unsuitable for habitation	3
Results in some minor injuries. Isolated damage to property	2
Results in no injuries. No property damage	1

Source: Ferrier and Haque, 2003 [18] (Note: 10 (ten) represents the most serious and far-reaching effects on the community and 1 (one) being relatively benign)

In the final phase, social consequences are evaluated by scoring from one to ten assigned to different level of social recognition of risk and vulnerability assessed [19]. This part of risk assessment reflects social concepts and meaning of risk (Table 3).

Table 3. Risk assessment table for risk rating.

1000	900	800	700	600	500	400	300	200	100
900	810	720	630	540	490	360	270	180	90
800	720	640	580	480	400	320	240	160	80
700	630	560	490	420	350	280	210	140	70
600	540	480	420	360	300	240	180	120	60
500	450	400	350	300	250	200	150	100	50
400	360	320	280	240	200	160	120	80	40
300	270	240	210	180	150	120	90	60	30
200	180	160	140	120	100	80	60	40	20
100	90	80	70	60	50	40	30	20	10

Note: The scores of the three schemes were multiplied together, in order to arrive at a Risk Rating on a 0 to1000 scale, and compare with the Risk Assessment table [800 – 1000 represent very high-risk zone, 500 – 700 refers to high-risk zone, 200 – 490 refers to moderate risk zone, 1 – 199 refers to low-risk zone]

Results and Discussion

Socioeconomic condition: This study was conducted by interviewing 50 participants from the local community of different occupation. Village transporter was the dominant as majority of the people engaged in driving different local transport such as easy-bike, van etc. Similarly, many people working as day labor, ship labor, industry job etc. The rate of different occupation among participants depicted in Table 4.

Table 4. Demographic attributes of the participants.

Participants	Percentage
Transporter (driver of easy-bike, motorized van, human pulled van	46%
Farmer	14%
Fisherman	8%
Other	32%

The monthly income of the major respondents was below standard national income level [20] which is 32,422 BDT and they struggled to meet their basic needs depicted in the pie chart (Fig. 3). Majority of them earned below BDT 5000 and the amount was also decrease at the time of serious weather. Specially, manual van driver struggled most. Easy-bike and other motorized driver, some fishermen and farmers earned as much as BDT 5,000 to 10,000 only. Lastly, job holders from different company and industries earned more money.

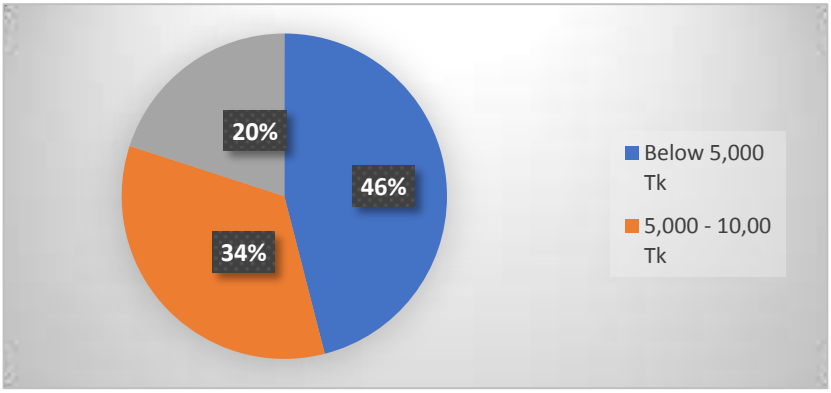

Fig. 3: Income range of all the participants.

Most of this areas people livelihood very poor. Mainly women look after their livestock. Poultry, cow, goat, sheep or other stock were very easy to maintain for women. This region had a maximum livestock stock of close to fifty percent (~ 46% of poultry stock). Moreover, fifteen percent (15%) of the goats, a fifth percent (~ 19%) of the cows, and 8% of the sheep livestock were found in this region (Fig. 4). Adding to this, twelve percent (12%) other livestock considered as farming by the people.

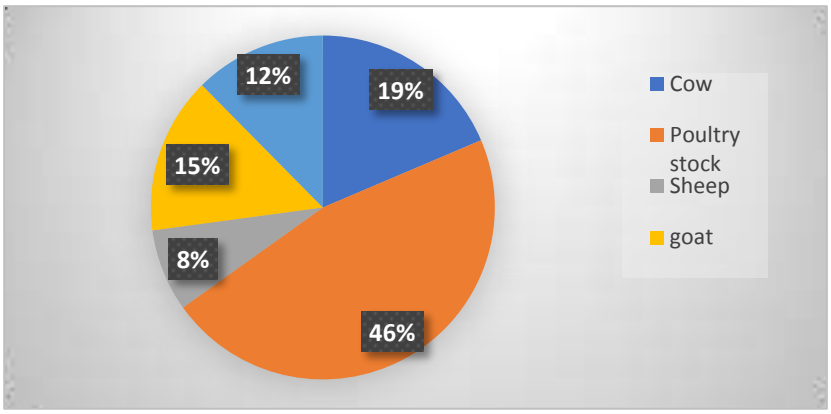

Fig. 4: Percentages of livestock.

In this study we observed the lack of reserve resources that could aid at the time of necessity. In this areas people were very poor. They couldn't earn their appropriate quantity for maintain of life. More than half of the people from the community (54%) were not able to sustain for one month depending on their reserve resources. (Fig. 5)

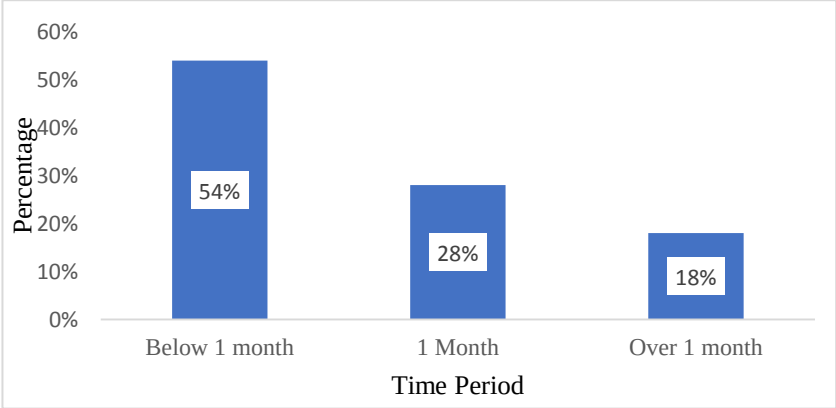

Fig. 5: Sustaining period of household reserve resources.

People from the study area were lack of owning land resources. More than two third people in this area there had no own land (~ 73%). Sometimes farmers without their own land were cultivating other lands in exchange of produced resources with the landowner, locally addressed as "Barga". But around a quarter part of total people had only less than 1 acre land while more than 1 acre of land owned only 1% of people (Fig. 6).

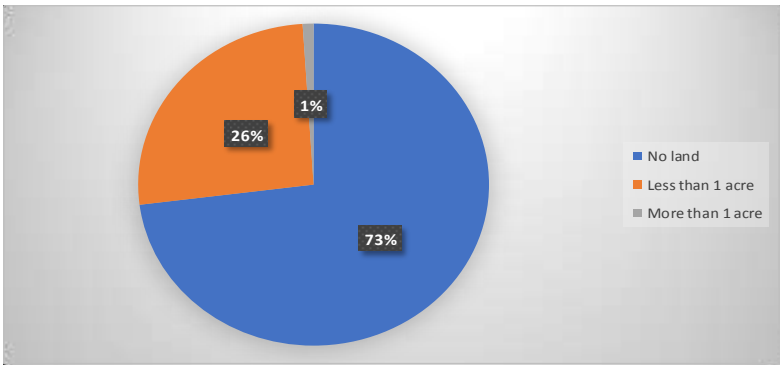

Fig. 6: Ownership of land.

The process of assessing the natural hazards was conducted by adopting a scoring method considering four criteria: frequency, intensity, damage, and recovery time. Each criterion had 15 points and for four criteria a total of 60 points were used in the assessment (shown in Fig. 7). According to the scoring system, salinity, obtained the highest score, 50. The second threatening hazard was a cyclone. Infrastructure like dikes helped to reduce the effects of floods. Lastly, drought scored 17.

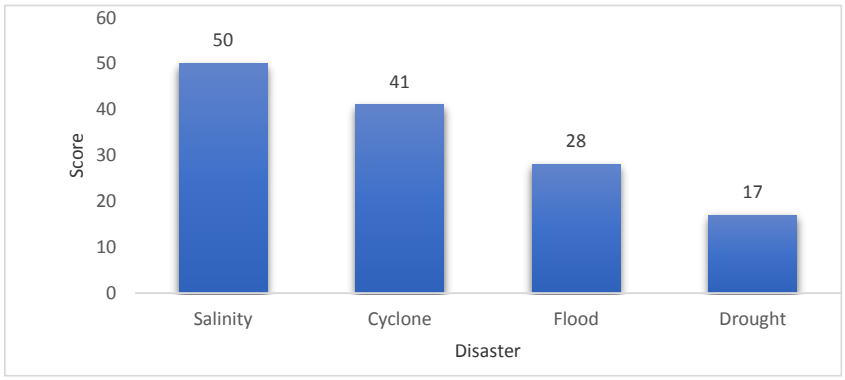

Fig. 7: Frequency and impact score of the natural disaster.

Natural disasters frequently affected the human life and nature. Coastal people are more vulnerable due to the direct exposure. Resources were damaged and life hault for heavy ecinomic loss. It took long time to recover from a disaster. In this area, around seventy percent (68%) of houses were damaged during disaster. The low income community couldn't afford well structured house. They mainly depended on earthen material, wood, bamboo etc. which are not strong enough to withstand storm wind. Livestock was the second vunerable resorce whereas 12% crop and 2% of other resources were damaged by the disaster (Fig. 8).

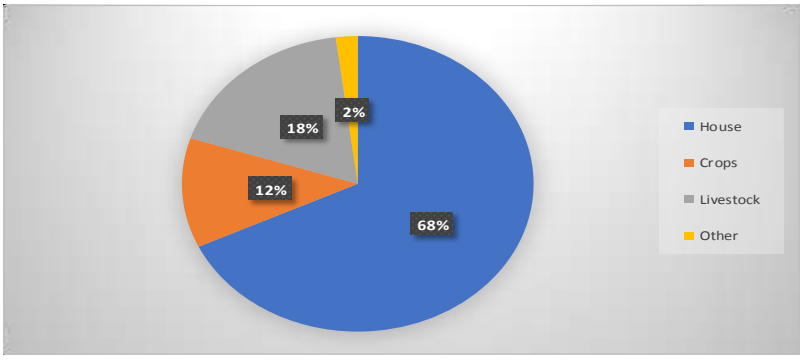

Fig. 8: Impact on specific asset by natural disaster.

Monetary losses make people destitute that caused 58% of people damaged BDT 20,000-50,000. This is the highest percentage of people. More than 50,000 Tk was damaged by only 13% of people while around thirty percent people fall under less than BDT 20,000 economic loss by natural disaster (Fig. 9).

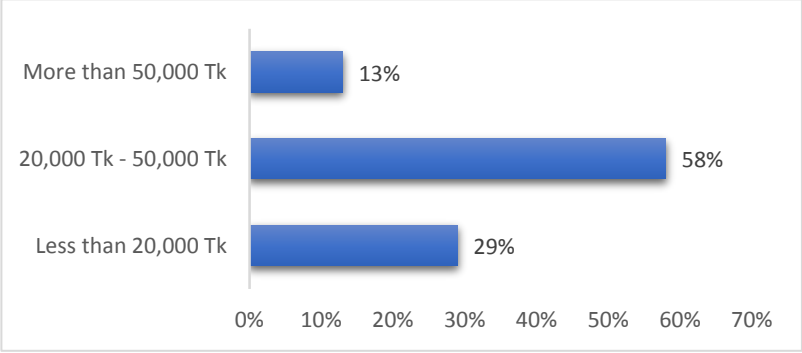

Fig. 9: Economic loss caused by natural disaster.

Participants stated that they assumed in the future disaster could affect livelihood such as 35% of salinity would be the most adverse. Besides, almost a third (~ 29%) of cyclones can also could cause tremendous affect, similarly, a quarter percent of floods (26%), and one in ten (10%) of drought would be the destruction on the livelihood as well (Fig. 10). Geographic location of the study area and nearness to river might have the prominent cause of natural calamities.

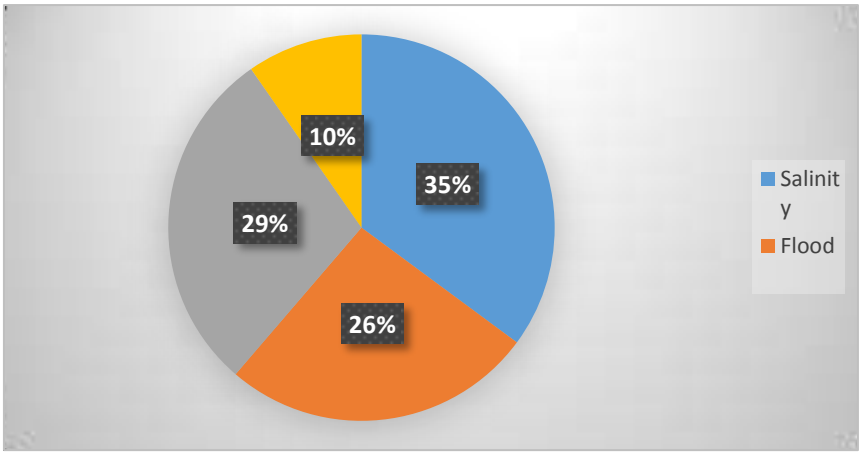

Fig. 10: Impact of different natural hazards.

The poor socioeconomic condition and other factors left almost fifty percent (~ 48% of people) without preparation before the natural calamities (Fig. 11).

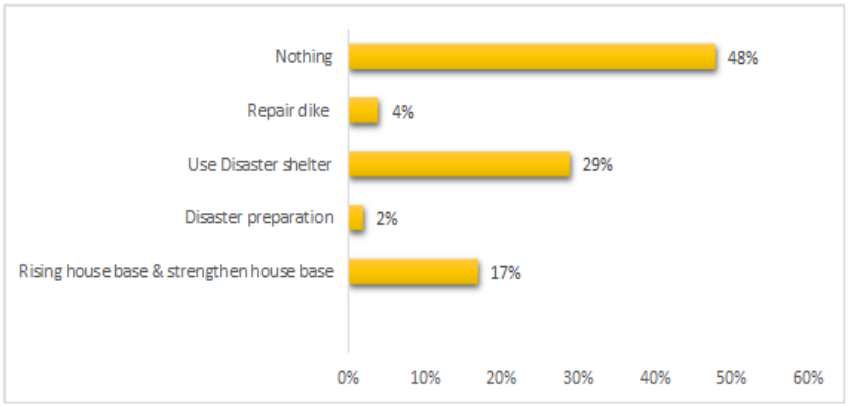

Fig. 11: Hazard mitigation practices.

They were used to the consequences and remained unprotected at the time of emergency. Disaster shelter used more than previous as government and other non- government organizations contributed lot to raise awareness. People with higher income source could raise the base of their house and strengthened it as precaution. Dike restoration process was laborious and causing economical support. So, this practice was not frequent. Lastly, a few people were prepared themselves for the disaster.

Community level vulnerability indexing: As Mongla is highly disaster affected area, a vast portion of community and land are under risk due to the impact of natural hazards and climatic consequences. Here almost third quarter part of land is low and almost 30 percent area close to riverside. The data are incorporated in Table 5 identify the hazards and vulnerability of the community. This information focuses the status of risks and vulnerable sector under extreme threat to disaster and livelihood threats. Although major part of community doesn't have clear concept about climate change but they are familiar with the threats and impacts like fresh water crisis, water logging, siltation, salinization and species depletion. The natural disasters during last two decades chiefly the SIDR in 2007, the AILA in 2009 and the MOHASEN in 2013 caused widespread damages to the locality.

Table 5. Hazards and vulnerability identified in *Mongla* under Bagerhat Districts.

Disasters	Notable events	Vulnerability and Risk Factor
Cyclone and Storm surges	Mongla is very much disaster prone to tropical cyclone and storm surges. Around seventy (70) major cyclones and six record tsunamis happened in the past 200-250 years that caused about 9 lack life loss.	▪ Highly impact on livelihood, economy, agricultural resources, food security, cropping pattern, land use ▪ Poses medium threat for fisheries, livestock etc.
Drainage congestion or water logging	In 1960 *Polderization* and in 1973 Khulna-Jessore Drainage Rehabilitation Project was started with short term benefits but later causes so many socio-economic problems, unsuccessful in many respects.	▪ Hampered health, sanitation and food security ▪ Severe to medium water logging in many areas ▪ Siltation on river bed
Salinization	Although people mentioned as their severe hazard events but not accurate statistics had found for study region. For the south-west region approximately 70 percent of 2.35 million ha crop land affected by salinity.	▪ Poses highly impact on fisheries, soil fertility, productivity, crop yield, rice production, health, infrastructure ▪ Moderate impact on agricultural resources, livestock
Scarcity of fresh water	People are severe facing fresh water crisis from 2009. Most of the shallow tube-wells are unsafe and around 53% contain arsenic beyond the permitted limit.	▪ Effect on health, sanitation, food, immunity etc.
Tidal flood and erratic rainfall pattern	The consequence of *polderization* and *dyking* around 5017 km by 123 polders appeared as human induced severe vulnerability for tidal flood.	▪ Poses high risk for the fisheries, agricultural resources, human resources and infrastructure sector ▪ Poses moderate risk for communication and livestock
Disasters	**Notable events**	**Vulnerability and Risk Factor**
Nor'easter and thunder storm	Some parts of coastal region like Mongla face nor'easter and thunder storm frequently were noticeable from 2005 to present.	▪ Highly affected the economy, agricultural resources, food security, cropping pattern and land use pattern ▪ Medium threat on fisheries, livestock and poultry industry
Contamination, pollution and environmental degradation	Illegal resource use, fishing, oil spills and domestic effluents cause ecosystem degradation with fauna and floral depletion.	▪ Poses high risk for fisheries, biodiversity, farming and natural resources etc. ▪ Poses moderate risk for humans, livestock and ecosystem by affecting different diseases like top-dying, root rot etc.

(**Source:** Field investigation, 2022; The International Disaster Database: www.emdat.be, 2012, [21])

Vulnerability assessment: Table 6 suggests that the community in Mongla is experiencing most vulnerability for high salinization, cyclone and storm surges with fresh water crisis. The risk evaluation suggests cyclone and salinity are the major hazards. Besides, drainage congestion and water logging also pose livelihood risks for the inhabitants. The risk evaluation indexing also suggests that *Mongla* lies in high-risk zone (Zone II) that requires immediate mitigation and planning for emergency response.

Table 6: Hazard ranking and risk valuation in *Mongla, Bagerhat*

	Hazard ranking	Vulnerability indexing	Social cost prioritization	Risk valuation
Drainage congestion or water logging	5	4	4	80
Salinization	**6**	**6**	**4**	**144**
Scarcity of fresh water	6	5	3	90
Cyclone and Storm surges	**7**	**8**	**4**	**224**
Contamination, pollution and environmental degradation	4	4	3	48
Tidal flood and erratic rainfall pattern	4	5	3	60
Nor'easter and thunder storm	4	3	3	36
Total value				**682**

Discussion: Interviews and FGD revealed the vulnerability factors for the natural disaster such as salinity, cyclone and flood. According to the respondents, the low elevated floodplain marks the coastal zone more susceptible to climate changes. Moreover, rivers and their aggressive erosional features put the entire coastal zone at risk. Bangladesh now one of the world's most disaster-prone country as its geographical position and natural dynamism [22, 23].

Salinity is one of the major reason that creates nexus with shortage of drinking water, skin problem and agricultural challenges [24, 25]. Interviews indicated that the sources of drinking water were very far from general community people and they were bound to drink saline water from nearest sources and suffer from intestinal and skin disease. Moreover, agricultural practices in the saline environment limited the opportunity. One of the most alarming natural calamities is cyclone and previously different occurrence disturbed the nature and livelihood [26].

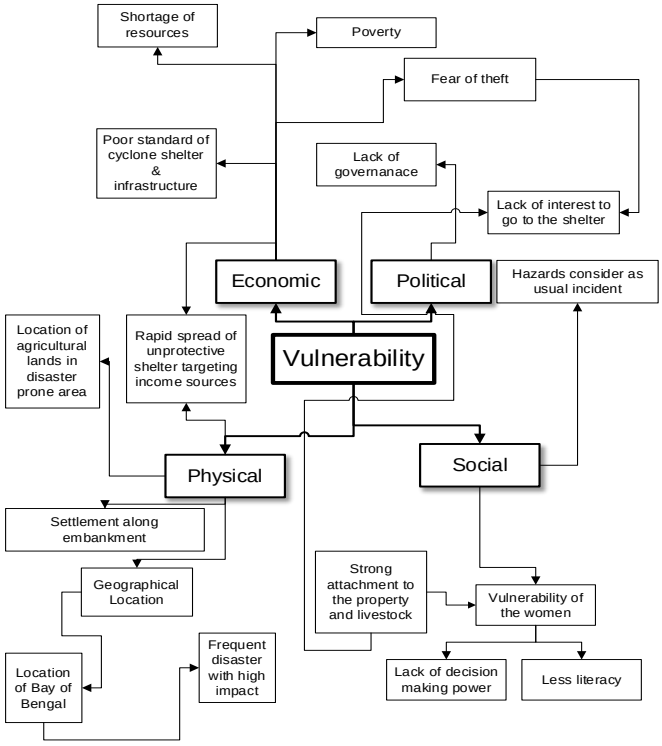

Fig. 12: Cyclone vulnerability factors of the community in Mongla Upazila (adopted from [29]).

Figure 12, incorporated the issues and linkages of livelihood vulnerability. The wind and storm surges damaged the household, livestock and agricultural farm. Rapidly growing settlement on the embankment without proper supporting structure, situation become risky. Yet, they deny to shift another. At the time of emergency like cyclone, the inadequate and unproper shelters could not perform at their peak [27]. Mismanagement and lack of proper maintenance turned these shelters into disaster itself and people preferred staying their house by their natural tendency [28]. People feared about burglary and thief and did not move to the shelter. Participants also stated that they were used to the impact cycle of the disaster.

Vulnerability of less able people and women during cyclones is another factor. Category IV storm, Cyclone Gorky, slammed Bangladesh on April 29, 1991, killing an estimated 140,000 people [29]. More women and children fatalities occurred during cyclone Sidr [30]. One of the female participants responded that majority of the women were illiterate and deprived from giving their opinion. Moreover, at the time of disaster food gathering and medical support became difficult [31].

Another insight indicated by the community was poverty which make them susceptible to the climate vulnerabilities. Poor wages and lack of resources made their struggle more intense. The majority of them were facing food shortage, lack of proper medical support, economic insolvency that made them unable to perform disaster preparation and post recovery activities [32].

Conclusions: The geographic location made this region vulnerable to frequent natural disasters and subsequent impacts. Due to low-income opportunities, the coastal community struggle to meet their basic necessities. Very few women are engaged in earning and most of them are homemaker. Surprisingly, only 1% of the total people had land-owning capability over 1 acre and basically most of them are without any asset. The household resource was found to be limited and provided service was less than

1 month during the time of emergency. Moreover, probability of being affected by natural disasters was very high. Salinity is a key issue that poses a constantly growing threat on their production capacity and surviving. The study found that the community is susceptible to the combined features of natural and man-made catastrophes due to lack of alternative options, solely in terms of economic and environmental constraints. Based on hazard ranking and risk evaluation, the community in Mongla lies in high-risk zone (Zone II). The total score value (682) represents serious or frequent but relatively less than very high-risk zone that have growing impact of potential hazards. Finally, generating alternative livelihood opportunities, promoting climate adaptive crop or aquaculture practices and community based management initiatives can help the coastal community to cope with the circumstances in the long run.

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