

# **Original Research Article**

## **Vulnerability of Agricultural Production due to Natural Disaster at Mongla, Upazila (Sub district) in Bangladesh.**

### **ABSTRACT**

**Aims:** To assess the vulnerability of natural disaster through participation of community and to identify the existing adaptation technique considering hazard's impact based on people's perception in the sense of agricultural production in the study area. Therefore this study was conducted to gain understanding on vulnerability due to natural disaster and its impact and to develop a strategy for minimizing the vulnerability through community participation.

**Study Design:** A total of 12 Focus Group Discussion's (FGD) and 05 Key Informant Interviews (KII) were conducted. A well-structured reconnaissance survey questionnaire was developed considering objectives and variables under this research.

**Place and Duration of Study:** Mongla Upazila (Sub district) of Bagerhat district in Bangladesh, from September 2013 to March 2014.

**Methodology:** Primary data was collected through face to face interview, oral talk with local expert, FGD, KII methods and 3 times field visit. Secondary data was collected from different books, Reports, daily newspapers, journal articles, research thesis.

**Results:** Mongla upazila (sub district) has the traditional practice of agriculture but now in extremely vulnerable due to frequent and intensive recurring phenomenon of natural hazards such as salinity intrusion, water logging, flood, cyclone and tidal surges causing the agriculture productivity gradually low down and makes the people economically vulnerable position. Due to those hazards and increasing frequency persistence time and intensity the local community especially the farmer's group are more exposed to vulnerability in the study area. As a result change in agriculture based occupation, increase migration, delay crop cultivation and conversion of agricultural land into shrimp cultivation locally called gher are common phenomena in the study area.

**Conclusion:** Due to recurring hazards like, increase salinity in agriculture land, water logging and cyclone are Aman and Boro paddy, drinking and irrigation water, agricultural labor are severely vulnerable, resulted change agriculture based occupation, increase migration and agriculture based land converted into shrimp cultivation gher.

**Key Words:** *Vulnerability, Agriculture, Production, Natural Disaster.*

### **1. INTRODUCTION:**

Vulnerability is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes as defined by the Intergovernmental Panel on Climate Change (IPCC) [1]. Vulnerability is a set of conditions and processes resulting from physical, social, economic and environmental factors that increase the susceptibility of a community to the impact of hazards [2]. Vulnerability we mean the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard (an extreme natural event or process) [3-5]. According to the Disaster Management Act vulnerability means measurement of elements at risk that are exposed to specific hazards both natural and human induced, and that have a low level of resilience to cope with the impacts or characteristics of that hazard [4].

The United Nations defined a disaster as a serious disruption of the functioning of a community or a society. Disasters involve widespread human, material, economic or environmental impacts, which exceed the ability of the affected community or society to cope using its own resources [6]. Disaster means natural, environmental and human induced hazards which require a significant coordinated

response by the Government and other entities to help the community recover with external assistance as it is not able to do so with its own resources and capabilities [4]. Bangladesh is one of the most disaster-prone countries in the world and the consequences of disasters and the resulting environmental degradation pose a serious threat to the economic development of the country [7]. Geographically, Bangladesh is located in the tropical region [8]. Natural disaster is a common phenomenon in Bangladesh is facing several disasters which is mainly attributed to the climate change [9]. Bangladesh is lies on a deltaic plain with five major river systems: the Jamuna Brahmaputra, the Padma-Ganges, the Surma-Meghna, the Padma Meghna, and the Karnaphuli. These geographical features of Bangladesh make its more vulnerable to natural disasters, such as floods and cyclones, Sidr, Aila [10].

United Nations International Strategy for Disaster Reduction (UNISDR) defined Hazard is a potentially damaging physical event, phenomenon, or human activity that may cause the loss of life or injury, property damage, social and economic disruption, or environmental degradation. Hazard can include latent conditions that may represent future threats and can have different origins: natural (geological, hydro-meteorological and biological) or induced by human processes (environmental degradation and technological hazards). Hazards can be single, sequential or combined in their origin and effects. Each hazard is characterized by its location, intensity, frequency and probability [6]. According to Community Risk Assessment (CRA, 2009) report the major hazards of Mongla upazila (Mongla upazila is a coastal city of Bangladesh is situated in bank of Pasur big river and opposite side of Sundarban) as salinity intrusion, water logging, tidal surges, cyclone and virus attack. It was reported that salinity problem create the most economic loss in land productivity [11]. Bangladesh Agricultural Research Council (BARC, 1997) showed that due to salinity problem loss of rice production was 4.42-MT which comprises the cost 586.75 million US\$ per year [12]. Adaptation is a concept that originated from ecology, which is defined as 'characteristics that help living organism survive under a given set of environmental conditions [13]. The IPCC defined adaptation as the 'adjustment in natural or human systems to a new or changing environment [1]. According to the IPCC, entitled the Climate change: impacts, adaptation and vulnerability stated that Bangladesh will lose the largest amount of cultivated land globally due to rising sea levels. This could lead to a significant drop in the production of rice (8%) and wheat (32%) by the year 2050 [1].

In Bangladesh agriculture is the overwhelmingly dominant sector of the economy, involving 80 percent of the total population and contributing to 25 percent the gross domestic product (GDP); Disasters like floods and cyclones cause substantial damage to standing crops, causing food insecurity and unemployment, for instances in 2007 devastating floods damaged 890,898 hectares of crops [7]. Most of agricultural production is concentrated on a limited number of crops, with rice occupying 82.6 percent of total cultivated area [14]. According to the Bangladesh Bureau of Statistics (BBS) District Statistics 2011, about 21.41% of people in Mongla upazila are involved in agricultural production. Total amount of cultivable land is 12867 acres, current fallow land 465 acres where single crop is 12987 acres, double crop is 6352 acres and triple crop land is 957 acres. Rice is the main crop, coconut; betel nut and sugarcane are nearly extinct crops. Main fruits are mango, black berry, lemon palm and papaya [15]. It is a coastal belt and near to bay of Bengale so Cyclone, heavy rainfall, and tidal wave hits almost every year and affects the people, damages their houses and crops, increase their sufferings which make them poor/ultra-poor. Poverty is persistent due to natural disaster and low income growth in the upazila. In the rainy season paddy, vegetable and other crops usually suffered by water logging. Fish farmer's loss their fishes due to overflow of saline water [23].

According to IPCC Report (2007), Agriculture is a major sector of Bangladesh's economy and the coastal area of country is very fertile for growing rice. Due to salinity intrusion in both soil and water will have serious negative impacts on agriculture and its adverse effects will be significant on coastal agriculture [16]. Coastal flooding and the intrusion of salt water on land similarly result in loss of cultivatable land, although there is no official record of reduced agricultural output due to salinity of the soil, analysts estimate the drop in agricultural production could be as much as 50 percent over the past 30 years, for example, in Khulna and Satkhira districts thousands of shrimp farms have been established, in some cases farmers have chosen to shift from agricultural production to shrimp farming as a result of salinization [17]. Salinity ingress also causes an increase in soil salinity, especially when farmers irrigate their lands with slightly saline surface water at the beginning of the low flow period

[24]. SRDI (1997) reported that, soil salinity levels south of Khulna and Bagerhat towns ranged between 8 to 15 dS/m during the low flow season [25].

Bangladesh is a disaster-prone country. Almost every year, the country experiences disasters of one kind or another such as tropical cyclones, storm surges, coastal erosion, floods, and droughts causing heavy losses [26] for farmers and agriculture sector. Agricultural activities are by nature prone to risks and uncertainties of various nature-biophysical, abiotic, climatic, environmental, biotic (pests, diseases) and economic [27]. At present roughly 25% of the population is considered food insecure [28]. Agriculture play a vital role in enhancing productivity, profitability and employment in the rural areas for improving the livelihood security status of the poor of the country [29].

The main objectives of the present study were to assess the present vulnerability due natural disaster in agricultural production, to identify the adaptation technique for the selected area and to develop a strategy for minimizing the vulnerability.

## 2. METHODOLOGY:

### 2.1: Study Area, Demography and Socio-economic status:

Current research work was conducted at Mongla upazila (sub-district) of Bagerhat district in Bangladesh. The Mongla upazila occupies an area of 1461.20 sq. km. of which 1260.87 sq. km. is land area. On the other hand the reserve forest area and riverine area is 5.46 and 1.56 sq. km. respectively. It lies between 21° 49' and 22° 33' north latitude and between 89° 32' and 89° 44' east latitude. It is bounded on the north by Rampal upazila, on the east by Morrelganj and Sarankhola upazilas, on the south by the Bay of Bengal and on the west by Dacope upazila of Khulna district [15].

Table 1. Demography and Socio-economic status of the study area

|                                            |        |                                |      |
|--------------------------------------------|--------|--------------------------------|------|
| No. of villages                            | 76     | Density (per sq. km.)          | 93   |
| No. of Municipality                        | 1      | Literacy rate                  | 57.2 |
| No. union parishad                         | 6      | No. of cycle shelter           | 21   |
| Total population (Male-71000. Fmale-65000) | 137000 | No. of river flow              | 02   |
| Household                                  | 32383  | Total agricultural land (acre) | 3500 |
| Average size of household                  | 4.02   | Diagnostic health center       | 2    |

(Source: BBS, District Statistics 2011: Bagerhat)

According to CRA Report-2009, the livelihood groups and their corresponding activities of Mongla upazila are very much diversified. The major livelihood activities include farming, fish culture, agro-labor, fishing service, business, van/rickshaw (mechanized van) pulling, cart pulling, date/palm climber), carpenter (wood), masonry, pottery, boat plying, blacksmith, barber, handicraft, imam etc. [11]. In the upazila the distribution of working people shows agriculture 21.41%, fishing 6.23%, agricultural laborer 12.41%, wage laborer 13.39%, commerce 15.09%, and transport 1.94%, service 16.27%, others 13.26% [15].

### 2.2 Soil Condition

The defining study area consists of one Agroecological Zones (AEZ) of Bangladesh namely; Ganges Tidal Floodplain (AEZ-8); the extent of the entire AEZ is 17,066 sq km. The region occupies an extensive area of tidal floodplain land in the southwest of the country. The greater part of this above the level of adjoining basins. Non-calcareous grey floodplain soil is the major component of region has smooth relief having large areas of salinity. Riverbanks generally stand about a meter or less general soil types. Acid sulphate soil occupies a significant part of the area, where it is extremely acidic during the dry season. Most of the topsoil's are acidic and subsoil's are neutral to mildly

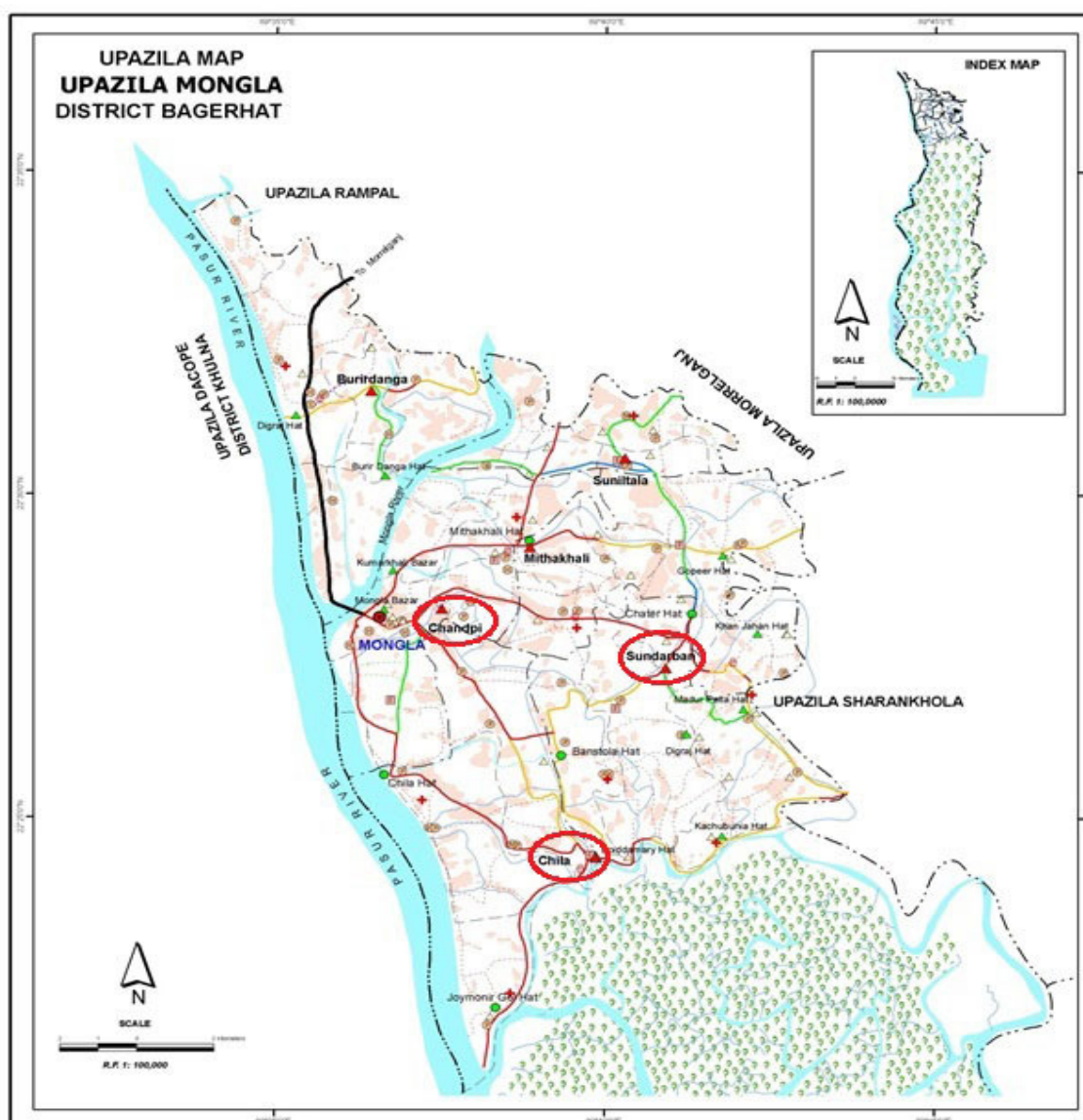


Fig. 1. Map of Mongla Upazila, Bagerhat in Bangladesh (Source: GIS Centre LGED)  
alkaline. Soils of the Sundarbans area are alkaline. General fertility level is high, with medium to high organic matter content [18].

### 2.3 Climatic condition:

As the study area is located near the world largest mangrove forests named Sundarbans (UNESCO, world heritage site). The highest temperature observes in April and May while lowest in December and January. The region has high relative humidity (80-90%) with mean annual rainfall ranges from about 1900mm to 2500mm. June, July and August are the wettest months while December, January and February the driest. The Mangrove forest of Sundarban geographically positioned at the apex of the Bay of Bengal and generally experiences violent storms in April and May with increase in temperature often above 35°C. Several cyclonic storms and tidal surges also generated in the Bay of Bengal and nearly 80% of which strike the Sundarbans resulting widespread inundation, damaged to property, vegetation and loss of life [19]. The main river of Mongla upazila is Pasur. The Pasur River is getting connect with national and international way of water transport. The Mongla River flows to the direction of east west from Pasur River [20].

## 2.4 Methods and Data collection:

In order to determine the vulnerability of agricultural production and to identify natural disaster simple stratified random sampling method was followed for selecting the villages in Mongla upazila. Mongla upazila consisted of 6 union parishads among them 3 unions were selected. The data collection methods included the Focus Group Discussion (FGD), structured interviews (questionnaire survey) with the community peoples, and oral talk with local experts direct field observation and Key Informant Interviews (KII). A total of 12 FGD sessions were conducted among farmers, day laborer, fisheries and female groups. A total of 144 respondents were selected from 3 villages for questionnaire survey. A total of 05 key informant interviews (KII) were done by sectoral specialists and social/community leader including upazila food and disaster management officer, fisheries officer and agriculture extension officer of Mongla Upazila. The further necessary secondary data was pertaining by accessing the relevant information from different books, Reports, maps, website, daily newspapers, journal articles, research thesis, and data from different local government administrative offices like union and upazila office. During data collection the following questions were focused to get the information i) The major hazards of the study area resulting losses in agricultural production ii) The amount of the agricultural production of the area; and iii) The occupational pattern and changes of livelihood during and without disaster. This study was conducted from September 2013 to March 2014.

## 2.5 Data Processing and Analysis:

After completion of all the relevant data and information, all of them were tabulated manually including editing, coding. All the data processing and analysis was done using Microsoft Office and Excel program. According to the United Nations Development Programme [21] defines Risk is conventionally expressed by the equation, Risk = Hazard + Vulnerability,  $[R = (H+V)]$ ; other scientists defines Risk (disaster), vulnerability, and hazard, whose relations it convenient to schematize in a pseudo-equation:  $R = H \times V$ , [22]. Therefore vulnerability assessment and computation was done following the equation;  $V = H \times R$ , (Here, V = Vulnerability, R = Risk and H = hazard).

## 3 RESULTS AND DISCUSSION:

### 3.1 Economic well-being and Household information:

Based on the research analysis among 144 respondent of the study area, 60% were male and 40% were female. Herewith, 46% respondent age were between 30-45 years old; 32% were 15-30 years old. The study depict that 70% respondent have elementary education and 20% of have secondary education. According to the table-1; 55% respondent income were below 5000 (BDT)/month and 20% respondent were 5000-10000 (BDT)/month. On the other hand, in the study area 55% of the respondent average land size was below 33decimal; 15% was above 100 decimal. The study revealed that 48% respondent have farming experience of at least 10 years, 37% up to 10 years and 15% above 25 years. It has found that 40% respondent occupation were both fishermen and forest dependent; 31% respondent were farming (agriculture) and 19% day laborer. As the Mongla upazila is situated in bank of Pasur big river and opposite side of Sundarbans. Almost about 60-70% percent people are living below poverty line. Most of the people at Mongla engage in agriculture, fishing, day labor, Port labor, shrimp farming and minor forest product (honey, nypa, fish, fuel) collection from Sundarbans [23].

**3.2 Hazards Identification:** According to the table. 2; for identification and prioritization of climate vulnerability. The prioritization was being done considering the frequency, intensity and level of impacts of the disaster on key resources and livelihoods. The overall present hazards of the Mongla Upazila have been identified through exchanging view with the general people through Focus Group Discussion (FGD) from the recent experiences/events of the last 5-10 years.

Table 2. Present Hazards of Mongla Upazila in Bagerhat

| Present Hazards                                                | Households Percentage (%) | Prioritization  |
|----------------------------------------------------------------|---------------------------|-----------------|
| Increase salinity in agriculture field and homestead pond      | 79                        | 1 <sup>st</sup> |
| Water logging during tidal Surge due to siltation in the river | 66                        | 2 <sup>nd</sup> |
| Cyclone                                                        | 56                        | 3 <sup>rd</sup> |
| River bank erosion during tidal surge                          | 30                        | 5 <sup>th</sup> |
| Crisis of fresh water for agricultural crop and fish culture   | 18                        | 7 <sup>th</sup> |
| Flood due to climate change                                    | 27                        | 6 <sup>th</sup> |
| Shrimp cultivation by local leader                             | 46                        | 4 <sup>th</sup> |

(Source: Field Surveyed data)

### 3.3 Seasonal Calendar of Agricultural Production:

The seasonal calendar of agricultural practice (Table-3) are formed by ground checking through direct conversation in the consultation meeting with the local people in the study area. The total agricultural practices of Mongla Upazila has been categorized as Aman paddy, Rabi crops, fruits like guava, sapoda, coconut/narikel, supari/betal leaf nut/areaca nut, jujube/kul, mango/amm, Boro paddy and IRRI paddy.

Table 3. Livelihood activities and seasonal calendar (agriculture) of the study area

| Main sources of livelihood | Season   |         |       |        |       |       |        |          |       |      |        |         |      |
|----------------------------|----------|---------|-------|--------|-------|-------|--------|----------|-------|------|--------|---------|------|
|                            | Boishakh | Jyostya | Ashar | Sraban | Badra | Aswin | Kartik | Agrahyan | Poush | Magh | Falgun | Choitra |      |
|                            | Apr.     | May.    | Jun.  | July.  | Aug.  | Sep.  | Oct.   | Nov.     | Dec.  | Jan. | Feb.   | Mar.    | Apr. |
| Aman Paddy                 |          |         |       |        |       |       |        |          |       |      |        |         |      |
| Rabi crops                 |          |         |       |        |       |       |        |          |       |      |        |         |      |
| Guava, Kul, Mango          |          |         |       |        |       |       |        |          |       |      |        |         |      |
| Boro, IRRI, paddy          |          |         |       |        |       |       |        |          |       |      |        |         |      |

(Source: Field Surveyed data)

Table. 3 showed that, respondents of study area mainly engaged with agricultural production. Aman paddy occupied the major contribution in the agricultural activities. Aman is planted in the mid-month

of July and harvested in the month of January. On the other hand Rabi crops are practiced in the month of November and harvested in the months of February-March. Nevertheless, IRRI paddy also contributes in agriculture. Although it is cultivated in whole year mainly it is harvested in the months of March-April and December-January. Last two years the Department of Agricultural Extension (DAE) of Mongla upazila tries to practice Boro paddy in some selected fields. Except the agricultural practice major portion of people are engaged in various types of non-agricultural works. Among the fruit species, most of the people were practiced in the cultivation of planting indigenous species like guava, kul, mango, narikel, supari etc. Some livelihoods activities were carrying out almost throughout the year such as: shrimp and fresh fish collection, shrimp fry collection, cottage industry, poultry farm, day labor, van puller and nosimon (mechanized van) driver, fisherman, small traders, country boat and trawler driver, mobile small business, water business, bricks and silica/sand business, rearing livestock, service holders, carpenter, golpata (Nypa)/goran collection, bawali, mowali etc.

### 3.4 Vulnerability of the Socio-Economic Variables:

The Socio-economic variables identified those sectors all of which are concerned with the economic vulnerability. For agriculture sector Aman and Boro paddy are severely vulnerable due to salinity hazards.

Table 4. Vulnerability status of socio-economic variables of the study area:

| Major hazards of Mongla upazila:<br>salinity intrusion, water logging, River siltation, Cyclone and Storm surge, Floods, Virus attack etc. | Vulnerability status to the hazards of Mongla upazila |                     |                          |                     |
|--------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|---------------------|--------------------------|---------------------|
|                                                                                                                                            | Socio-economic variables                              | Vulnerable elements | Ranking of vulnerability | Most affected group |
|                                                                                                                                            | Agriculture                                           | Aman and Boro       | ++++                     | Aman and Boro       |
|                                                                                                                                            |                                                       | Rabi crop           | +++                      |                     |
|                                                                                                                                            |                                                       | Jute                | ++                       |                     |
|                                                                                                                                            |                                                       | Wheat               | +                        |                     |
|                                                                                                                                            |                                                       | Vegetables          | +++                      |                     |
|                                                                                                                                            |                                                       | Fruits              | +++                      |                     |
|                                                                                                                                            | Fisheries                                             | Shrimp              | +++                      | Shrimp farming      |
|                                                                                                                                            |                                                       | White fish          | +++                      |                     |
|                                                                                                                                            |                                                       | Crab                | ++                       |                     |
|                                                                                                                                            | Forest                                                | Forestry/Trees      | ++                       | Homestead plants    |
|                                                                                                                                            |                                                       | Homestead plants    | +++                      |                     |
|                                                                                                                                            | Livestock's                                           | Cow                 | ++++                     | Cow                 |
|                                                                                                                                            |                                                       | Goat                | ++                       |                     |
|                                                                                                                                            |                                                       | Poultry             | +                        |                     |
|                                                                                                                                            |                                                       | Duck-hen            | ++                       |                     |

|  |                             |                         |      |                               |
|--|-----------------------------|-------------------------|------|-------------------------------|
|  | Occupation                  | Agriculture Labor       | ++++ | Agricultural Labor            |
|  |                             | Business                | +    |                               |
|  |                             | Fishing                 | +++  |                               |
|  |                             | Formal services         | +    |                               |
|  |                             | Informal services       | ++   |                               |
|  |                             | Handicraft              | ++   |                               |
|  |                             | Others                  | ++   |                               |
|  | Infrastructure              | Kacha road              | ++++ | Kacha road                    |
|  |                             | Pacca road              | +    |                               |
|  |                             | Office                  | +    |                               |
|  |                             | Health care center      | ++   |                               |
|  |                             | Educational Institution | +    |                               |
|  | Shelter                     | Pacca house             | -    | Kacha house                   |
|  |                             | Semi-pacca house        | +    |                               |
|  |                             | Kacha house             | +++  |                               |
|  | Health                      | Physical/mental health  | +++  | Physical and mental health    |
|  |                             | Maternal health         | ++   |                               |
|  |                             | Child health            | ++   |                               |
|  | Water supply and Sanitation | Drinking water          | ++++ | Drinking and irrigation water |
|  |                             | Water for domestic use  | +++  |                               |
|  |                             | Irrigation water        | ++++ |                               |
|  |                             | Sanitation facility     | +    |                               |

Notes: Ranking of Vulnerability  
data)

(Source: Field Surveyed

++++ = severely vulnerable; +++ = highly vulnerable; ++ = moderately vulnerable, + = vulnerable; — = No vulnerable

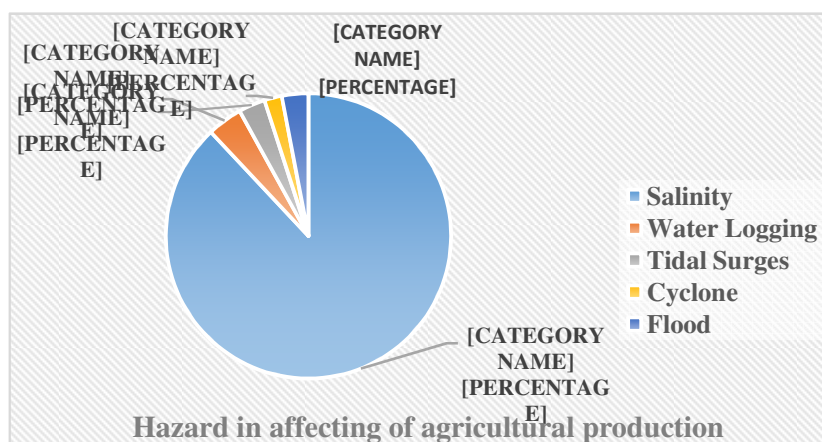
Table. 4 depict that, Fisheries sector (shrimp, prawn and white fish) of the study area is highly vulnerable due to the problems of salinity, virus attack, cyclone etc. Homestead tree species also highly vulnerable for the problems of salinity, water logged, cyclone and tidal surges. It was found in the field direct observation, questionnaire survey, KII and FGD, the most of the land area of study area is now practiced by the shrimp gher (small area inundated by saline water for shrimp culture) farming. There is no available grazing land for livestock farming and thus cattle were severely vulnerable condition and suffering from nutrition. Among the occupational practice, farmers and agricultural labors are severely affected due to extensive practice of shrimp gher farming and the total shrimp gher farming is controlled by some local leader. As a result, the poor farmer and agricultural

labors are in severe vulnerable situation. Kacha house and Kacha road are highly vulnerable to hazards like flood, water logging and tidal surge. Physical and mental health of the peoples in the area is in frustrated condition due to soil and water salinity and acute fresh water crisis. Drinking water scarcity and ground water lifting for irrigation purposes were also the major problem of the area.

### 3.5 Vulnerability with Respective Hazards: People's Perception in the Sense of Agricultural Production:

#### Hazard's Impact on Agricultural Production:

The study revealed that (Fig.1), 88% respondent opined that most serious hazard for decreasing agricultural productivity of the study area is salinity; 4% respondent opined that water logging possess hazards and 3% respondent given their opinion both tidal surges and flood retain hazards for decreasing agricultural productivity. The main cause of decreasing agricultural production is the rapid expansion of shrimp farming over the area. By using tidal fluctuation enter saline water into gher area for shrimp farming. For extensive shrimp farming in present few years the salinity level of land has been increased and the productivity has been decreased gradually. Increase in salinity intrusion and increase in soil salinity will have serious negative impacts on agriculture. In Bangladesh, rice production may fall by 10 % and wheat by 30 % by 2050 [16]. Impacts of Salinity 10% more land (relative to 1990) will be saline-affected and intensity will be increased by 10 %; Decreases availability/productivity of agricultural land Creates socioeconomic problems, generally women are more vulnerable [24].



(Source: Field Surveyed data)

Fig. 2. Percentage of hazard in affecting of agricultural production.

### 3.6 Adaptation strategies to minimize the vulnerability of agricultural production:

The study analysis that the perception levels of adaptation option from the respondent were determined through the questionnaire survey, FGD, KII and field level direct observation. The database in this regard denotes only three problems are mostly identified for agricultural productivity induces vulnerability. The following figures (Fig.3, Fig.4, Fig.5 and Fig.6) showed different strategies of adaptations is taken by the community people for reducing vulnerability of agricultural production.

The perception level of adaptation for salinity problem in agricultural production; 81% respondent opined that change/shifting their agriculture based occupation; 79% were saline tolerant rice (HYV) cultivation as a part of adaptation options. At the same time research revealed that 36% respondent said, the farmers has taken loan for agricultural practice; 14% viewed that people think to migrate from the place (climate refugee) as their adaptation approach resulting from low agricultural productivity. The graph exhibit that (Fig. 4) in case of water logging perception level of adaptation option is given by the adapt with water logging problem 36% of population think to changes agricultural based

occupation and canal cutting to drain out water, 21% respondent viewed delay crop cultivation consider adaptation practice in water logged situation. According to the Fig.5, about the perception level of adaptation option for cyclone and storm surge of agricultural production, after taking place of a cyclone 45% of respondent take loan for agricultural production to cope with the vulnerability. In case of storm surge 43% of respondent views is to build embankment around the agricultural land for protecting the entrance of saline water into their farm land. Here, 79% respondent recommended that require modern techniques (adaptation options) in crops cultivation; 55% construct sluice gate to reduce water logging and 50% opined both re-excavate of canal, river, and streams and to enforce reducing of shrimp culture.

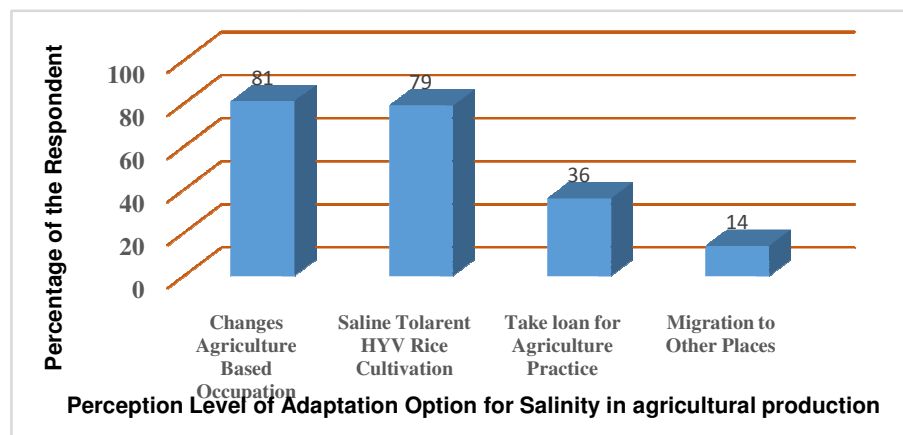


Fig.3. Respondent Perception on local Adaptation Option

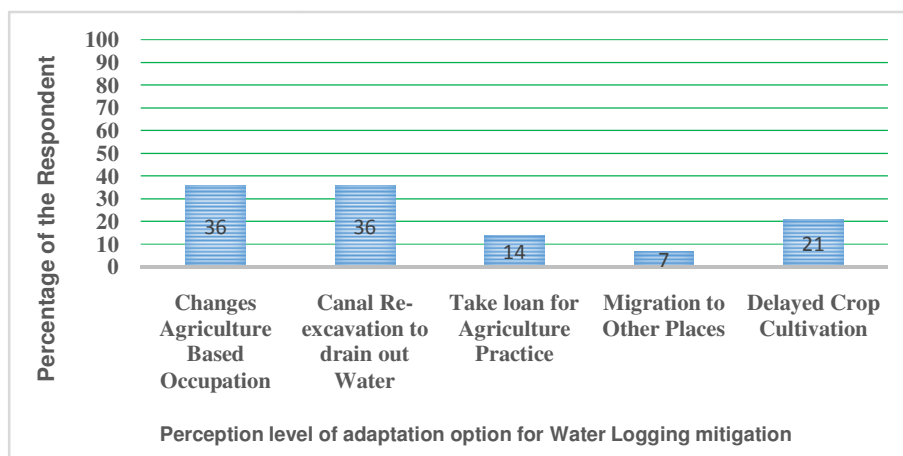


Fig.4. Perception Level of Adaptation for Water Logging in agricultural production

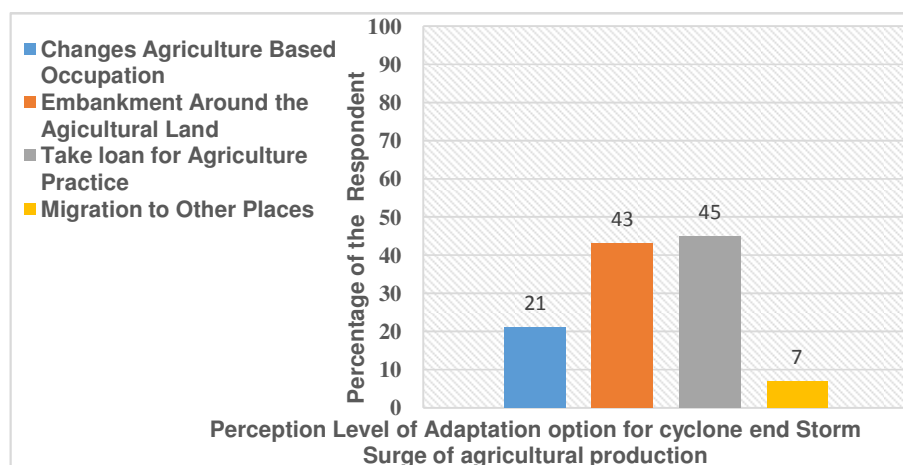


Fig.5. Perception Level of Adaptation option for cyclone end Storm Surge of agricultural production

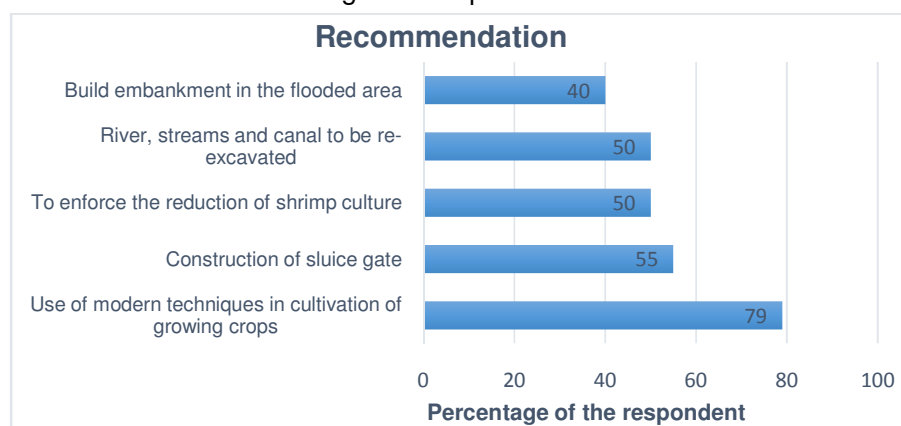


Fig. 6. Recommendation of the respondents

### 317 Conclusion:

318 The study area have the traditional practice of agriculture but now in extremely vulnerable due  
 319 frequent and intensive recurring phenomenon of natural hazards. About 31% of people in selected  
 320 community are involved in agriculture based occupation but the recurrent event of hazards like salinity  
 321 intrusion, water logging, flood, cyclone and tidal surges causing the productivity gradually low down  
 322 and makes the people economically vulnerable position. In the sense of agricultural production salinity  
 323 is the highest ranking problem and it possess 88% of the respondent view. Present research shown  
 324 that delayed crop cultivation, change/shifting agriculture based occupation, saline tolerant rice  
 325 cultivation, changing cropping pattern, canal re-excavation to drain out water, built embankment  
 326 around the agriculture land were adopted by the farmers to cope with climate vulnerability and to  
 327 minimize the vulnerability of agricultural production in terms of salinity, water logging and cyclone,  
 328 storm surge. Here, 79% respondent recommended that require modern techniques (adaptation  
 329 options) in crops cultivation; 55% construct sluice gate to reduce water logging and 50% opined both  
 330 re-excavate of canal, river, and streams and to enforce reducing of shrimp culture.

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### 332 REFERENCES:

- 333 1. IPCC (Intergovernmental Panel on Climate Change), 2007. Climate Change 2007: Impacts, Adaptation and  
 334 Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental

- Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, pp.6,869
2. Philipp, S.T., 2006. Natural and Technological Hazards and Risks Affecting the Spatial Development of European Regions. Geological Survey of Finland, Special Paper 42, pp. 66
3. Blaikie, P., T. Cannon, I. Davis & B. Wisner, 1994, At Risk: Natural Hazards, Peoples' Vulnerability and Disasters, London: Routledge, pp. 10
4. Ministry of Disaster management and Relief, 2012. The Disaster Management Act. Bangladesh Gazetted, on September 24, 2012. The People's Republic of Bangladesh.
5. WHO (World Health Organization), 2002. Gender and Health in Disasters. Department of Gender and Women's Health. World Health Organization, 20, Avenue Appia, Geneva, Switzerland
6. UNISDR (United Nations International Strategy for Disaster Reduction), 2012. UNISDR Terminology on Disaster Risk Management. Geneva, Switzerland; 2015. Accessed 02 July, 2012. Available: [www.unisdr.org](http://www.unisdr.org)
7. BDRCS (Bangladesh Red Cross and Red Crescent Societies), 2008. International Federation of Red Cross and Red crescent Societies: Bangladesh. Third strategic development plan 2009-2010.
8. FAO, 2011. State of forest genetic resources conservation and management in Bangladesh. Available at: <http://www.fao.org/docrep/007/ad870e/ad870e01>. htm. Accessed on: June 14, 2011.
9. Daily Star, 2011a. Major disasters and management issues. Available at: <http://www.thedailystar.net/suppliments/2011/anniversary/part6/pg10>. htm. Accessed on: June 14, 2011.
10. ICDDR, B, 2011a. Our Strategy. Available at: [http://www.icddrb.org/what-we-do/publications/cat\\_view/52-publications/10043-icddrb-documents/10055-annual-report/10056-annual-report-2009/10063-our-strategy-](http://www.icddrb.org/what-we-do/publications/cat_view/52-publications/10043-icddrb-documents/10055-annual-report/10056-annual-report-2009/10063-our-strategy-). Accessed on: June 14, 2011.
11. CDMP, 2009. CRA (Community Risk Assessment) Report on Mongla Upazila by Area Development Organization (ADO), 2009. Hazards and Risks of Mongla Upazila. Community Risk Identification and Risk Reduction Action Plan. Implemented by: Mongla Upazila Disaster Management Committee. Mongla Upazila, Bagerhat. May.
12. BARC (Bangladesh Agricultural Research Council), 1997. Land Degradation Situation in Bangladesh. Soil Division, Bangladesh Agricultural Research Council. Dhaka, Bangladesh.
13. Miller, G.T. 2005 Living in the environment—principles, connections, and solutions. Brooks/Cole–Thomson Learning, Pacific Grove, CA, pp. 90
14. GoB, 2004. Agribusiness Development Project final report for the Government of Bangladesh (GoB) and Asian Development Bank (ADB). TA 4319 BAN. Agrico Limited, New Zealand. In association with ANZDEC Limited, Agrifood consulting International INC, SODEV consult and HB consultants.
15. BBS (Bangladesh Bureau of Statistics), District Statistics 2011: Bagerhat. Bangladesh Bureau of Statistics. Planning Division, Ministry of Planning. Peoples Republic of Bangladesh, Dhaka, Published in December, 2013
16. IPCC (Intergovernmental Panel on Climate Change), 2007. Climate Change in Asia 'too alarming to contemplate'-report.

- 372 17. BIIS (Bangladesh Institute of International and Strategic Studies), 2009. Climate change and security in  
373 Bangladesh: A case study. June 2009.
- 374 18. SRDI (Soil Resource Development Institute), 2000. Land and Soil Resource Utilization Guides, Upazilla  
375 Nirdeshika, Khulna and Barisal Division, Ministry of Agriculture, Dhaka –1215.
- 376 19. BFD, 2014. SEALS Newsletter no.1, Improved management and conservation of Sundarbans through EU  
377 funded SEALS, Bangladesh Forest Department (BFD), People's Republic of Bangladesh
- 378 20. SRDI (Soil Resource Development Institute), 2001. Land and Soil Resource Use Manual. Mongla Upazila,  
379 Bagerhat District. Upazila Manual Series-402. Ministry of Agriculture, Peoples Republic of Bangladesh.
- 380 21. UNDP (United Nations Development Programme). Reducing Disaster Risk: A Challenge for Development.  
381 Bureau for Crisis Prevention and Recovery, S. Swift Co. New York; 2004, pp. 98
- 382 22. Wisner B, Blaikie P, Cannon T, Davis I. At Risk, Second Edition. Routledge, London; 2006, pp. 49
- 383 23. UNICEF, 2014. Mongla Upazila Profile District: Bagerhat, Local Capacity Building and Community  
384 Empowerment (LCBCE) Programme, pp. 4-5
- 385 24. PRDI (Participatory Research and Development Initiative), 2012. Increasing Salinity Threatens Productivity  
386 of Bangladesh; Climate Campaign Brief, Dhaka 1215. Bangladesh
- 387 25. SRDI (Soil Resource Development Institute), 1997. Land and Soil Resource Utilization Guides, Upazilla  
388 Nirdeshika, Khulna and Barisal Division, Ministry of Agriculture, Dhaka–1215.
- 389 26. Ali A, 1999. Climate change impacts and adaptation assessment in Bangladesh, Climate Research, Vol. 12:  
390 109–116
- 391 27. Gitz V, Meybeck A. Risks, vulnerabilities and resilience in a context of climate change. Building Resilience  
392 for Adaptation to climate Change in the Agriculture Sector. Agriculture and Consumer Protection  
393 Department, FAO, Rome. Accessed 23 January, 2015, Available: <http://www.fao.org/docrep/017/i3084e/i3084e03.pdf>  
394
- 395 28. World Bank. Bangladesh: Bolstering Economic Growth to Reduce Poverty. April 15; 2013.
- 396 29. BBS (Bangladesh Bureau of Statistics). Statistical Year Book of Bangladesh. Bangladesh Bureau of  
397 Statistics, Bangladesh, Dhaka; 2013.