CLIMATE CHANGE AND FARMING VULNERABILITY IN THE COAST OF BANGLADESH

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Abstract

The research was conducted in the coastal wetland to investigate farmers' livelihood vulnerabilities. The farmers within the study area of costal wetland were earnestly affected by various types of hazards like, river bank erosion, salinity intrusion, cyclone, tidal flood, heavy rainfall, water logging as well. Agriculture is the main source of economy, which is threatened by almost all the hazards. In the study area most of the farmers (46.36%) were having below 0.2 hectors of land and only 4.54% farmers had above 0.3 hectors. The major field crop of the study area was rice (Boro/Aman). Generically farmers were not acquainted to cultivate Aus in this area. During Aus growing season (kharif-1) the salinity intensity became higher and they had less opportunity to use the land for Aus cultivation. Majority of the farmers (72.73%) used rain water for agricultural purpose instead of river water. In adverse situations, around 37% farmers were migrating from affected areas to non affected areas and among the displaced farmer 21% were permanent and 16% were seasonal. The present study revealed that climate change induced hazards severely leading to crisis of freshwater, damage of houses, decreasing in rice and other essential crop production.

Keywords: Livelihood, Climate Change, Salinity, Agriculture, Environmental Migration, Coastal Wetland.

1. Objectives of the Study

The main objective of the study is to assess the livelihood vulnerability of farmers in the coastal wetland due to various climatic disruptions.

The objective is further subdivided into following way:

✓ To identify farmers perception about climate and climatic hazards;

✓ To describe selected socio-economic characteristics of the farmers livelihood in the coastal wetland, and

✓ To explore climate change impact on socio-economic characteristics of the farmers livelihood.

2. Significance of the Study

Satkhira District is situated in the western coastal district of Bangladesh and vulnerable to climate change (MoF&DM, 2010). This union (the lowest administrative units) under the Satkhira district is exposed to various climatic hazards which lead to serious negative impact on agriculture. As a result, farmer suffers most and the face a lot of losses. Besides, purity of drinking water, daily life faces a threat. Along with these, hailstorm, river bank erosion etc. cause a lot of mishaps. Again tidal or rainfall flood visits every years either for which untold suffering and heavy loss of life and properties are observed. Realizing all these negative aspects, Protapnagar union has been selected as the study area for the study.

3. Methodology

An appropriate and systematic methodology is always expected in every study. For good accomplishment of the research work a well arranged methodology is extremely needed. A chronological description of the methodologies followed in conducting this research work has been presented below.

3.1 Conceptualization

It means developing clear understanding about what is intended to do in the study. This is done by the two ways includes consultation with resource persons, and literature review.

3.2 An Overview of the Study Area

The study was conducted in the western coastal district of Bangladesh. Some criteria have been followed during selection of the study area includes located in the coastal area, degree of vulnerability, representativeness in newspaper and documents.   Following these, Protapnagar Union[34] in the sub-district of Assasuni of Satkhira district has been selected to meet the study objectives. It is located 22° 22′ north to 22° 24′ north latitude and 89° 12′ east to 89° 16′east longitude. River locked area is bounded by Kholpetua and Kapothakkho river. The total area of this union is about 16.70 km^2 with population density of about 1500 per sq. km (BBS, 2010).

3.3 Reconnaissance Survey

In order to get a view of the nature of the study area and prior to data collection, a reconnaissance survey was initiated to acquire some basic ideas regarding livelihood vulnerability through the personal interview with the farmers' of the study area. During the survey, views were exchanged with the farmers about the objectives. Preliminary, the survey has helped to realize the farmers' existing adverse condition in the study area.

3.4 Questionnaire Preparation

Considering the objectives of the study a structural questionnaire was prepared for the selected community. The questionnaire was used to detect the problems of the existing farmers' livelihood vulnerability in the selected coastal area.

3.5 Data Collection Method
3.5.1 Primary Data Collection Method

The data has been collected through personal interview. A set of questionnaire has been developed which covers the information necessary for the study. The method is also called 'structured interview'. After developing the questionnaire, interview has been conducted in the study area. The household survey was completed in four intervals.

3.5.2 Field Investigation

Field investigations were conducted through the sequential completion of the following:

a) Respondent Group Selection:

Participants have been selected for the study from different age of farmers livelihood representatives of present nine wards of Protapnagar union and as secondary stakeholder there have been participated the members of the

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[34] Lowest administrative unit of Bangladesh

disaster management committee and Govt. officials as vulnerability assessment activities.

b) Population and Sample of the Study:

With the help of Upazila Agricultural Officer (UAO), his field staff and local leader, an updated list of farmers was collected. The total number of the farmers is 1100.   In old ward of Protapnagar union, 110 farmers were selected considering 10% of the total number of the farmer. The respondents were then selected following simple random method. But due to absence of some selected farmers during the data collecting the researcher made a reserve list of the farmers.

c) Questionnaire Design and Pre-testing and Finalization:

An interview schedule was prepared for collection of data from the respondents keeping the objectives of the study in mind. The questions and statements contained in the schedule were simple, direct and easily understandable by the farmers. Simple and direct questions, different scales, closed and open form statements were included in the interview schedule to obtain necessary information. Appropriate scales were also developed to operation the selected characteristics of the farmers. The draft interview schedule was prepared in English and was pre-tested with 15 farmers. This pre-testing facilitated the researcher to examine the suitability of different questions and statements in general. On the basis of pretest result, corrections, modifications and adjustment were done in the interview schedule.

3.5.3 Farm Size

The farm size of a respondent was measured in hectares using the following formula:

$$Fs = A1 + A2 + A3 + A4 + \tfrac{1}{2}(A5 + A6) - A7 + A8$$

Where, Fs = Farm size, A1 = Homestead area, A2 = Vegetable land besides homestead, A3 = Own land under own cultivation, A4 = Fallow land, A5 = Own land given to other on borga, A6 = Land taken as borga from others, A7 = Own land given to others as lease and A8 = Land taken as lease from others. The data were first recorded in term of local unit i.e. 'bigha' and then converted to hectare.

3.5.4 Environmental Hazards in Coastal Areas

A-four point rating scale ranging from "frequently" to " not at all" was developed to measured the extent of environmental hazards in coastal areas of the farmers. However, use of four point scales identical to one was found in many studies employed to ascertain the "extent of environmental hazards in coastal areas" of the respondents.

3.5.5 Scoring Techniques

The method of assigning scores to the four alternatives in each statement was considered. For assign score 0, 1, 2, 3 indicate no environmental hazards, rarely environmental hazards, occasionally environmental hazards and frequently environmental hazards respectively. The range of environmental hazards score of the respondents could vary from 0 to 21, where, 0 indicate no environmental hazards and 21 indicated full environmental hazards. However, besides having calculated the "extent of environmental hazards" score for each of 110 respondents, an effort was also made to compare the relative hazards.

An Environmental Hazards Index (EHI) was developed to fulfill this objective using the following formula:

$$EHI = N1_3 + N2_2 + N3_1 + N4_0$$

Where, EHI= Environmental Hazards Index, N1=Number of farmers affected by the environmental hazards frequently, N2= Number of farmers affected by the environmental hazards occasionally, N3= Number of farmers

affected by the environmental hazards rarely, N4= Number of farmers not at all affected by the environmental hazards, The EHI for each of the environmental hazards ranged from 0 to 330.

3.6 Data Collection

3.6. 1 Primary Data Collection

Data were collected by means of interviewing the selected sampled farmers. The researcher himself collected data for this study. But to familiarize researcher with the selected farmers and establishing report during conducting the interview, the researcher had to seek help from local leaders of the study area. Before going to the respondent's home for interviewing they were informed verbally to ensure their availability at home as per schedule date and time. Twenty respondents from the reserve list were interviewed because the respondents were repeatedly unavailable for date collection. In some cases the respondents felt shy to give answer at some aspect of questioning. However, data were collected during November, 2009 to January, 2010.

3.6. 2 Secondary Data Collection

Secondary information such as statistical data, demographic information, reports, maps have been collected from various Government, Non-government organizations, universities and local Union Parishad (UP) office of Protapnagar.

3.7 Data Analysis

After collecting the data from primary sources, efforts were made for processing the data. After sorting out the data and information were categorized and interpreted according to the objectives and descriptive analysis were done using statistical treatment with SPSS (Statistical Package for Social Sciences) computer package. Such statistical measures as number, and percentage were used in describing the variables wherever applicable.

3.8 Data Presentation and Collection of Feedback

After analyzing the total data obtained from primary and secondary sources, it is presented in a systematic way to reach the expected goal based on the objectives of the thesis. To present the data in a more authentic way some feedback were collected from the experienced person.

3.9 Report Writing and Final Preparation

The report of the study is written through the systematic way by using the computer program Microsoft Office.

4. Results and Findings

4.1 Summary of the Findings

The study considered the variables to met the objectives which includes age, family size, annual income, educational status, earners dependents, farm size, cropping pattern/system, food sufficiency, natural resource accessibility, environmental displacement, housing characteristic, water supply and sanitation, health and diseases, knowledge about climate, environmental hazard faced by farmer, and impact of climatic change on livelihood. The summary of the findings are cited below:

4.1.1 Socio-economic Characteristics of the Farmers

4.1.1.1 Age structure

The analysis of the age structure of the study area showed that 31-40 years age groups are manly engaged in income activities (34.55%) in average of total population. The groups are 21-30 years of age (21.82%), above 60 years (4.54%) and below 20 years (7.27%). Below 20 years age group may be regarded as occasional working age group. The decrease of percentage distribution for above 60 years age group due to less working capacity and but also show interest in the profession.

4.1.1.2 Family Size

In case of sample, the medium size family (1-3 members) accounts for about 51.82%, respectively. As the highest in respect of total sample unions followed by small, large and larger families, the percentages in respect of sample were 8.18, 30, and 10, respectively. From the distribution it is evident that 51.82% for medium size family (highest) and 10% for larger size family (lowest) in the study area. The small size families

are positively associated with low income, nuclear family and lower capital investment. Medium and large families are due to the more birth rate. It is also associated with the high sex ratios, higher income, extended family and capital investment in different ways and multi income sources. The more family members create additional burden for the farmers.
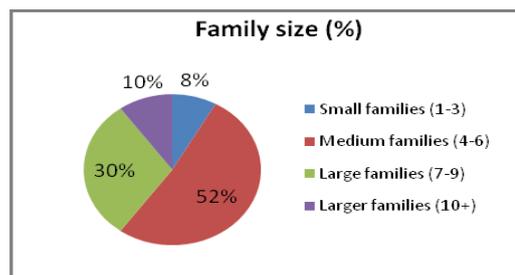
4.1.1.3 Annual Income

The highest portion (60.91%) of the respondents have low annual income (upto Tk. 50.00 thousand) compared to 13.64% had high income (above Tk. 100.00 thousand) and 25.45 % under medium annual income (Tk 50.00-100.00 thousand) level. The average income of the peoples of the study area (<200 US Dollar) is lower than the average per capita income of the country i.e. 740 US dollar (BBS, 2007). The findings indicate that major portion farmer's annual income is lower than the average per capita income of the country. Hence, their livelihood is vulnerable in terms of economy.
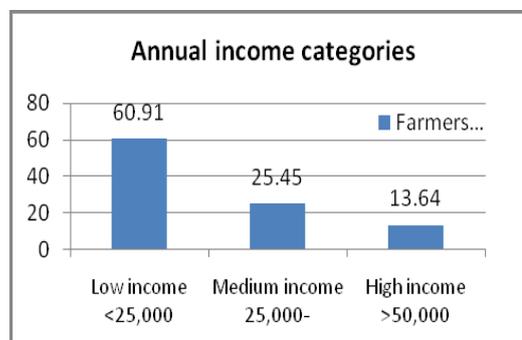
4.1.1.4 Educational Status

Majorities of the members were class I-V group (54.57%). The second largest education group (41.82%) occurred in illiterate group and only sign but literate. Their tenancy earned money rather than education. This means that the low education of the farmers, the more rate of their livelihood vulnerability.
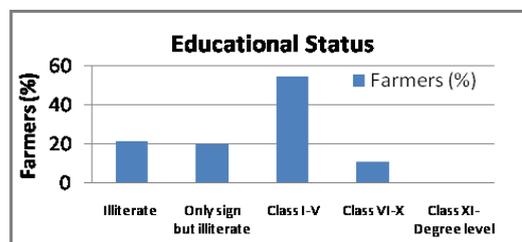
4.1.1.5 Earners Dependents

Earners dependents in the study sample 110 (20.23%) out of 734 population were earning members. In the view of the samples in the earning consideration 20.23% and 79.77% were earner and dependent members, respectively and the earner and dependent ratio was 1:3.94 in average out of 180 populations. From the result, the more dependency ration indicates the economic insolvency as well as social insecurity.

4.1.1.6 Farm Size

The farm size of the respondents ranged from 0.028 to more than 3.23 hectares. The highest portion (46.36%) of the farmers had marginal farm as compared to 34.55% small farm, 14.55 % medium farm and 4.54 % had large farm. Large farm size is less vulnerable rather than small farm size.
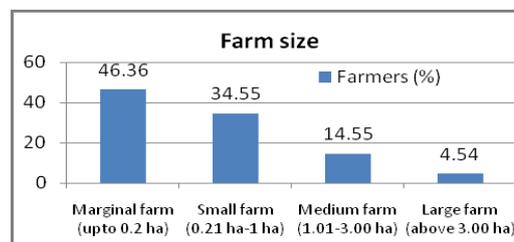
4.1.1.7 Housing Characteristic

Most of the dwellers in my study area have kacha house (90%) and small percentage of the dwellers use semi-pacca and pacca house (5%). About 25 % households of my study area use golpata as for roofing material. 30% households use thatch (rice straw) as roofing purpose. Majority plinth height of the house was medium (75%) categories and was prime consideration for housing to protect against water logging and flood. On the other hand low plinth height of the house (25%) was at risk in various hazards. The weak housing as well as low plinth height of the house shows more vulnerability.

4.1.2 Cropping Pattern/System

In the study area single cropped production farmers were 34.55% and the double cropped production farmers were 66% and triple cropped were 5.45%. The major field crop of the study area is rice (aman/boro). Generally farmers did not cultivated Aus in this area. During Aus growing season (Kharif-1) the salinity intensity becomes higher and they have less opportunity to use the land for Aus cultivation. Other crops like sesame, groundnut, potato, vegetables (especially winter vegetables) are also grown in limited field.
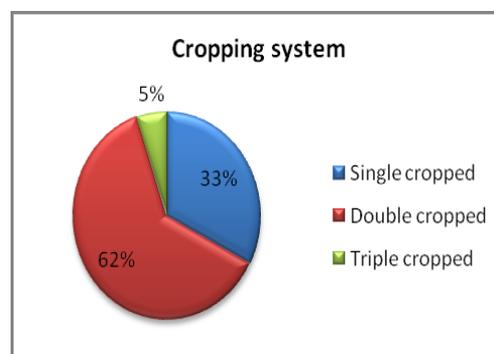
4.1.3 Food Sufficiency

It is proved that about 11.83% of the people in the study area have food sufficiency for the whole year. On the other hand 30% of farmer has food sufficiency for the less than one month. The findings indicate that that majority (59.18 percent) of the farmers had food sufficiency for the less than six months. Food insecurity of farmers had a significant and positive relationship with their livelihood vulnerability.
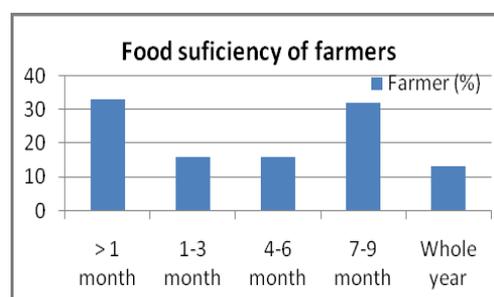
4.1.4 Natural Resource Accessibility

In the study area 65.91% poor and marginal farmer has access to natural resources for additional income and they are facing various problems to access natural resources. The majority (62.5%) of the respondent are facing problem during accessing natural resources due to ill planned shrimp culture in canals followed by 26.39% for environmental hazards and 11.11% for lack of adequate money. So, less accessibility of poor and marginal farmers to natural resource has increased their livelihood vulnerability.
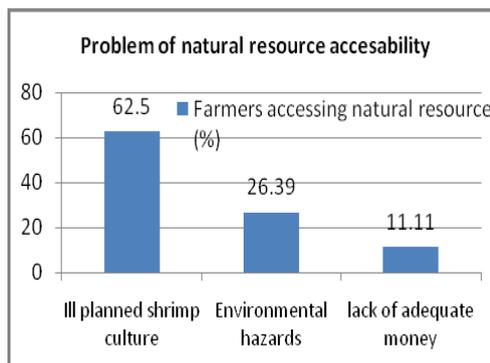

4.1.5 Environmental Displacement

In the study area 57.27% of the farmers have displaced to another area, for either permanent or seasonally. About 62% of the respondents have cited the absence of job in the village as the principal reason for displacement to the areas, where 54% for seasonally and 8% for permanent. On the other hand about 37% of the respondents have displaced for lack of land for habitat due to environmental hazards, where about 16% for seasonally and 21% for permanent. The findings indicates that majority of the small farmer have displaced in the absence of job in the village.
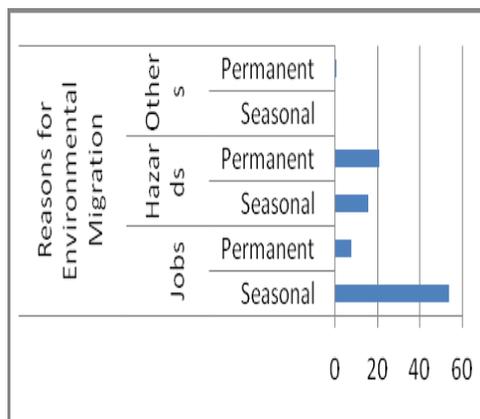
4.1.6 Water Supply

Majority (90.91%) of the villagers used tub-well water for drinking. On the other hand the respondents who (9.09%) used pond water for drinking water were at risk by water born diseases. Majority of the villagers reserved their drinking water in earthen pot. Other findings indicate that majority farmers (72.73%) used rain water for agriculture purpose. The respondents were not used river water for agriculture due to saline intensity. Findings shows that majority of the farmers were not using river water for their daily need.
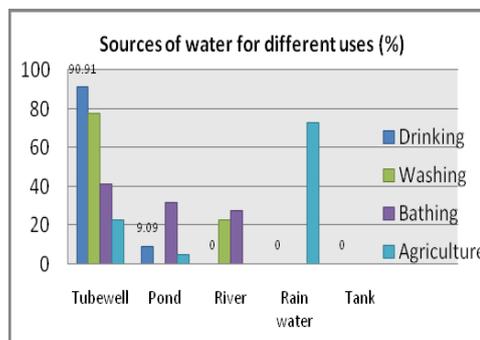
4.1.7 Health and Diseases:

In the study area, 37.29% respondents facing various climate change related diseases. People suffering from Malaria 11.83%, Dengue 4.55%, Cholera 6.36%, Enteric Typhoid Fever 3% and Malnutrition 3.64%. The prevalence[35] rate of the climatic diseases is 5.09. For these types of climate change related health problem 56% of the suffering people visited doctor first time in the last year, 26% visited two times and 18% did not visited any

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[35] It is a number of current cases of a specified disease during a specified time period divided by the estimated mid interval population at risk (Park, 2008).

doctor. The prevalence of the climatic diseases is 5.09. Findings indicate that majority of respondents and their family suffering from climate change related like Malaria, Dengue, Cholera, Typhoid Fever and Malnutrition.

### 4.1.8 Environmental Hazards Faced by Farmer

In the study area, 88.78% of the farmers faced river bank erosion is to a considerable extent rather than others environmental hazards. Salinity is another hazards which also faced by the 65% farmers. Climatic Hazards are caused by one or a combination of heavy rainfall, hailstorm, cyclone, moderate drought, and flood (West Coast Regional Council, 2002). So, hazards that are prevalent in the study area are called climatic hazards. Using environmental hazard index, the rank of the environmental hazard was drawn, which is cited below:

Hazards	Farmers (N = 110)				Environmental hazards index (EHI)	Percent of hazards scores faced by farmers	Rank order
	High	Medium	Low	Not at all			
River bank erosion	82	19	9	0	293	88.78	1
Salinity	65	18	8	19	231	70.00	2
Cyclone	45	17	9	39	178	53.93	3
Tidal flood	30	18	9	53	135	40.90	4
Heavy rainfall	26	15	8	61	116	35.15	5
Water logging	23	18	9	60	114	34.54	6
Hail storm	20	18	9	63	105	31.81	7

Findings indicate that major hazards in the locality are river bank erosion, salinity, and cyclone. Apart from that tidal flood, heavy rainfall, water logging and hail storm also present in the locality but has limited existence.

4.1.9 Climate Change Hazards and Vulnerability

Climatic hazards like salinity have noticeable negative impacts on 57.27% for agriculture, 11.18% for health, and 30.91% for water. Similarly, river bank erosion also has adverse impacts on 37.27% for agriculture, and 62.78% for house. Findings indicate that farmer's livelihood components especially agriculture is highly affected by salinity. In contrary, river bank stuck the house of farmers' community.
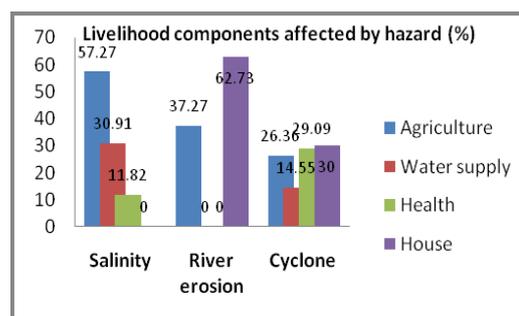
5. Conclusion

Livelihoods and economic activities in coastal wetland of Bangladesh are closely tied to the natural resource base, and are hence, highly sensitive to changes in the climate. Agriculture will be threatened by a combination salinity effects, sea level rise, increased flooding, and strong winds associated with intense tropical cyclones. Freshwater availability for domestic and agricultural uses is further impacted by climate change. Due to the declination of agriculture production, farmers particularly in the coastal wetland of selected study area have to change their

means of livelihood in order to climate change induced hazards. The loss of agricultural productivity due to environmental degradation and the non-adoption of technological inputs have resulted in a decrease in the food supply, while demand continues to grow. Human population growth, declination in agricultural production and a prevailing disease epidemic have typically been seen as the primary causative factors of insecurity within farmers' livelihood in the coastal wetland. The present study revealed that climate change induced hazards severely leading to crisis of freshwater, decreasing in rice and other cash crop production. Finally, the study found that environmental migration, food deficiency and health problems that increasing vulnerability and reducing the sustainable capacity of the farmers to adapt to the climate change.

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