JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Environmental Impact of Climate Change in Coastal Livelihoods of Bangladesh

Engr. Pankaj Kumar Nath, P. Eng., PhD
[B.Sc. (Civil Engg.); M.Sc. (Env. Engg.), PhD (Env. Engg.)]
Managing Director
Ideal Consultants & Builders Ltd.
Dhaka, Bangladesh

ABSTRACT

This paper is an effort to evaluate the environmental impacts of climate change in the coastal livelihoods of Bangladesh. This research has been conducted via quantitative process with semi-structured questionnaire for data collection in purposive method. The research examines the impacts of climate change on agricultural productivities, food securities and institutional challenges that the coastal public faces. This article finds that the frequency and strictness of natural disasters have increased in recent years, that risk on food securities by inundating low agriculture land, restricting economic actions, decreasing employment opportunities, increasing different health diseases, destructing houses, crops and other infrastructures in Bangladesh. The findings indicate that the most climate change induced vulnerable and risky people are women, children, elderly and disabled people as they cannot easily cope with the unfavorable environment during disasters. There has not been conducted greatly experiential study about the impacts of climate change, so policy makers can get inclusive view about this concern by this study and implement policy for the survival of the climate change induced affected coastal people.

Keywords: *Climate change, impacts, Natural disasters, Livelihoods, Coastal people*

INTRODUCTION

Bangladesh is globally considered one of the most vulnerable and exposed countries to climate change (Climate Change Cell 2007). Bangladesh is geographically exposed to a multitude of adverse impacts of climate change, because of its location in the tropics, in the delta of three of the world's biggest rivers and its flat low-lying deltaic topography. The country has low adaptive capacity due to its extreme poverty (World Bank 2000). Global warming and climate change are unmistakable which are agreed by all scientists around the earth. Observing the worldwide regular air and ocean temperatures, scientists agree with that the world climate is gradually changing (IPCC 2007). Experts and Environmentalists from across the world collectively recognized the latest findings of the Inter-Governmental Panel on Climate Change (IPCC) that the average temperature might increase up to about 5.5 °C with respect to current mean values by 2100 in Asia (Cruz et al. 2007). The rising temperature is responsible for climate change and different kinds of natural calamities in the world. The UNDP has identified Bangladesh to be the most vulnerable country in terms of cyclone and the 6th most vulnerable country in terms of floods. The intensity of vulnerability is further extending by climate change. The country faces six key climate change-induced challenges i.e. cyclones, floods, droughts, riverbank erosions, erratic rain fall and salinity intrusion into the coastal land. Scientists have indicated that climate change is not causing anything new in Bangladesh but the frequency

and severity of events are increasing day by day (Siddiqui et al. 2010). Currently, climate change possesses a new threat to the lives and livelihoods of the people in Bangladesh because over the last 10 years the frequency and intensity of natural hazards such as cyclones, floods, tidal surges etc. increased that brought unprecedented miserable situations to the people, especially the coastal people of Bangladesh.

The coast of Bangladesh is particularly vulnerable to sea level rise as 12 out of 19 coastal districts are directly exposed to the sea. The inland coast of Bangladesh has a population density of 1,200 persons/ km2, while the exposed coast has a density of 570 persons/km2. The exposed coast is a hazardous zone in terms of frequent floods, cyclones and tidal surges (Akter 2009). As a result, the livelihoods of coastal people become vulnerable as they struggle with nature through the whole years. This work tends to shed light on the livelihoods of coastal people and their coping strategies during and after the natural hazards in Bangladesh.

COASTAL AREA IN BANGLADESH

The coast of Bangladesh is known as a zone of vulnerabilities. It is prone to natural hazards like cyclone, tidal surge and flood. The combination of natural and manmade hazards, such as erosion, high arsenic contamination in ground water, water logging, earthquake, salinity in water and soil, various forms of pollution, risks from climate change etc. have adversely affected to the livelihoods of coastal people and slowed down the pace of social and economic developments in this territory (GOB 2005).

This study has been conducted in 8 villages of two unions named Dhandia and Islamkati under Tala upazila of Satkhira district in the costal part of Bangladesh. In this upazila about 65% households depend on cropping livestock, forestry and fishery and 26.82% are agricultural laborers. The overall literacy rate is about 28% whereas the national average is 32% (BBS 2006).

The logic behind choosing this area as study site is that it is one of the most vulnerable zones of natural disasters in Bangladesh. The type, intensity and frequency of natural disasters such as cyclone, tidal surge, soil salinity, and flood are common phenomena in this area. Moreover, being located adjacent to the Bay of Bengal and the Sundarbans people's vulnerabilities have increased to a great extent.

METHODOLOGY

The study is quantitative in nature. For conducting this study a semi-structured interview questionnaire has been used to obtain quantitative data from eight villages in Tala upazila of Satkhira districts in Bangladesh (Figure 1 shows the location of the study area). With an aim to arrange this work in a representative manner, 200 samples were selected purposively from the study area. Each male and female (age 15–85) who lives in the selected area is the unit of the study. Statistical analysis used SPSS Windows program to process the data in this work. Relevant information was also collected from secondary literatures including books, journals, annual reports, newspaper and magazines etc.

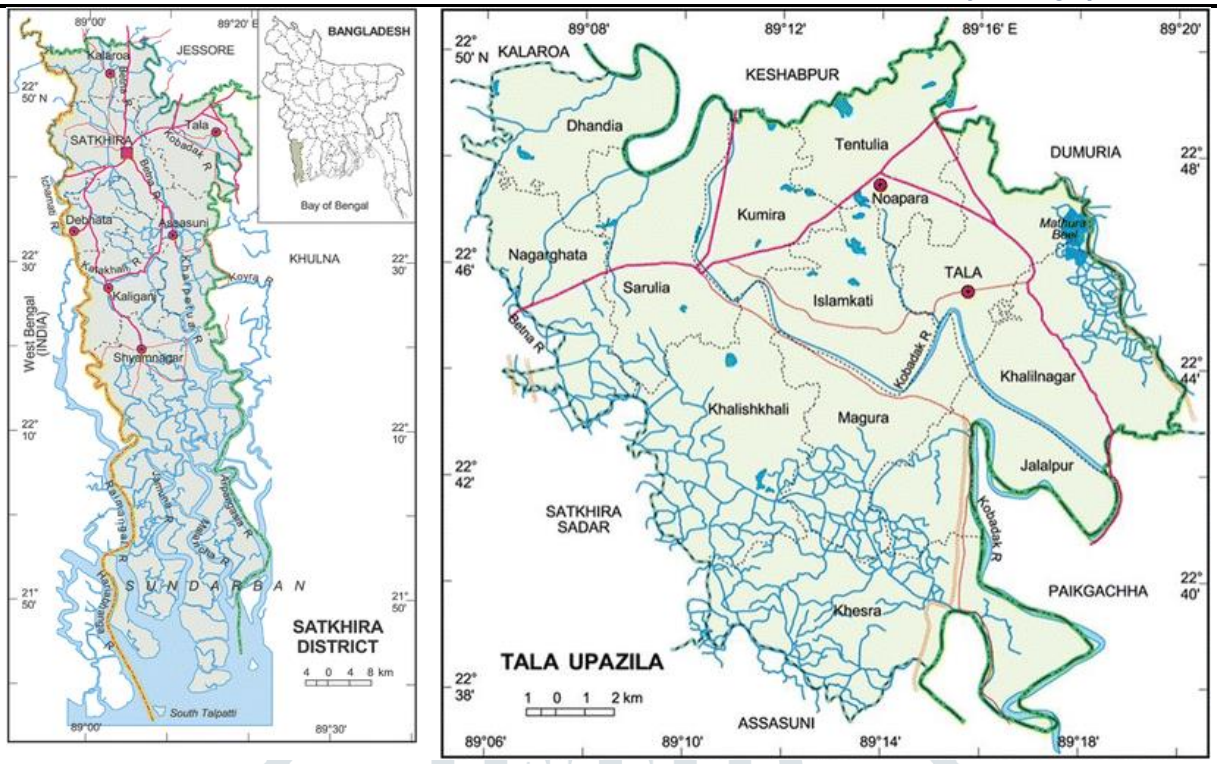

Figure 1: Maps show the location of the study sites at Tala upazila of Satkhira district in Bangladesh

CLIMATE CHANGE AND ITS IMPACTS ON THE LIVELIHOODS OF COASTAL PEOPLE

The major focus of this study is to explore the impacts of climate change on the livelihoods of coastal people. The study also delves into the climate change induced risk and vulnerability of coastal people especially on women, children, elderly and disabled people.

EDUCATIONAL CONDITION OF COASTAL PEOPLE

There are 12 districts out of 19 coastal districts in Bangladesh are directly exposed to cyclone, storm surge and other natural hazards. Being one of the districts of the 19th coastal districts, the people of Tala upazila in Satkhira always struggle with natural hazards; as a result, they can get limited scope to study much. Among the samples, only 38.5% has completed primary education and 3% accomplished post-graduate. The total illiteracy rate of that locality is 27.5% (see Table 1).

MARITAL STATUS AND RELIGION OF COASTAL PEOPLE

The observed data indicate that among the 200 samples, 78.5% are male and total married persons are 85.5%. In the study area it is found that a large proportion of the parents have the tendency to married their sons and daughters off at childhoods because of their ignorance and poor economic conditions. The study data reveal that there are 52.5% Muslim and 47.5% Hindu in that locality (see Table 1).

OCCUPATIONAL STATUS AND INCOME LEVELS

Since the study site remains remote from Satkhira upazila and are adjacent to the Sundarbans people's livelihoods of this area mainly depend on natural resources. In particular, 26% people work as fishermen, 20% as farmers and 21% work as agro laborers. It is unfortunate but true that most of the people of the selected area cannot afford their daily foods properly. The observed data indicate that 79% respondents income level is maximum 3,000 taka is not enough to maintain the cost of their family, but some months it is also decreased (see Table 1). So many of them bound to eat less or starve, especially in disaster periods. The inherent cause of this low income is climate change, because natural hazards such as floods, tidal surges etc. have destructed natural resources of that locality to a great extent. The people who maintain their lives

by collecting honey cannot collect that due to the destruction of beehives by natural hazards. Salinity intrusion in the soil and water affects severely to crop productions and livestock rearing, so farmers and agro-laborers lost their income sources. At the same time, due to severity of salinity in water, white spots diseases are found in GHER (place of shrimp cultivation), so fishermen and traders faced great problems in their lives. Moreover, many of the coastal people who maintain their lives by catching fishes and collecting prawns in the river now hardly get those in expected level. So they cannot pay for the hiring net and boats. In addition, about the expenditures of their family 66.5% respondents mentioned that they spend maximum 3,000 taka for their livelihoods and 31.5% spend maximum 5,000 taka per month (see Table 1). Among them a large proportion of the respondents asserted that they cannot earn enough money to support their family. So they borrow money from different sources and run their family deficiently through the year. However, most of the respondents said that before natural disasters their incomes were reasonably well but the devastating disasters have destroyed their working sources and decrease their incomes.

Table 1: Socio-economic conditions of the respondents of coastal people

Socio-economic variables	N = 200	Percentage
Education of the respondents		
Illiterate	55	27.5
Primary	77	38.5
Secondary	45	22.5
Higher Secondary	8	4.0
Graduate	9	4.5
Post Graduate	6	3.0
Sex of the respondents		
Male	157	78.5
Female	43	21.5
Marital status		
Married	171	85.5
Unmarried	24	12.0
Separated	2	1.0
Deserted	3	1.5
Religion of the respondents		
Hindu	95	47.5
Muslim	105	52.5
Occupations of the respondents		
Farmer	40	20.0
Teacher	3	1.5
Agro-laborer	41	20.5
Fisherman	52	26.0
Service holder	19	9.5
Student	8	4.0
Unemployment	4	2.0
Tailor	1	0.5
Businessman	5	2.5
Housewife	22	11.0
Elderly people	5	2.5
Income of the respondents (in BDT)		
0–3,000	158	79.0
3,001–5,000	29	14.5
5,001–7,000	4	2.0
7,001-above	3	1.5
Nothing	6	3.0
Expenditure of the respondents (in BDT)		
0–3,000	133	66.5

3,001–5,000	63	31.5
5,001-above	4	2.0

Source: Data Collection from the respondents

RESTRICTION OF ECONOMIC ACTIVITY

Being an agro-based country the women of Bangladesh traditionally play a vital role to collect foods, fodders and fibers for their family that have an importance in the economy. Due to climate change, women face severe problems to do their traditional activities. Different natural hazards destruct natural resources i.e. forest creepers, roofs, tubes from the forest, honey, fuel woods and mineral water and so on, that are the collecting materials for women in the coastal area. In addition, a large proportion of women in the coastal area who collect fishes and prawns in the river cannot find that any more as natural hazard contributes to decline their productivities.

Salinity intrusion around the home ground restricts women to do horticultures, livestock rearing and other economic activities. Women also cannot do agro-based processing activities such as harvesting crops, boiling paddy, drying cereals etc. during disaster periods. They also face problems in moving to the flooding kitchen garden to prepare foods and other household activities. All of these situations contribute to make women vulnerable economically and also psychologically. The study findings reveal that climate change limits women economic activities in disaster periods and 86.5% respondents agreed with it (see Table 2). Moreover, 52.5% respondents said that they cannot collect food, fodder and fiber for their livelihoods. Approximately 33.5% respondents said that they cannot do horticulture and 12% said that they cannot collect forest creepers, roofs, tubes from the forest. In addition, 21% respondents mentioned that they cannot collect larvae and marshes from the rivers due to climate change that limit their economic activities in the family (see Table 3). At the same time, man cannot find job during and post disaster periods, as natural hazards destruct the sources of income in the coastal area.

NUMBER OF NATURAL DISASTERS OCCURRED DURING THE LAST 5 YEARS

From the prediction of environmentalists, it is found that the frequency and severity of natural disasters have increased to a great extent in recent year. Global warming has melted the ice of Himalaya and risen water in the sea which results in frequent coastal floods, salinity intrusions and other natural hazards in the country. The present research finds the same scenarios in the coastal areas of Tala in Satkhira, as the environment being disrupted due to climate change causes to bring natural hazards in the locality. The survey data show that in the last five years 52.5% respondents said that maximum 2 times, 39% said that maximum 5 times and 8.5% respondents mentioned that more than 5 times natural hazards occurred in the locality (see Table 2).

NATURE OF DISASTERS IN THE COASTAL AREA

Bangladesh is a disaster prone country and her coastal people always struggle with natural hazards. The major causes of these natural hazards according to the respondents are deforestations, carbon emissions and other environmental pollutions in the country. The respondents of the study area claimed that they face different kinds of natural disasters in the locality as 53.5% said that cyclone occurred in the study area. Significant number of respondents 14.5% said that flood and 11.5% claimed that tidal surge occurred in the area that contributes to create miserable situation on their living (see Table 2).

Table 2: Climate change and its impacts on the livelihoods of coastal people

Climate change affects coastal people's livelihoods	N = 200	Percentage
Natural disasters have negative effect on family income		
Yes	170	85.0
No	30	15.0
Climate change limits woman's economic activity		
Yes	173	86.5
No	27	13.5
Number of natural disasters occurred during the last five years		
1–2 times	105	52.5
3–5 times	78	39.0
5-above	17	8.5
Nature of disasters occurred in the locality		
Flood	29	14.5
Tidal surge	23	11.5
Cyclone	107	53.5
Soil salinity	28	14.0
Other natural hazards	13	6.5
Degree of suffering after natural disasters		
Extreme	116	58.0
High	39	19.5
Moderate	44	22.0
Low	1	0.5
Degree of suffering before natural disasters		
Extreme	9	4.5
High	12	6.0
Moderate	86	43.0
Low	87	43.5
Nothing	6	3.0

Source: Data Collection from the respondents

NATURAL HAZARDS AND MIGRATIONS

The findings of the present study indicate that the frequency and severity of natural disasters enforced people to migrate elsewhere and 37% of the respondents agreed with it. The main causes of this migration of the affected people are ruined houses or factories, loss of trade, damage of agro-products, death or illness of family members, fear etc. due to the occurrence of natural hazards in that particular locality. This work also finds that the affected people losing their properties migrate to other districts in search of work. Some of them come back to their locality after some months back, in fact many of them do not return to their locality for the fear of frequent natural hazards (see Table 3).

Table 3: Natural disasters and its impacts on coastal people

	Multiple variables	Percentage
Suffering from different kinds of diseases due to climate change		
Measeales	25	12.5
Malnutrition	28	14.0
Pneumonia	8	4.0
Diarrhea	153	76.5
Fever/Cold	89	44.5
Bacterial infection	14	7.0
Contagenious diseases	9	4.5
Jaundice	14	7.0
Dysentery	52	26.0
Accidental disability	32	16.0
Disaster and its impacts on coastal people's livelihoods		
Out migration	74	37.0
Ruined houses/factories	144	72.0
Loss of trade	23	11.5
Damage of agro products	117	58.5
Death/illness of family members	21	10.5
Fear	12	6.0
Damage of standing crops	77	38.5
Most vulnerable people during disaster periods		
Women	134	67.0
Children	93	46.5
Elderly people	86	43.0
Disabled people	27	13.5
Ways of limiting women's economic activities and facing vulnerability		
Cannot collect food, fodder and fiber	105	52.5
Cannot do horticulture around their houses	67	33.5
Cannot collect larvae and marshes from the river	42	21.0
Cannot collect fishes and prawns	30	15.0
Challenging in moving to flooding kitchen garden	75	37.5
Cannot collect forest creepers, roofs, tubes, and other things	24	12.0
No scope in agro-based processing activities	40	20.0

Source: Data Collection from the respondents

CLIMATE CHANGE INDUCED RISK AND VULNERABILITY FOR DIFFERENT GROUP OF PEOPLE

In the study area, it is found that women, children, elderly and physically challenged people are the most vulnerable during natural disasters. Approximately 67% respondents claimed that women are the most vulnerable during natural disaster because of their household activities they cannot get information easily about the upcoming natural hazards and face problems. In addition, they have to save their homestead resources i.e. livestock and other properties during disaster periods, as a result they become victim of natural hazards. Moreover, they face problems to save their children and also face problems in the current of water by getting struck their cloths (sari) with sticks or other materials in the water. A significant number of respondents (46.5% and 43%) mentioned that children and elderly people are vulnerable during natural

hazards respectively because they cannot easily cope with the hazard situations for their physical weakness (see Table 3).

HEALTH PROBLEMS AND ACCESS OF MEDICAL FACILITIES TO THE COASTAL PEOPLE

Due to climate change the frequency and intensity of natural hazards increased in the coastal area, as a result people easily affected from various kinds of diseases in the locality. Furthermore, because of the intrusion of saline water to the ground water, people face severe scarcity of pure drinking water and so they bound to drink impure water that also liable for spreading various kinds of diseases in the locality. In addition, due to low incomes many of the people cannot afford nutritious foods for their family, so they suffer from malnutrition for long time. The observed data indicate with 76.5% responses that they suffer from diarrhea and a significant number of respondents (44.5%) said that they suffer from fever as well as cold. On the other hand, 16% mentioned that they suffer from accidental disability (see Table 3).

The study findings reveal that the people of the study area faced institutional challenges in terms of hospital, clinic and other medical facilities because there is no hospital or clinic in their localities especially in the area of Dhandia union. They have to cross the Chunu river and come to Tala sadar for medical treatment. To cross the river for medical purposes and others they have to be the victims of great problems especially in case of emergency patients and pregnant women. They also claimed that they could not get boats all the time to cross the river. About the degree of suffering of diseases due to climate change before natural disasters, only 4.5% respondents said that they suffer extremely and 6% said that they suffer highly. To share about the degree of suffering after natural disasters 58% said that they suffer extremely and 19.5% said that they suffer highly. So the findings of this study reveal that the degree of suffering of various diseases increases after natural disasters of that locality (see Table 2).

PROBLEMS OF CROP PRODUCTIONS AND FISH CULTIVATIONS

Agricultural productivity has declined to a great extent in the coastal area of Bangladesh due to climate change. The inherent cause of this problem is saline water intrudes into farm land and hampers usual growth of crops. Moreover, in saline-intruded farmland livestock cannot grow properly as it suffers from different diseases. At the same time, flooding water in the coastal area inundates farmlands that refrain farmers from crop cultivation causing a threat for food securities of coastal people as 42.5% respondents mentioned (see Table 4). Homestead forests, horticultures, livestock also cannot find suitable environment for its growth in the flooding situation. Agriculture and fish cultivations are the main occupations in the coastal area. Besides the agricultural problems they also face problems in fish cultivation because of the salinity in water and soil which always create various kinds of diseases such as white spots disease leads to hamper fish cultivation especially shrimp cultivation.

Table 4: Climate change and food insecurity of the coastal people

Climate change affects agricultural productivities	N = 200	Percentage
Problems of crop productivities		
Yes	192	95.5
No	9	4.5
Factors affecting agricultural productivities		
Soil erosion	11	5.5
Drought	6	3.0
Flood	85	42.5
Soil salinity	58	29.0
Cyclone	22	11.0

Tidal surge	11	5.5
Sand cost	7	3.5
Perception of food consumption and food insecurity		
Deficit of food through whole year	76	38.0
Seasonal deficit especially dry lean periods	63	31.5
During disaster periods	41	20.5
Neither deficit nor surplus	17	8.5
Surplus	3	1.5
Access of food immediately after natural disasters		
Yes	62	31.0
No	138	69.0
Access of pure drinking water after natural disasters		
Deep tube well water	25	12.5
Pond water	156	78.0
Rain water	19	9.5

Source: Data Collection from the respondents

ACCESS TO PURE DRINKING WATER AND SANITATION SYSTEM

The study area located adjacent to the Sundarbans. The water condition of this area is salty and people are facing problem to drink salty water. The deep tube well as well as the pond water is also affected by salinity. So the people of this locality use pond water by using Pond Sand Filter (PSF) method as 78% respondents claimed this. On the other hand, 9.5% respondents use rain water by preserving it in rainy season. Before natural hazards such as tidal surge, cyclone etc. sanitation system was in satisfactory state but after the hazards, it was destroyed and people face problem to use their sanitation system (see Table 4).

ACCESS TO FOODS, LIVESTOCK AND OTHER NATURAL RESOURCES

The coastal people of the study area frequently face acute problem of food scarcity during and immediately after the disaster. Due to poor communication and management system they cannot get access to food or other commodities in this period. Moreover, the prices of daily foods hike swiftly during this period, so poor people are not possible to afford their foods from the market and bound to starve frequently. Many of the people suffer from food deficits through whole year because; they cannot overcome or cope with natural hazards easily.

In the coastal area, natural disaster frequently swept away the livestock such as hens, ducks, cattle and at the same time, homestead crops and trees are destroyed which are found to contribute economical vulnerability to the people during disaster. The study indicates with only 31% responses, they have access to food after natural disaster and 69% said that they do not have access to food immediately after natural disaster. However, 38% respondents have food deficit through whole year and 31.5% respondents have seasonal food deficit in their family, especially in dry lean periods (see Table 4).

COPING MECHANISMS AND SUSTAINABLE LIVELIHOODS IN COASTAL AREA OF BANGLADESH

Tyndall Center for Climate Change Research (2004) has provided two approaches namely Institutional Approach to Livelihood Adaptation and Adaptation to Livelihoods Context which emphasize on institutional and organizational support, generic knowledge and collective action of the people for adaptation. In the approach taking collective action, understanding the use of endowment, applying generic knowledge sustainable livelihood can be brought in the study area. In the study area this approach is rarely

found as many of the respondents cannot get sufficient supports from the institutions and organizations during the disaster periods. The findings indicate that only 16.5% respondents receive relief as support for coping with the situation during disasters (see Table 5). They receive foods, house making materials, medicines, cash money etc. as relief for coping with the situations.

As a coping strategy of the coastal people approximately 27.5% respondents borrow money from different NGOs to overcome the losses incurred by natural disasters. In addition, approximately 16.5% respondents sell livestock and 12% respondents borrow money from local money lenders with high interest to overcome the losses after disasters. Moreover, the adaptation system of the locality is not good enough as 71% respondents said that they do not have any training on adaptation strategies. Only 29% of them receive training for adaptation of that particular locality.

Sustainable livelihood is important in coastal area but it is not prevailed in the study area as 66% respondents claimed it. However, to make sustainable livelihoods in the coastal area people should emphasize on saving environment from destructions as 40% respondents said this. Significant number of respondents (20.5%) said that by receiving training about disaster management and 12% said that by utilizing the existing resources, sustainable livelihoods can be brought in the study area (see Table 5).

In order to adopting sustainable livelihoods by minimizing various kinds of shocks and stress and reducing social, economic and natural losses, there is need to incorporate some assets such as natural capital i.e. (land, water, wildlife etc.), physical capital i.e. (water, sanitation, energy, transportation, communication etc.), human capital i.e. (knowledge, skill, information, ability to labor etc.), social capital i.e. (relationship of trust, membership of groups, network etc.,) and financial resources i.e. (regular remittances or pensions saving etc.), (Quoted by Tyndall 2004 developed by DFID). By incorporating these assets along with being aware, receiving training and changing structure sustainable livelihoods can be brought in the disaster prone coastal area of Bangladesh.

Table 5: Coping mechanisms & sustainable livelihoods of coastal people in Bangladesh

Coping mechanisms of coastal people	N = 200	Percentage
Coping strategies of coastal people		
Borrowing money from local moneylender with high interest	24	12.0
Borrowing money from NGOs	55	27.5
Borrowing money from relatives	35	17.5
Selling livestock	33	16.5
Selling properties	21	10.5
Relying on relief	32	16.0
Types of relief get coastal people from different organizations		
Foods	125	62.5
House making materials	36	18
Medicines	22	11
Cash money	8	4
Others	9	4.5
Having sustainability to the livelihoods of coastal people		
Yes	68	34.0
No	132	66.0
Having training on adaptation		
Yes	58	29
No	142	71
Ways of bringing sustainability to the lives of coastal people		
Being aware about responsibilities	27	13.5
Receiving training about disaster management	41	20.5

Developing infrastructures in the locality	29	14.5
Saving environment from destructions	80	40.0
Utilizing the existing resources	23	11.5

Source: Data Collection from the respondents

CONCLUSIONS

Bangladesh is considered one of the most vulnerable countries of the world. The geographic location i.e. Bay of Bengal to the south and Himalayas to the north, this two different environments along with gradual climate change make Bangladesh vulnerable. This work aims at to find out the impacts of climate change on the livelihoods of coastal people. The important finding of the work is that climate change affects severely to the lives and livelihoods of coastal people in terms of agricultural productivities, food securities and people's vulnerabilities. Due to climate change, floods, tidal surges and cyclones have become common phenomena for the life of coastal people and to minimize the loss and cope with the situations coastal people use their own strategies. However, the work indicates that to cope with the hazard situations coastal people should give emphasize on taking disaster management training, being aware about their responsibilities and utilizing existing resources, so that there can be brought sustainable livelihoods in the coastal area of Bangladesh.

REFERENCES

1. Ahammad AU (ed) (2010) Reducing vulnerability to climate change: the pioneering example of community based adaptation in Bangladesh. Centre for Global Change (CGC) and CARE Bangladesh, Dhaka, p 156
2. Akter T (2009) Climate change and flow of environmental displacement in Bangladesh. Unnayan Onneshan, Dhaka, Bangladesh.
3. Ali A (1996) Vulnerability of Bangladesh to climate change and sea level rise through tropical cyclones and storm surges. Water Air Soil Pollut 92:171–179
4. BBS (2006) Population census wing. Bangladesh Archived from the original on 27 March 2005. http://web.archive.org/web/20050327072826/, http://www.bangladeshgov.org /mop/ndb/ arpc91_v1/tables04.htm
5. Cruz RV, Harasawa H, Lal M, Wu S, Anokhin Y, Punsalmaa B, Honda Y, Jafari M, Li C, Ninh NH (2007) Climate change 2007: impacts, adaptation and vulnerability. In: Parry ML, Canziani OF, Palutikof JP, van der Linden PJ, Hanson CE (eds) Contribution of working group ii to the fourth assessment report of the intergovernmental panel on climate change. Cambridge University Press, Cambridge
6. Government of Bangladesh (2005) Coastal zone policy. Dhaka, Bangladesh
7. IPCC (2007) Climate change, 2007: the physical science basic. Contribution of working group I to the fourth assessment report of the intergovernmental panel on climate change, Switzerland
8. Rahman MH, Lund T, Bryceson I (2011) Salinity impacts on agro-biodiversity in three coastal, rural villages of Bangladesh. Ocean Coast Manag 54:455–468
9. Shaw R, Krishnamurthy R (2012) Coast and communities: the Linkages. In: Shaw R, Tran P (eds) Environment disaster linkages. Community, environment and disaster risk management, vol 9. Emerald Group Publishing Limited, Bingly, pp 101–112
10. Siddiqui T, Abrar CR, Alamgir M, Ali MS (2010) Climate change and community adaptation: case study from Bangladesh. Monash Sustainable Institute, Monash University, Australia
11. Tyndall (2004) Adaptive, adaptation to climate change in vulnerable environment. A Tyndall Center for Climate Change Research Project at the University of Sheffield, UK