

IMPACT OF CLIMATE CHANGE ON FOOD SECURITY IN SOUTHWEST COASTAL REGION OF BANGLADESH

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ABSTRACT

This paper examines the impact of climate change on food security of the population residing in the coastal area of Bangladesh. Based on multistage random sampling technique, a survey was conducted to collect socioeconomic and food datasets of the people affected by extreme climate events in the country. The study found that climate change caused food insecurity in the region; it led to greater dependence on pond and rain water for cooking food and water intake. Catastrophe due to extreme weather events adversely affected the livelihoods and level of income. The severe cyclonic storms, Sidr (November 2007) and Aila (May 2009) severely affected the vulnerable people of this region, especially the extremely poor.

The study came out with several coping strategies to address adverse effects of climate change, including rehabilitation with income and employment generating activities and skill development training; alternative livelihood adaptation practices; access to subsidized inputs and credits; introduction of crop calendars; conservation of arable and fellow land; and innovation of saline-tolerant, heat-resistant, moderate water consuming and short-rotation crops for the coastal people.

Keywords: *Climate Change, Food Security, and Agriculture.*

1. INTRODUCTION

Climate change is sometimes used to refer to global warming, a change in climate, which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (UNFCCC, 1994). The main causes of climate change are the burning of fossil fuels to meet increasing energy demand, as well as the spread of intensive agriculture to meet increasing food demand, which is often accompanied by deforestation. It is increasingly recognized as the most pressing issue that poses serious global threat and has the potential to irreversibly damage the natural resource base on which agriculture depends, and thus, adversely affects agricultural productivity in general.

In Bangladesh, the significant impacts of climate change is being observed in the form of hotter

summer; irregular monsoon with untimely rainfall; increased river flow with inundation during the monsoon season; heavy rainfall over shorter period causing water logging, and increased frequency, intensity and recurrence of floods; very scarce rainfall in dry period; drought in summer; very short and acute cold spell; and salinity intrusion along the coastal region. All these factors have been damaging the agricultural production to a significant extent.

The geographical location and geo-morphological condition makes Bangladesh one of the most vulnerable countries to climate change, where floods, droughts, cyclones and tidal surges are common threats. Bangladesh is situated at the interface of two different environments, with the Bay of Bengal to the south and the Himalayas to the north. This particular geography of Bangladesh causes not only life-giving monsoons, but also catastrophic ravages of natural disasters. About 10 percent of the country is hardly one meter above the Mean Sea Level (MSL), and one third is under tidal excursions (Karim, 2010).

The southern part of Bangladesh consists of coastal lowland and mangrove areas, formed by the delta of large river systems. According to 2001 population census, the coastal zone of Bangladesh has a population of 35.1 million. More than a quarter of the population of the country lives in a coastal environment with multiple vulnerabilities and opportunities. Their despair and dream, their plight and struggle, their vulnerability and resilience, are exclusively dependent on an intricate ecological and social setting that makes their livelihoods distinctive from other parts of the country to a considerable extent. The combination of natural and man-made hazards seem to have adversely affected lives and livelihoods in the coastal zone, and slowed down the pace of socioeconomic developments in this region.

Since the coastal part of Bangladesh is extremely vulnerable to floods, cyclones and many different kinds of calamities, many people are affected by these calamities every year. The occurrence of Very Severe Cyclonic Storm Sidr on 15 November 2007 and Very Severe Cyclonic Storm Aila on 25 May 2009 are the relatively recent cyclonic catastrophes that have permanently altered the agricultural production in the southern region of Bangladesh to have downwards trend. The southwest coastal region is the most affected region of Bangladesh where most of the people are vulnerable. Thus, crop production in the

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country seems to be vulnerable under climate change scenarios leading the country's food security at risk. Food security exists when all people at all times have physical or economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO, 2006).

Climate change is likely to have serious impacts on the four dimensions of food security: food availability, food accessibility, food utilization and food system stability. Effects are already being felt in global food markets, and are likely to be significant in specific rural locations where crops fail and yields decline. Impacts are more visible in southwest coastal regions where supply chains are disrupted, market prices increase, assets and livelihood opportunities are lost, purchasing power falls, human health is endangered, and affected people are unable to cope. Thus, southwest coastal region has been shaken by the devastating cyclones, Sidr and Aila, which affected millions of people, and destroyed their land, house and ways of living. Besides, sea level rise flooded many areas with saline water, which is detrimental to crop production. Food is one of the fundamental rights of the people. Production and availability of sufficient quantities of safe and healthy food lay the foundation of healthy communities, culture and environment. Hence, the study regarding climate change and its impact on food security was conducted to understand ways and means to improve the quality of life of the people affected by climate change.

In order to suitably highlight the findings of the study, this paper is organized as follows: objectives of the study; data and methodology; results and discussion; and conclusion and recommendations.

2. OBJECTIVES OF THE STUDY

The following specific objectives were set forth to examine the climate change and its impacts on food security in the southwest coastal region of Bangladesh:

- To identify the affectees of climate change in the southwest coastal region of Bangladesh;
- To identify impacts of climate change on the socio-economic conditions of the target population in the area;
- To suggest appropriate policy options to address climate change and food security concerns.

3. DATA AND METHODOLOGY

The study was a survey research, based on primary data collected. To conduct the study a multistage sampling technique was adopted. In southwest coastal region of Bangladesh, there are three districts, namely Khulna, Bagerhat and Satkhira. The Khulna district has nine upazilas. The Dacope upazila of Khulna district has 10 union councils, of which three union councils, namely Bajua, Kamarkhola, and Saherabad, were purposively selected for the study. From within these three councils four villages were purposively selected keeping in view that residents from these villages were seriously affected by climatic calamities. To determine an appropriate sample size 20 households from each selected villages were randomly surveyed, and thus, the sample size stood at 80. The heads of affected households were considered as respondents to the survey.

An interview schedule containing both closed and open-ended questions was used to collect data from the respondents. The schedule was pre-tested; necessary correction and modification were made before it was run for final data collection. Data were collected through face-to-face interview during the period of March-April 2010. Collected data were analyzed using SPSS 16.

4. RESULTS AND DISCUSSION

4.1 Socioeconomic Characteristics of the Victims of Climate Change

Characteristics of individuals largely influence their behaviors. The investigated characteristics included age, education, family size, annual income, occupation and housing. The gathered information of the socioeconomic characteristics of the target population is summarized in the Table-1.

Age Distribution: Most of the respondents (37.5%) belonged to the 46 to 60 years age bracket; 30 % to the 31 to 45 years age bracket; while 20 % respondents had the age between 15 to 30 years. Only 12.5 % respondents were above 60 years of age.

Educational Status: Educational status is one of the most important indicators of social development and standard of living. Fifty percent of the respondents were found to be illiterate; 30 % had only received primary education; while 12.5 % had secondary and 7.5 % had tertiary education. Thus, the people of the region were even below the national average literacy

Table-1: Socioeconomic Characteristics of the Victims of Climate Change

Characteristics	Categories (Score)	Distribution of respondents			
		Number	(%)	Mean	Standard Deviation
Age	Young (15-30)	16	20	43.18	12.25
	Mid age (31-45)	24	30		
	Old (46-60)	30	37.5		
	Above 60	10	12.5		
Educational Status	Illiterate	40	50	0.78	0.94
	Primary education	24	30		
	Secondary	10	12.5		
	Above	6	7.5		
Occupational Status	Farmer	40	50	-	-
	Shrimp farming	16	20		
	Small business	10	12.5		
	Day laborer	6	7.5		
	Others	8	10		
Income (Taka)	< 1500	30	37.5	1705	886.63
	1501-2000	24	30		
	2001-3000	14	17.5		
	3000 above	12	15		
Expenditure (Taka)	0-1000	2	2.5	2995	1136.78
	1001-2000	12	15		
	2001-3000	38	47.5		
	3001-4000	10	12.5		
	4001-5000	12	15		
	above 5000	6	7.5		

Source: Field Survey, March 2010

rate of 55 % (World Bank, 2010).

Occupational Status: Most of the respondents were directly or indirectly relying on agriculture and fisheries in the absence of industry. Fifty percent of the respondents were involved in agriculture, 20 % were doing shrimp farming along with small scale of agriculture. Besides, 12.5 % of the respondents were engaged in small-scale businesses, 7.5 % were day laborers, and 10% were engaged with various service sectors, like education and NGOs.

Income Status: Most of the respondents belonged to the low-income group with little income per month. Out of the target population surveyed, 37.5 % had income below Tk. 1,500, followed by 30 % having an income bracket between Tk. 1,500 and 2,000. The surveyed group that was earning between Tk. 2,000 to 3,000 made 3, and only 15% had a monthly income of over Tk. 3,000.

Expenditure Status: The households under the study were unable to fulfill their basic needs due to high costs and low income. It was evident from the survey that most of the households (47.5%) were spending between Tk. 2,001 to 3,000 to meet their needs. Only 15 % of the respondents had family expenditure

between 1,001 to 2,000; 12.5 % between 3,001 to 4,000; 15 % between Tk. 4001-5000, and merely 7.5% were spending above Tk. 5,000. Thus, there was a gulf of difference between the income and expenditure of the target populations, reflecting the extent of misery of people living in the coastal belt of Bangladesh with little opportunities and greater hardships.

4.2 Source of Income

Source of income indicates the quality of life and the level of food security. About seven years ago most of the people of the region were well-off and their main sources of earning were agriculture and fisheries. The severe cyclonic storms, Sidr and Aila, destroyed their crop lands, and many people were compelled to change their occupations.

Table-2 shows the source of income of the respondents. As per the survey conducted, the table indicates the sources of income at the time of the survey and the source of income about seven years before that. It shows that seven years ago, 62.5 % of the respondents were engaged in agriculture, while 22.5% in fisheries, and 5 % in small businesses. After the two severe cyclones, the population under study was compelled to consider changing their occupations and sources of income. After Sidr and Aila cyclones,

Table-2: Sources of Income

At the time of study	Respondent		Seven years before the study	Respondent	
	Number	%		Number	%
Agriculture	38	47	Agriculture	50	62.5
Fisheries	22	27	Fisheries	18	22.5
Small business	6	7	Small business	4	5
Day laborer	6	7	Day laborer	4	5
Sundarbans	4	5	Sundarbans	2	2.5
Others	4	5	Others	2	2.5
Total	80	100		80	100

Source: Field Survey, March 2010

Table-3: Daily Food Intake

Menu of Food	Respondents	
	Number	%
Rice	80	100
Wheat	30	37.5
Fish	60	75
Milk	20	25
Meat	4	5
Vegetable	60	75
Fruits	6	8

Source: Field Survey, March 2010 (Multiple Response)

vast agricultural land become unusable due to salinity intrusion, and people were compelled to switch to shrimp farming on agricultural land. Besides, a segment of the population opted for establishing small businesses and earning living as day laborers. The share of agriculture as source of income, drastically declined to 47 %. That of fisheries increased to 27 %, and similarly share of small businesses and day laboring increased to 7 % and 5 %, respectively.

4.3 Dietary Habits

As the surveyed inhabitants of the coastal region of Bangladesh were mostly poor, their food intake was neither enough nor nutritionally rich. They were unable to meet the minimum food requirements for a normal human body.

Table-3 reveals the dietary habits of the surveyed sample group. It was noted that all the respondents consumed rice on daily basis, 75 % took vegetable and fish, 37.5 % consumed wheat, 25 % took milk, and a very few could afford meat and fruit in their daily diet.

4.4 Frequency of Meals

Many of the surveyed people were not able afford three meals a day. They were not getting proper meals and some even went without a meal. The frequency with which the surveyed group was taking meals is shown in Table-4.

The survey showed that 30 % households were able to manage three meals a day at the time of the survey, while 62.5 % used to take three meals a day seven

Table-4: Frequency of Meals

Number of meal	Food Intake at the time of Survey		Food takings seven years ago	
	Number	%	Number	%
One time	16	20	0	0
Two times	40	50	24	30
Three times	24	30	50	62.5
More than 3 times	0	0	6	7.5
Total	80	100	80	100

Source: Field Survey, March 2010

Table-5: Sources of Drinking Water

Sources	At the time of survey		Seven years ago	
	Number	%	Number	%
Rain Water	40	50	36	45
Pond Water	70	80	60	75
Deep Tube-well	10	12.5	50	62.5
Others Sources	10	12.5	6	7.5

Source: Field survey, March 2010 (Multiple Response)

Table-6: Dynamics of Land Use Pattern

Land Use Purpose	Average Land Holding (Katha)	
	At the time of survey	Seven years ago
Dwellings	8	15
Cultivable land	45	60
Uncultivable	20	5
Shop, bazaar etc.	1.5	2.4

Source: Field Survey, March 2010; Note: 60.61 Katha = 1 Acre

years ago. It is also found that half of the respondents (50 %) were taking two meals a day and 20 % of the respondents managed only one meal a day. At the time of the survey none of the respondents were able to manage more than three meals a day, while 7.5 % informed that they had more than three meal a day seven years ago. Thus, climate changes lowered food intake of the coastal inhabitants.

4.5 Sources of Drinking Water

Due to extreme salinity, ground water was it is absolutely undrinkable. So the coastal people were making use of rain and pond water to drink. The water crisis was seen to be worsening due to adverse effect of climate change. Table-5 summarizes the information given by respondents indicating their source of drinking water.

Through the survey, multiple responses were found regarding the source of drinking water. The survey disclosed that a majority (62.5 %) households used to take drinking water from deep tube-well 7 years ago, but at the time of survey only 12.5 % households were able to get water from that source. Fifty percent of the households were relying on stored rain water as the chief source of drinking water. It was also noted that 80% of the households were using pond water as the main source of drinking water.

4.6 Land Use Pattern

The Table-6 provides data on the land use pattern of the inhabitants of the southwestern coastal region of Bangladesh.

The survey showed that on average 8 katha land was being used for dwelling purposes at the time of the survey, while about 7 years ago 15 katha land was used for the same purpose. The land use for cultivation purposes also decreased, on average 45 katha land was being used at the time of the survey while 7 years ago on average 60 katha land was used for the purpose. Similar, downtrend was seen in the average land use for shops and bazaars. The average size of uncultivable land was drastically increased during the same period. Thus, over the years the land use pattern had a declining trend.

4.7 Perceived Causes of Declining Land Property

Table-7 provides data on the causes of declining land property as perceived by the respondents of the study area.

Table-7 depicts that 80 % of the respondents of the survey considered river erosion as the main cause of declining land property. Three-fourths of the respondents considered salinity intrusion, 50 % viewed cyclones, and 37.5 % perceived land fragmentation as the causes of declining land property.

4.8 Climatic Impact on Agriculture and Food Security

The southwest coastal region of Bangladesh being vulnerable to climate change witnessed socio-economic condition of this area altered especially after the two major cyclones, Sidr and Aila. Many crop lands, shrimp farm, trees were inundated due to cyclones, floods, and salinity intrusion. The

Table-7: Perceived Causes of Declining Land Property

Causes	Respondents	
	Number	%
River erosion	64	80
Salinity intrusion	60	75
Cyclones	40	50
Land fragmentation	30	37.5

Source: Field survey, March 2010 (Multiple Response)

catastrophes caused by climate change led to reduced monthly incomes of the inhabitants, degraded crop lands, reduced agricultural yield, made food inaccessible and the prices of food items went up, in a nut shell increasing food insecurity.

4.9 Changing Income Pattern

The main source of income of the southwestern coastal people has been agriculture. Due to climate change the coastal people had to change the occupations. The disaster caused by the severe cyclones changed the financial and economic status of the people.

From the Table-8, it is evident that there was a huge difference between the incomes before and after the natural disasters, and the people of the southwest coastal region were severely affected by the climate change manifested by Sidr and Aila, and their food security was threatened.

4.10 Changing Expenditure Pattern

Due to climate change expenditure pattern of the surveyed population have changed over the years.

Table-9 shows that the expenditure before and after cyclone Sidr. It is evident that the mean expenditure before major natural disaster was Tk. 4,272.5, while after the disaster the mean expenditure was reduced to Tk. 2995 only. Thus, it is evident that due to climate change the expenditure pattern of the respondents drastically declined over the years.

4.11 Dynamics of Cost of Foods

Due to climate change the source of income and food production has been on decline. The cost of food in this area has been increasing day by day. It was noticed that average expenditure on food items by the coastal people was Tk.1,000 some seven years ago, and it increased to Tk.1,500 now at the time of survey. This shows how drastically food prices went up for the vulnerable people of southwest coast of Bangladesh (Field Survey).

4.12 Vulnerability Effect on the Study Areas

Households suffer not only from natural disasters but also from a broad range of other affiliated issues. The households are vulnerable when they are unable to cope with the risk, stress, and shock. Based on the field survey in the target area, the vulnerability contexts posing several threats on the lives, property, settlements and livelihood patterns were identified. The effect for the vulnerability contexts of the study were assessed as a percentage of population affected by the problem.

Table-10 shows that cyclones left 50 % of the respondents homeless, 75 % faced food shortages, 65 % bore loss to property, 15 % got affected by diseases, 89 % faced shortage of drinking water, 42 % observed decreased production, 59 % suffered from reduced income, 70 % faced sanitation problem, and 55 % were left with damaged homes and 88 % with damaged communication system. The cyclones had severe impacts on the livelihood of people of the study

Table-8: Test of the Significance of the Differences of between Income Before and After the Natural Disasters

Method	Value	Level of Significance	Test	
Z-test	3.23	0.05	Two Tailed	
Category Statistics				
Variables	Sample Size	Mean	Std. Deviation	Std. Error Mean
Income Seven years ago	80	5105.00	1858.44	293.84607
Present income	80	1705.00	886.63	140.19

Source: Author's calculation

Table-9: Changing Expenditure Pattern

Expenditure	Before				After			
	Number	%	Mean	SD	Number	%	Mean	SD
0-1000	0	0	4272.5	1688.11	2	2	2995	1136.78
1001-2000	8	10			12	15		
2001-3000	14	17.5			38	48		
3001-4000	12	15			10	12.5		
4001-5000	30	37.5			12	15		
Above-5000	16	20			6	7.5		
Total	80	100			80	100		

Source: Field Survey, March 2010

area. In the same fashion, tidal surge, floods, river erosion, heavy rainfall, and salinity intrusion all had more or less similar impacts on the people of the study area as depicted in table 10. The respondents were mainly dependent on pond and rain water. Due to lack of potable water 81 % of the respondents face water crises, and 44 % of them had water-borne diseases.

4.13 Vulnerability Ranking of Declining Agricultural Production

Food production is hampered when farmers are unable to cope with and respond to risk, stress and shocks. On the basis of the field survey the vulnerability contexts were prepared that interrupted the target population's food production. The vulnerability scores of food production were classified as high, medium and low.

Table-11 indicates that 100% respondents viewed that salinity intrusion and river erosion occurring throughout the year posed major risks. Cent percent respondents perceived that salinity intrusion was the

major cause of declining food production, and ranked it 'high'. While 93 % of respondents viewed river erosion as a high and 30 % as a medium degree problem responsible for declining food production. All the respondents recognized cyclones as a high degree risk, which occurred 2~3 times a year. The cyclones, Sidr and Aila, carried out devastating impacts in the area under study; 90 % of the respondents perceived cyclone as a high risk and 62.5 % as a medium level threat responsible for declining food production in the region. Similarly, floods, tidal surge, and heavy rainfall had more or less similar impacts on the food production in the study area. Thus, it is evident that climate change has been causing significant impact on the food production in the study area.

4.14 Dynamics of Agricultural Production

Agricultural production was reduced tremendously due to frequent natural disasters and climatic events over the years. The following table shows agricultural production in the study area at the time of survey and

Table-10: Vulnerability Effects of Climate Change on the Study Area
(Figures in terms of % of population)

Vulnerability Contexts	Homeless	Food Shortage	Property Loss	Diseases	Drinking Water Shortage	Production Decline	Reduce Income	Sanitation Problem	Snake Attack	Home Damage	Damage Communication System
Cyclone	50	75	65	15	89	42	59	70	6	55	88
Tidal Surge	29	24	47	12	51	42	33	55	7	77	61
Floods	47	47	35	35	35	59	29	59	29	29	29
River Erosion	31	0	35	0	0	21	11	3	0	47	36
Heavy Rainfall	4	29	11	2	0	24	18	4	0	4	47
Salinity Intrusion	0	35	12	0	24	47	29	0	0	0	0
Portable Water Crisis	0	0	0	44	81	0	0	0	0	0	0

Source: Field Survey, March 2010 (Multiple Responses)

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Table-11: Average Frequency of Climatic Problems and Ranking in Declining Food Production

Climatic Problem	Respondents		Average Frequency	Ranking in Declining Food Production					
	Number	%		Highly		Medium		Low	
				Number	%	Number	%	Number	%
Salinity Intrusion	80	100	Round the year	80	100	0	0	0	0
River Erosion	80	100	Round the year	74	93	30	37.5	0	0
Cyclones	80	100	2~3 times	72	90	50	62.5	0	0
Floods	60	75	1~2 times	68	80	44	60	58	72.5
Tidal Surge	24	30	1~2times	40	50	30	37.5	20	25
Heavy Rainfall	30	37.5	2~5 times	40	50	44	55	32	40

Source: Field Survey, March 2010 (Multiple Responses)

seven years before it.

Table-12 depicts data on the production of major crops in the study year. It is evident from the table that production of all major crops, including vegetables, was drastically decreased due to climatic reasons, while only the production of water melon increased as it grows well in saline soils and water.

4.15 Loss of Average Food Production Due to Climate Change

Climate change mostly affected the agricultural production in southwest coastal region of Bangladesh due to adverse effects of rising sea level, chronic salinity intrusion, cyclone, tidal surge and others calamities. Thus food production was observed to be decreasing day by day.

Table-13 shows yearly loss of average food production due to climate change. Most of the respondents (30 %) claimed that loss of food production was around Tk. 2001-3000; 25 % of respondents argued that their losses remained within the range of Tk. 3001-4000; while 20 % of respondents claimed that their loss of food production was around Tk. 4001-5000. On the other hand, a small number of respondents claimed that their loss of food production was around Tk. 5001-6000 (5%), Tk. 6001-7000 (7.5%), and Tk. 7001-8000 (5%). However, the mean loss of food production was estimated to be Tk. 3,755 per year.

4.16 Price Trends of Rice

The climate is taking place severely for the last few years and its adverse effects are seen on the price of basic commodities as their productions are declining over the years. Since most of the coastal people are poor, they feel contented if they get their daily necessities at cheaper rates. Rice being the main food, the price trends of average quality rice are shown in following table:

Table-14 shows that price of rice has been increasing over the years at a faster rate. In the year 2007, when the Sidr cyclone struck, the price of rice increased by 45 %, although it came down by the next year, but again it increased in the following year when another cyclone Aila struck. Thus, the price of rice has had increasing trend over the years because of adverse impact of climate change and a severe food insecurity was observed taking place in the southwest coastal area of Bangladesh.

5. CONCLUSIONS AND RECOMMENDATIONS

After the severe cyclonic storms that were triggered by climate change effects, the food security situation deteriorated for the coastal inhabitants. The drinking water crisis became worse due to adverse effects of climate change, and majority of the respondents were compelled to use pond and rain water as the main sources of drinking water. Most of the respondents

Table-12 : Yearly Agricultural Production (Kg/Bigha)

Crops	Before 7 years	Present
Rice	700-900	200-300
Wheat	200-250	90-120
Water melon	200-320	350-600
Brinjal	160-200	Negligible quantity
Aurum	400-500	
Vegetable varieties (Cabbage, coli flower, beans)	300-400	

Source: Field Survey, March 2010

Table-13: Average Loss of Food Production Due to Climate Change

Average loss (Tk)	Respondents	%	Mean	SD
0-1000	1	2.5	3755	1568
1001-2000	2	5		
2001-3000	12	30		
3001-4000	10	25		
4001-5000	8	20		
5001-6000	2	5		
6001-7000	3	7.5		
7001-8000	2	5		
Total	40	100		

Source: Field Survey, March 2010

were found to be illiterate and poor with low income per month. Being inhabitants of coastal belt of the country, they directly or indirectly relied on agriculture and fisheries as the source of income. The survey research showed that people in the coastal belt were unable to fulfill their daily needs as there existed a gulf of difference between their income and expenditure, reflecting the extent of misery of living in a coastal line vulnerable to climate change. Many of them were not able to afford three meals a day and even went without a single proper meal. Only half of the respondents were able to take two meals a day.

The catastrophes caused by Sidr and Aila cyclones compelled the inhabitants to switch their occupations, and it affected their monthly income levels. Over the years, the land use pattern towards cultivation had a declining trend due to climate change. Many croplands, shrimp farm, trees were inundated by the severe cyclones, floods, and salinity intrusion, and many agricultural land become unusable. The subsistence farmers were compelled to switch to shrimp farming on inundated crop land. The two extreme weather events left the inhabitants homeless, caused severe shortage of food and drinking water,

damaged property, caused spread of diseases, affected agricultural production and levels of income, inundated sanitation networks, and destroyed communication system.

Salinity intrusion, river erosion, cyclone, floods, tidal surge, and heavy rainfall have been causing significant declining impact on the food production of the area under study. The price and cost of food production has had an increasing trend over the years and, thus, food insecurity has been taking place in southwest coastal area of Bangladesh. Some of the policy options suggested to mitigate the effects of climate change are:

- Rehabilitation should include different measures for income and employment generating activities, including skill development trainings.
- Flood forecasting and early warning system should be made effective, and crop calendars should be kept up-to-date along with special methods to be used to grow seasonal crops after disasters caused by extreme weather events.
- Saline tolerant and heat resistant, less water-requiring and short-rotation crops should be

Table-14: Price Trends of Rice (Tk/50Kg)

Year	Price	Change rate (%)
2000	500	-
2001	510	2
2002	540	5.8
2003	550	2
2004	660	20
2005	800	21.21
2006	820	2.5
2007	1190	45
2008	875	-26.24
2009	1010	15.45

Source: Field Survey, March 2010

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identified and harvested for the coastal areas through research and development.

- Alternative livelihood adaptation practices, such as cultivation of vegetables on floating beds of water or cultivation of beans, gourds and other vegetables on embankments surrounding, should be promoted.

REFERENCES

- FAO, 2006. Policy Brief on Food Security, Issue 2, Available at ftp.fao.org/es/ESA/policybriefs/pb_02.pdf (Accessed on June, 03, 2010).
- Karim Z., 2010. Climatic impact on agriculture and food security. The Daily Star, P 6, Wednesday, February 24.
- UNFCCC, 1994. "The United Nations Framework Convention on Climate Change", 21 March 1994. Available at: http://unfccc.int/essential_background/convention/background/items/1349.php
- World Bank, 2010. The World Development Indicators, Washington DC.