

Climate Change and Its Impact on Food Security: A Study on South-west Coastal Region of Bangladesh

ABSTRACT

Aims: This paper examines the climate change and its impacts on food security in context of southwest coastal region of Bangladesh. It intends to identify the impacts of climate change on food security in particular and to address appropriate strategies to overcome it.

Materials and Methods: 20 households were taken from each selected villages. The heads of households were taken as the respondents, to carry out the survey. Data were collected through face-to-face interview during March to April 2010. Collected data have been analyzed using SPSS 16.

Results and Discussion: The study demonstrates the sources of income in two time periods: present and 7 years ago. Seven years ago 62.5% of the respondents were engaged in agriculture, while 22.5% in fisheries, and 5% in small business. There happened a drastic revision in income sources due to compulsion by climate change. Recent disasters such SIDR and AILA significantly caused change in income sources. At present share of agriculture has drastically declined to 47%, that of fisheries has increased to 27% and similarly the share of small business and day laborer have increased to 7% and 5% respectively. Study reveals that cyclone resulted 50% respondents to homeless, 75% to food shortage, 65% to property loss, 15% to diseases, 89% to shortage of drinking water, 42% to decreased production, 59% to reduced income, 70% to sanitation problem, 55% to damaging homes, and 88% to damaging communication.

Conclusion: Most of the respondents are found illiterate and poor low income per month. They directly or indirectly rely upon agriculture and fisheries due to lack of industrial activities. Therefore they are unable to people fulfill their daily needs as there is a gulf of differences between the income and expenditure of the people of the study area reflecting the extent of misery of costal lives.

Keywords: Climate change, food security, adaptation, agriculture, vulnerability

1. INTRODUCTION

Global warming and climate change are unequivocal, are agreed by all scientists around the world. Observing the global average air and ocean temperatures, physical and biological systems scientists agree with all that the world climate is gradually changing day by day [1]. Experts and officials from across the world collectively endorsed the latest findings of the Inter-Governmental Panel on Climate Change (IPCC) through its fourth Assessment Report (AR4) that the average temperature might increase up to about 5.5 degree Celsius with respect to current mean values by 2100 in Asia [2]. Bangladesh, a South Asian LDC, has recently been reported as in the worst position of long-term climate risk [3]. The geographical location and geo-morphological condition made Bangladesh one of the most vulnerable to climate change [4]. 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 [5]. The intensity of vulnerability is further enhanced by climate change. A number of major studies in the past investigated the causes of vulnerability of Bangladesh due to climate change. [6, 7]. Historically the country has been subject to a variety of water-related hazards, mostly in the forms of flood, cyclone, storms surge, river bank erosion, drought and salinity intrusion [8, 9]. A large number of recent analyses suggest that such hydrological hazardous events are likely to be aggravated due to climate change [6, 10, 11]. Agriculture is important for food security in two ways: it produces the food people eat; and (perhaps even more important) it provides the primary source of livelihood for 36 percent of the world's total

workforce. In the heavily populated countries of Asia and the Pacific, this share ranges from 40 to 50 percent, and in sub-Saharan Africa, two-thirds of the working population still make their living from agriculture [12]. If agricultural production in the low-income developing countries of Asia and Africa is adversely affected by climate change, the livelihoods of large numbers of the rural poor will be put at risk and their vulnerability to food insecurity increased. Ensuring food security has been one of the major goals of Bangladesh since its independence in 1971 when most of the people were living under the poverty line [13]. Scientists throughout the world are paying much effort to explore the relationship between irreversible climate change and its impact on food production and therefore, food security. However, with improvement of calculation models they have found tacit relationship between climate change and food security. The unprecedented impacts of climate change along with other environmental and geomorphologic changes make more concerns over food security especially, for the poor and marginal population [14, 15, 16]. In Bangladesh the major impacts of the climatic issues are the hotter summer, irregular monsoon with untimely rainfall, increased river flow with inundation during monsoon, heavy rainfall over short period causing water logging, increased frequency intensity & recurrence of flood, very scarce rainfall in dry period, drought in summer, very short acute cold spell and salinity intrusion along the coastal region all of which cause agricultural production to a significant extent. The occurrence of SIDR on 15 November 2007 and AILA on 25 May 2009 are the recent cyclonic catastrophes which have permanently altered the agricultural production to downward trend in the southern region of Bangladesh as a result of climate change. Thus, crop production in Bangladesh seems to be vulnerable under climate change scenarios, resulting the country's food security at risk. Bangladesh has an area of 14.43 million hectares of land of which 3.75 million hectares (26.0%) covers housing, water bodies, roads etc and forest covers 2.25 m ha (15.6%). Agriculture remains the most important sector of Bangladeshi economy, contributing 19.6 percent to the national GDP and providing employment for 66 percent of the population [17]. Southwest coastal region has shaken by the recent devastated cyclone SIDR and AILA, which affected millions of people, and destroyed their land, house and ways of living. Besides, sea level rise flooded many areas by saline water which is the obstacle to crop production. Food is one of the fundamental rights of the people. Production and availability of sufficient quantities of safe and healthy food is also foundation of healthy communities, culture and environment. This paper examines the climate change and its impacts on food security in context of southwest coastal region of Bangladesh. It intends to identify the impacts of climate change on food security in particular and to address appropriate strategies to overcome it.

2. METHODOLOGY

The study is a survey research and based on primary data. To conduct the study a multistage sampling technique was adopted. In southwest coastal area there three districts viz. Khulna, Bagerhat, and Satkhira; out of which, Khulna was purposively selected. In Khulna district, there are nine upazila, out of which Dacope upazila was selected purposively. In Dacope upazila, there are 9 union parishad, of which three union parishad namely Bajua, Kamarkhola, and Saherabad were purposively selected. Then from Bajua Chankuri village, from Kamarkhola Kamarkhola and Jaliakhali villages, and from Saherabad Poddarganj village were purposively selected. Thus people living in these most climate affected four villages were treated as the active population, where climate victims were more visible. To determine an appropriate sample size 20 households were taken from each selected villages, and thus the sample size stood at 80, who were the victims of climate change. The heads of households were taken as the respondents, to carry out 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 March to April 2010. Collected data have been analyzed using SPSS 16.

3. RESULTS AND DISCUSSION

3.1 Socioeconomic Characteristics of the Climate Victims

Characteristics of individuals largely influence their behaviors. The characteristics investigated includes age, education, family size, annual income, occupation and housing.

Age Distribution: Most of the respondents (37.5%) belonged to 46 to 60 years age group, 30% respondents belonged to 31 to 45 years age group, while 20% respondents had the age between 15 to 30 years and only 12.5% respondents were found who were above 60 years (Table 1).

Educational Status: Educational status is one of the most important indicators of social development and standard of living. 50% of the respondents were found illiterate, 30% respondents had only primary education, while only 12.5 % respondents had secondary and 7.5% had tertiary education (Table 1). Thus the people of this region are having lower literacy rate than national average of 55 %.

Occupational Status: Occupation is one of the important means to earn living. Most of the respondents directly or indirectly rely upon agriculture and fisheries due to lack of industrial activities. 50% of the respondents were involved in agriculture, 20% were involved with shrimp farming along with small scale of agriculture. Besides, 12.5% of the respondents were found with business, 7.5% day laborer, 10% were in various services like teaching, NGOs and other professions (Table 1).

Income status: Most of the respondents fall under low income group with little income per month. For example, 37.5% had income below Tk 1500; followed by 30 % Tk.1500 to 2000, 17.5% ranging Tk 2000-3000, and only 15% had monthly income above Tk 3000 (Table 1).

Expenditure status: Expenditure is the most important and logistic indicator to show the dynamics of food security. The people of the study area do not fulfill their livelihood due to high expenditure and low income. It was evident that the most of the families (47.5%) possessed expenditure range between Tk 2001 to 3000 and followed by 15 % respondents whose family expenditure lies between 1001-2000 and 4001-5000. Very few portions of the respondents (7.5%) are in income range above 5000. Thus, there is a gulf of differences between the income and expenditure of the people of the study area reflecting the extent of misery of costal lives (Table 1).

Table 1: Socioeconomic Characteristics of the Climate Victims					
Characteristics	Categories (Score)	Distribution of respondents			
		Number	(%)	Mean	SD
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(BDT)	< 1500	30	37.5	1705	886.63
	1501-2000	24	30		
	2001-3000	14	17.5		
	3000 above	12	15		
Expenditure (BDT)	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					

3.2 Dynamics of Income Source

Dynamics of income source indicates the lives and food security in coastal area. About seven years ago most of the people were well-off and their main earning sources were agriculture and fisheries. Recent AILA and SIDR divested their crop land gher, so many people are compelled to change their earning sources. Following table shows the dynamics of income sources of the respondents.

Table 2: Dynamics of Sources of Income					
Source of Income					
Present	Respondent		Seven years ago	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 2 shows the dynamics of income sources of respondents. It demonstrates the sources of income in two time periods: present and 7 years ago. Seven years ago 62.5 % of the respondents were engaged in agriculture, while 22.5% in fisheries, and 5 % in small business. There happened a drastic revision in income sources due to compulsion by climate change. Recent disasters such SIDR and AILA significantly caused change in income sources. Due to disasters many agricultural land have become unusable due to salinity intrusion, and people are compelled to go for shrimp farming on those land. Besides, many people having no options opted for small business and day laborer. Thus, at present share of agriculture has drastically declined to 47%, that of fisheries has increased to 27% and similarly the share of small business and day laborer have increased to 7 % and 5 % respectively (Table 2).

3.3 Daily Menu of Food Items

Food is main basic need of human being. As the inhabitants in coastal region are mostly poor, the food items taken by them are not rich enough. They can't fulfill their minimum food requirements for human body. The daily food item taken by the respondents is presented in table 3.

Table 3: Daily Food Items of the Respondents		
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)		

Table 3 reveals the food items of different categories taken by the costal people. All respondents consume rice, 75% take vegetable and fish, 37.5 % consumes wheat, 25 % take milk, and a very few respondents can afford meat and fruit in their regular food menu.

3.4 Dynamics of Food Takings

Dynamics of daily food taking is a crucial issue of the AILA and SIDR affected areas. Many people of this area cannot afford three times food in a day. They do not get meal properly or even passing a day without meal. The dynamics of food takings of the selected area is shown in table 4:

Table 4: Dynamics of Daily Food Takings				
Number of meal	Present food takings		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	0	0	6	7.5
Total	80	100	80	100
Sources: Field Survey, March 2010				

Table 4 demonstrates the dynamics of foods takings of the respondents of the study area. At present half of the respondents (50%) take meal twice per day while it was only 30% seven years ago. About seven years ago 63% respondents used to take three times meal per day but at present the figure is only 30%. It is also found that 20% of the respondents take meal once a day which was not seen seven years ago. At present no respondents is found taking meal more than three times while 7.5% respondents used to take more than three times meal a day. Thus, climate changes deteriorated the food taking ability of coastal inhabitants.

3.5 Sources of Drinking Water Used by the Respondents

Water is one of the most important elements to sustain on the earth. Life is impossible without water. Due to extreme salinity ingredients into the ground water, it is totally undrinkable. So the coastal people use rain and pond water to drink. However, the water crisis is deteriorating due to adverse effect of climate change. The dynamics sources of drinking water are presented in the table 5:

Table 5: Sources of Drinking Water of the Respondents				
Sources	Present Sources		Sources 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
Sources: Field survey, March 2010 (Multiple Response)				

Multiple responses were found regarding the source of drinking water. Table 5 reveals that majority (80%) of the respondents use pond water as the main sources of drinking water, the figure was 75% before seven years. At present 50% respondents relied upon stored rain water as the chief sources of drinking water which used 45% before seven years. 62.5% respondents used to drink deep tube-well water 7 years ago, but now only 12.5 % respondents have access to tube-well water (Table 5).

3.6 Dynamics of Land Use Pattern

Table 6 provides information on land asset in terms of amount of land possessed by the respondents at present and seven years ago.

Table 6: Dynamics of Land Use Pattern		
Land Use Purpose	Average Land Holding (Katha)	
	Present	Seven years ago
Dwellings	8	15
Cultivable land	45	60
Uncultivable	20	5
Shop, bazaar etc.	1.5	2.4
Sources: Field Survey, March 2010		
Note: 60.61 Katha = 1 Acre		

Table 6 depicts that at present on average 8 katha land is used for dwelling purposes, while 7 years ago 15 katha land was used for the same purpose. On the other hand, on average 45 katha land is used for cultivation purposes, whereas 7 years ago on average 60 katha land was used for the same purpose. Similarly, average land size for shop and bazaar also declined over the years, while average size of uncultivable land is drastically increased during the same period. Thus over the years the land use pattern had a declining trend.

3.7 Causes of Declining the Land Property

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

Table 7: Causes of Declining Land Property		
Causes	Respondents	
	Number	%
River erosion	64	80
Salinity intrusion	60	75
Cyclone	40	50
Land fragmentation	30	37.5
Sources: Field survey, March 2010 (Multiple Response)		

Table 7 reveals that 80% of the respondents perceived that river erosion was the main cause of damage the land property, followed by 75% respondents perceived about salinity intrusion, while 50 % respondents perceived about cyclone, 37.5% respondents perceived about land fragmentation as the causes of declining land property.

3.8 Climatic Impact on Agriculture and Food Security

Climate change has become a burning issue throughout the world, and the southwest coastal region of Bangladesh being the adversely affected, the socio-economic condition of this area got altered. Many crop lands, shrimp farm, trees are being overwhelmed by the crucial attack of cyclone, flood, and salinity intrusion. Therefore it has brought a curse for the people of this area, and affected people's income, expenditure and food security.

3.9 Changing the Income Pattern

The main source of income of the southwestern coastal people is agriculture. Due to climate change and its impact changing their income sources. Recent disaster (AILA and SIDR) have changed the income level ferociously.

Table 8: Test of the Significance of the Differences of between Income Before and After Natural Disaster				
Test for Equality of Means Between Series				
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	293.84
Present income	80	1705.00	886.63	140.19
Author's calculation				

From the above statistics, it is evident that there is a huge difference between incomes before and after disaster, and the people of the southwest coastal region are severely affected by the climate change manifested by SIDR and AILA, and their food security is at risk. [18] reports that due to flood caused by tropical cyclone, SIDR (2007) & Aila (2009) average income has dropped about 44% and debt increase 40% in the affected households in Satkhira and Khulna Districts.

3.10 Changing Expenditure Pattern

Due to climate change expenditure pattern is changing over the years. The changing expenditure patterns are shown in following table

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								

Table 9 demonstrates the expenditure before and after SIDR. It is evident that the mean expenditure before major natural disasters was Tk.4272.5, while after the disasters present mean expenditure is only Tk.2995, and so on. Thus, it is clear that due to climate change the expenditure pattern of the respondents is drastically deteriorating over the years.

3.11 Dynamics of Cost of Foods increasing

Due to climate Change the means of income and food production is declining over years. Therefore cost of food in this area is increasing day by day. It is found that average of cost on foods of the coastal people was Tk.1000 seven years ago, but it is Tk.1500 now, demonstrating drastic increase in cost on food staffs (Field Survey 2010).

3.12 Vulnerability Effect on the Study Areas

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

Table 10: Effects of Climate Change on the Study Area											
Vulnerability contexts	Homeless	Food Shortage	Property Loss	Diseases	Shortage of Drinking Water	Decrease of Production	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)											

Table 10 brings out that cyclone resulted 50% respondents to homeless, 75% to food shortage, 65% to property loss, 15% to diseases, 89% to shortage of drinking water, 42% to decreased production, 59% to reduced income, 70% to sanitation problem, 55% to damaging homes, and 88% to damaging communication. Thus cyclone had severe impacts on the livelihood of people of the study 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 portable water 81% of the respondents face water crises, and 44% of them had water-borne diseases. Thus, ensuring safe portable water is very much necessary for safe health condition; therefore supply of safe portable water is inevitable.

3.13 Vulnerability Ranking of Declining Agricultural Production

Foods 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 are prepared that interrupted their food production. The vulnerability scores of food production are classified as high, medium and low.

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	Throughout the year	80	100	0	0	0	0
River Erosion	80	100	Throughout the year	74	93	30	37.5	0	0
Cyclone	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)									

Table 11 indicates that 100% respondents viewed that salinity intrusion and river erosion occurring throughout the year, were the major climatic problem. 100% respondents perceived that salinity intrusion was the major cause of

declining food production, and put in high rank. While 93% respondents viewed river erosion as a high and 30% as a medium problem responsible for declining food production. However, 100% respondents claimed cyclone as the high degree of climatic problem which occurred 2~3 times per year. Recent cyclone SIDR and AILA carried out devastating impacts on the study area that might make its ranking high. 90% of the responses perceived cyclone as a high and 62.5% as a medium problem responsible for declining food production. Similarly, floods, tidal surge, and heavy rainfall had more 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 of the study area.

3.14 Dynamics of Agricultural Production

Agricultural production was reduced tremendously due to frequent natural disasters and climatic change over the years. The following table sketches on agricultural production in the study area.

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	300-400	
Cabbage, coli flower, beans		
Source: Field Survey, March 2010		

Table 12 depicts data on the production of major crops in the study year. It is evident from the Table 12, that production of all major crops including vegetables are drastically declined due to climatic reason, while only production of water melon has got some positive growth as it grows well in saline soils and water.

3.15 Loss of Average Food Production Due to Climate Change

Climate change mostly effected the agricultural production in southwest coastal region of Bangladesh due to adverse effects of sea level rising, chronic salinity intrusion, cyclone, tidal surge and others disaster. So food production is decreasing day by day. The average loss of food production per year is shown in following table.

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				

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% respondents argued that their losses confined around Tk. 3001-4000, 20% respondents claimed that their loss of food production was around Tk. 4001-5000. On the other hand very few respondents (5%, 7.5% and 5%) claimed that their loss of food production was around Tk.

5001-.6000, Tk. 6001-7000, and Tk. 70001-8000 respectively. However, the mean loss of food production was Tk. 3755 per year.

3.16 Price Trends of Rice

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

Table 14: Price Trends of Rice (Tk/50Kg)		
Year	Avg. Rice 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		

Table 14 shows that price of rice has been increasing over the years at very faster rate. In the year 2007, when SIDR stroked this area, 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 took place. Thus, the price of rice has had increasing trend over the years because of adverse impact of climate change and a severe food insecurity is taking place in southwest coastal area of Bangladesh.

4. CONCLUSION AND RECOMMENDATION

Most of the respondents are found illiterate and poor low income per month. They directly or indirectly rely upon agriculture and fisheries due to lack of industrial activities. Therefore they are unable to people fulfill their daily needs as there is a gulf of differences between the income and expenditure of the people of the study area reflecting the extent of misery of costal lives. Since, it is shrinking their means of income day by day posing great impact of their purchasing that is the prime asking for fulfilling food security. Many people of this area cannot afford three times food in a day. They do not get meal properly or even passing a day without meal. Only half of the respondents can take meal twice per day. Thus, climate changes deteriorated the food taking ability of coastal inhabitants. The crisis drinking water is deteriorating due to adverse effect of climate change, and majority of the respondents use pond water and rain water as the main sources of drinking water.

Recent disasters such SIDR and AILA significantly caused change in income sources. Thus over the years the land use pattern towards cultivation had a declining trend due to climate change. Many crop lands, shrimp firm, trees are being overwhelmed by the crucial attack of cyclone, flood, and salinity intrusion. Therefore it has brought a curse for the people of this area, and affected people's income, expenditure and food security. Due to disasters many agricultural land have become unusable due to salinity intrusion, and people are compelled to go for shrimp farming on those land. Besides, many people having no options opted for small business and day laborer, even relying upon the Sundarbans.

Recent disasters have changed the income level ferociously. There is a huge difference between incomes before and after disasters, and the people of the southwest coastal region are severely affected by the climate change manifested by SIDR and AILA, and their food security is at risk and incomes sources of the respondents were significantly influenced by climate change. Major disasters led the respondents to be homeless, caused severe food shortage, property loss, diseases, shortage of drinking water, decrease in production, reduction in income, sanitation problem, damage in homes, and communication system. Salinity intrusion and river erosion, cyclone, floods, tidal surge, and heavy rainfall have been causing significant declining impact on the food production of the study area. Therefore cost of food is increasing day by day, and the price of rice has had increasing trend over the years and severe food insecurity is taking place in southwest coastal area of Bangladesh.

- Farmers should be given access to subsidized inputs and loans. Rehabilitation should include different measures for income and employment generating activities for the climate victims and with this end skill development trainings should be given.
- 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 disaster.
- Saline tolerant and heat resistant, less water-requiring and short rotation crops should be invented for the coastal areas.
- Alternative livelihood adaptation practice for coastal people such as cultivation of vegetables on floating beds of water or cultivation of beans, gourds and other vegetables on embankments surrounding should be adapted.
- Coconut tree can be the effective alternative means of food security because coconut is very much nutrient food and adaptive in this saline prone area. Besides, it is possible to add value through its multiple usages.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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