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Climate Change, Natural Disaster and Vulnerability to Land Displacement in Coastal Region of Bangladesh

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ABSTRACT: The climate change is a frequent feature accompanied by chronology of major disaster in the coastal areas of Bangladesh. Particularly coastal and offshore areas of Bangladesh are widely vulnerable to natural disasters due to its geographical location and very high population density. This paper attempted to study the land displacement pattern and possible vulnerability faced by internally displaced persons in the pace of natural disasters, and to identify the interrelated aspects of possible socioeconomic impacts of tropical cyclone, storm surge, river erosion, flood and drought on the coastal inhabitants. The study concentrated on the recent five environmental disasters. Sample survey into the selected costal region was undertaken to obtain data on land use, settlement and displacement pattern. Focus group discussion (FGD) was also undertaken to understand the vulnerability to short-term hazards, in particular, tropical SIDR and AILA impacts. SPSS 16 and ATLAS.ti were used to analyze data. The study found that the rate of landless households increased alarmingly due to frequent disasters which significantly caused the declining availability of land. Similarly the number of petty land owners increased significantly, while the hand medium and high land owners decreased over the years. It also found that frequent disasters in every year compelled the farmers to sell their land consistently because these displaced lands became unusable due to its excessive salinity and long time water logging. Consequently life, livelihood and occupation of these vulnerable people were widely affected and force them to outward migration especially towards urban areas.

KEYWORDS: Vulnerability, Coastal inhabitants, Land displacement, Short-term hazards, Environmental migration.

1 INTRODUCTION

Climate change and disaster induced land displacement emerged in the research agenda on global environmental change in the recent decades with the realization that land displacement occurred due to environmental disruption, either be manmade, natural or both. This study investigates into the pattern of climate change and disaster induced land displacement during last 5 years along with the possible socioeconomic impacts of climate induced natural disasters such as cyclone, storm surge, river erosion, flood and drought.

Current evidence strongly suggests that the concentration of climate change causes an increase in the frequency and the severity of sudden onset of natural disasters like flood, cyclone drought, riverbank erosion and salinity intrusion. Bangladesh seems to be one of the worst victims of climate change ravaged by major disaster events like 1998 flood, 2000 flood, 2007 cyclone SIDR and 2009 cyclone AILA. The cyclone SIDR and cyclone AILA displaced over 33 thousands people from their land and damaged crops of 112,879 hectares [1]. Even after a long time of occurrence of SIDR and AILA, most of the lowlands still remain waterlogged or under submergence, and farmers cannot use their submerged lands due to soil salinity. Alternatively in view of the high probability of climate change, the impacts of climate change on coastal areas a one-meter rise in sea level could displace nearly at least 2 million people from their homes in Bangladesh [2].

Reference [3] shows on climate change impacts in Bangladesh, 45-50 cm rise in the sea level along the Bay of Bengal coast will submerge about 11 percent of the country's land area (1600 sq km) by 2070 and this submergence will cover nearly 75 percent of the Sundarbans forest [4]. Recent studies shows that thirty eight coastal vulnerable upazilas of the districts of

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Shatkhira, Khulna, Bagherhat, Jhalakathi, Barguna Ptuakhali, Barishal, Bhola, Lakkhipur, Noakhali, Chittagong and Cox's Bazar experiencing permanent loss of large areas of coastal land affecting 35 million people- about one-quarter of the country's population [5].

Past study predicted that Bangladesh would have 15 percent of land inundated with a 1.5 m rise altogether and 21.3 percent of agricultural production could be lost, mainly rice, sugarcane and jute [6]. Past flood studies suggest that about 60 percent land area of Bangladesh is flood prone while 25 percent of land is inundated during the monsoon [7]. These flooded arable land, damaged food crops and reduced agricultural production, permanently. Farmers could neither cultivate water-logged fields nor can yield their expected produce later decrease in exports due to disruption of production process including transportation infrastructure. Flash floods and storm surges lead to increased salinity and decreased output of farmland. It is found that after cyclone SIDR and cyclone AILA the seasonal migrants who migrated toward urban area, all of them were displaced farmer, seeking different opportunities for survival even driving an auto rickshaw, and pulling a rickshaw or rickshaw van. Hence the impacts are definitely evident which are taking place not only the population alone, but also on the large amount of high- valued land property for residential as well as agricultural purpose.

Thus changes in the climate is likely to take place more rapidly over the next few decades and obviously, flood, storms, cyclones will occur more frequently in great intensities. Therefore study of land displacement seems to be an interesting issue which needs to be brought into discussion.

2 OBJECTIVE OF THE STUDY

The overall objective of the study is to prepare a synthesis for the general relationship between climate change induced natural disasters with land displacement for Bangladesh. In particular this study examines following specific objectives:

1. To study the existing land use pattern of land displacement during last 5 years in the study area,
2. To determine the extent of land displacement due to climate change in the selected area,
3. To find out the possible socioeconomic impact of cyclone, storm surge, river erosion, flood and drought on the coastal inhabitants,
4. To suggest appropriate policy options addressing climate change and mitigation measures.

3 METHODOLOGY AND SOURCES OF DATA

The study is based on primary data and a multistage sampling technique was adopted. To collect data Bagherhat district of southwest coastal region of Bangladesh was purposively selected, where severity of climate change impact is more visible. Then Sarankhola upazila of Bagherhat district was again selected purposively. Then at the third stage three villages namely Rainda, Khontakhata and Southkhali were purposively selected to collect data from the target respondents. Thus the people of these three selected villages formed the active population for this study. To determine an appropriate sample size 10 percent of the households of the selected villages were drawn as the target respondents who were the victims of climate change.

Thus a total of 100 respondents were drawn as the sample size in the process of survey. A questionnaire containing both close-ended and open-ended was prepared to collect data. The questionnaire was pre-tested before final data collection. Data were obtained from general households, who were selected from each village following a systematic random sampling technique: 1 household was chocked after 4 houses. The survey formats were designed to understand the condition of existing land use pattern, settlement and displacement pattern although land displacement status was ascertained for the last five natural disasters. The survey was conducted during June, 2011. Besides a Focus Group Discussion (FGD) was also conducted with 12 respondents (6 male and 6 female of different age group) which usually started with formal and open strategy. FGD lasted two hours and every participant completed written informed consent prior to the start of the focus group. In the FGD study, the primary concern was with vulnerability to *short-term* hazards, in particular, tropical SIDR and AILA impacts. Collected data were processed for subsequent analysis using software such as SPSS and ATLAS.ti[1].

[1] **ATLAS.ti** *is a powerful workbench for the qualitative analysis of large bodies of textual, graphical data.*

4 RESULTS AND DISCUSSION

4.1 EXISTING LAND USE

Although diversified uses of land were found in the study area, agriculture and water body occupied the dominating feature. A huge area of land were predominantly used for agricultural purpose over the years although, some area were used seasonally for shrimp cultivation and crab fattening. A considerable area under arable land totally free from shrimp cultivation was used only for agricultural purpose. The cultivated area dominates land use, covering nearly two-fifth of the total land. Household settlement was another significant feature of land use, which covered most of the highlands of the study area. Land use pattern of the study area was mainly dominated by low and low-middle income farmers, crab fattener and shrimp fry collectors and *gher* owner's settlement. Land use in view of social institutions is mostly *Hat*/*Bazzar*, Schools, Post office, Mosques, Church, Temple, Community Clinic, and Settlement Office.

Table 1. Existing Land Use Pattern of the Study Area

Land use		Total area (acre)	Percent	
Household Settlement		924	26	
Commercial		143	4	
Water body	Pond, Ditches, River	285	8	18
	Permanent *Gher*	355	10	
Gher & Agriculture		1387	39	
Institution		249	7	
Road		107	3	
Others		106	3	
Total		3556	100	
Source: Field Survey, June, 2011				

Table 1 summarizes existing land use pattern of the study area. Major lands of the study area were used for gher and agriculture (39 percent) followed by household settlement 26 percent, water bodies i.e., pond, ditches, river and permanent *gher* 18 percent and so on. Although a negligible amount (3 percent) of land was used for road networks, the physical condition of roads was poor that is partly semi-pukka[2] and mostly kacha- made of mud.

Table 2. Distribution of Current Land Ownership

Unit	Percent	
Landless	26.7	
1-10 katha	25.1	73.3
10-19 katha	24.2	
1-10 bigha	11.2	
20-30 bigha	8.1	
Over 30 bigha	4.7	

Source: Field Survey, June, 2011 Note: 1 Acre = 60.61 Katha, 20 Katha = 1 bigha

Table 2 shows the distribution of current land ownership pattern. The study found that almost 73.3 percent people have their own homesteads in their villages. This ownership of land mostly achieved through their descendents. Even though the

[2] Permanent structure built with concrete

land has lost its conventional value, people still remember quite well the amount of land they owned. In this area about 26.7 percent don't have land, while only 25.1 percent population owned 1 to 10 *katha* land, whereas about 4.7 percent people owned over 30 *bigha* land. These lands were used for fishing, crop, and livestock and not for gardening, as people have general lack of knowledge regarding gardening.

Table 3. Comparative Land Ownership Pattern According to Years

Unit of Land	Amount of Land				
	Current	2 years ago	5 years ago	10 years ago	15 years ago
Landless	26.7	23.4	9.8	3.2	1.5
1-10 katha	25.1	11.2	14.2	11.5	10.3
11-19 katha	24.2	24.6	27.0	27.0	28.1
1-10 bigha	11.2	20.0	23.9	32.7	30.3
20-30 bigha	8.1	11.0	17.3	18.9	20.9
Over 30 bigha	4.7	9.8	7.8	7.3	8.9

Source: Field Survey, June, 2011

Table 3 shows that currently 26.7 percent of households are landless, the figure was 23.4 percent, 9.8 percent, 3.2 percent and 1.5 percent land only before 2 years 5 years, 10 years and 15 years respectively. Thus over the years the rate of landless households increased alarmingly. Similarly the number of petty land owners having 1 to 10 katha land increased significantly over the years. For example currently 25.1 percent of the land owners became petty land owners; the figure was 11.2 percent 14.2 percent 11.5 percent and then 10.3 percent before 2 years 5 years, 10 years and 15 years respectively. By contrast medium and high land owners ranging from 11 to 19 katha, 1 to 10 bigha, 20 to 30 bigha decreased over the years. The surveyed data demonstrate that frequent disaster in every year compelled the farmers to sell their land consistently.

Table 4. Yearly Land Loss in Terms of Taka (Thousand)

		< 10	10-30	31-50	51-70	71-90	91-110	111-130	131-150	>150
Landless	Current Land	*	*	*	*	*	*	*	*	*
	2 Years Ago	13%	19%	6%	5%	2%	*	*	*	*
	5 Years ago	*	*	11%	15%	3%	11%	2%	13%	*
1-10 katha	Current Land	6%	3%	2%	1%	*	*	*	*	*
	2 Years Ago	7%	12%	11%	9%	*	*	*	*	*
	5 Years ago	*	*	*	7%	11%	3%	13%	15%	*
11-19 katha	Current Land	2%	2%	1%	4%	*	*	*	*	*
	2 Years Ago	*	*	17%	19%	11%	*	*	*	*
	5 Years ago	*	*	10%	13%	21%	*	*	*	*
1-10 bigha	Current Land	*	5%	9%	11%	9%	4%	*	*	*
	2 Years Ago	*	*	2%	*	*	1%	6%	1%	*
	5 Years ago	*	*	*	*	12%	12%	14%	9%	5%

Source: Field Survey, June, 2011

Intergovernmental Panel on Climate Change (IPCC) predicted that the future disasters under climate change could be both more frequent and severe than in previous years, hence vulnerability of land displacement and its capacity to adapt demands closer examination. Table 4 shows how people of the study area became landless due to the adverse affects inflicted by natural disaster, and clearly illustrates the vulnerability of agriculture to severe climate conditions. People currently having 1 to 10 *katha* land 5 years ago approximately 7 percent had land property of Tk between 51000 to 70000 although in the same year 11 percent, 3 percent, 13 percent and 15 percent had land property fairly (between 71000 to 90000), (between 91000 to 110000), (between 110001-130000) and (between 130011-150000) taka respectively. Similarly, the landowners currently having 11-19 *katha* land owning 2 percent value less than 10000 Tk whereas 12 percent household have land value ranged (between 10000-300000) Tk. Five years before approximately 10 percent, 13 percent, and 21 percent had landed property fairly (between 31000-50000), (between 51000-70000), and (between 71000-90000). Hence from the information in the table 4 we can see that there seems to be a relationship between land displacement and continuous disaster.

4.2 SETTLEMENT AND LAND DISPLACEMENT PATTERN

This estimate is based on periodical agricultural census 1996 and shows that per capita net cultivable land has declined from 0.6 to 0.13 hectare after SIDR (MofDM, 2007). Frequent disasters such as floods, cyclone, and land erosion significantly caused this declining availability of land. Moreover these displaced lands are still unusable due to its excessive salinity. People could never cultivate these lands only because of its infertility owing to salinity after cyclone SIDR and AILA. The impact of sea level rise will further intrude the saline water to landward. The rate of saline water intrusion will also affect the ability of the ecosystem to adapt.

4.3 LAND DISTRIBUTION PATTERN BEFORE AND AFTER SIDR

Fig. 1. Land Distribution Pattern before and after SIDR

From the above figure it has been clarified that the total displaced land whereas the left sided map represents the land distribution pattern before cyclone SIDR and the right sided map represents the land distribution pattern after cyclone SIDR.

Table 5. Area of Flooded Agricultural Land According to Flood Depth (SIDR)

<table>
<tr><td>Class</td><td>Flood Phase</td><td colspan="2">Area (Sq. Km.)</td><td colspan="2">Percent</td></tr>
<tr><td>F0</td><td>Non-Flooded</td><td colspan="2">38.67</td><td colspan="2">13.3</td></tr>
<tr><td>F1</td><td>Shallow Flood</td><td>63.98</td><td rowspan="3">252.04</td><td>22.02</td><td rowspan="3">86.70</td></tr>
<tr><td>F2</td><td>Medium Flood</td><td>121.58</td><td>41.82</td></tr>
<tr><td>F3</td><td>Deep Flood</td><td>66.48</td><td>22.86</td></tr>
<tr><td>F4</td><td>Very Deep Flood</td><td colspan="2">0.00</td><td>0.00</td><td></td></tr>
<tr><td>Total</td><td></td><td colspan="2">290.71</td><td>100.00</td><td></td></tr>
</table>

Source: Field Survey, June, 2011

The data in Table 5 depicts that total agricultural land in the study area was 290.71 sq. km, out of which a total of 252.04 sq. k.m agricultural land became inundated by determined gauge level. This inundated area is 86.70 percent of the total agricultural land. It also shows the percentage area of flooded agricultural land according to stagnant flood depth during SIDR. Flooded agricultural land in the study area is shown in the previous map. The quantities of this land are 252.04 sq km which are 86.70 percent of the total agricultural land. Among the flooded land medium flooded agricultural land is the most dominating category gradually followed by deep and shallow flood depth. In contrast the two vivid maps assess the displaced agricultural land. First map illustrates agricultural land before SIDR and second map illustrates displaced land after SIDR.

Table 6. Year Wise Depletion of Agricultural Land and Price Defection

	Income (thousand)	Income From Agricultural Production (%)			
		Current Income	Before 2 years	Before 5 years	Before 10 years
Landless N=20	1-5	*	19	23	27
	6-10	*	7	5	6
	11-15	*	2	3	4
	Over 15	*	1	2	1
1-10 katha N=15	1-5	3	6	13	12
	6-10	2	6	7	9
	11-15	3	4	9	16
	Over 15	1	2	7	6
11-20 katha N=20	1-5	4	5	7	9
	6-10	5	7	16	9
	11-15	3	4	11	6
	Over 15	1	3	7	3
Over 1 Bigha N=25	1-5	7	11	9	3
	6-10	2	7	16	9
	11-15	1	4	11	6
	Over 15	1	3	7	3

Source: Field Survey, June, 2011

The relationship between agricultural income as a proportion of total net income and land size spectrum is depicted in Table 6. It is estimated that among the farmers had income ranged 1-5 thousand taka are now landless with current zero income from agriculture, but constituted 27 percent, 23 percent and 19 percent of agricultural income before 10, 5 and 2 years respectively. Similarly, the farmers had income ranged 11-15 thousand taka are presently landless with zero income from agriculture, but constituted 4 percent, 3 percent and 2 percent of the same before 10, 5 and 2 years respectively. In fact, there are many aspects of climate to which prairie agriculture is vulnerable; drought[3] can inflict the most extensive damage. In third portion of Table 6, the farmers having land range 11 to 20 *katha* had income ranged 1-5 thousand taka constituted only 4 percent income from agriculture, but it was 5 percent, 7 percent and 9 percent of agricultural income before 2, 5 and 10 years respectively. Similarly, the medium farmers having 11-20 *katha* land, the current income from agricultural land ranged 6-10 thousand taka and was only 5 percent of it, but the figure was 7 percent and 16 percent and 9 percent before 2, 5 and 10 years respectively. Thus, it is evident that frequent disasters like flood, cyclone, drought, and high temperature significantly reduced the income from agricultural land over the years.

[3] Drought is defined as a long period of abnormally low rainfall, especially one that adversely affects growing or living conditions.

Table 7. Land Uses at Risk during Different Natural Disasters and Vulnerability Score

Land Uses	Vulnerability Rank				
	Non Vulnerable	Less Vulnerable	Medium Vulnerable	High Vulnerable	Total
Agriculture (Sq. Km)	38.67 (13.30)	63.98 (22.01)	121.58 (41.82)	66.48 (22.87)	290.71
Settlement (Sq. Km)	27.98 (47.78)	14.68 (25.06)	13.82 (23.60)	2.08 (3.55)	58.56
Road (KM)	134.72 (21.26)	160.12 (25.27)	259.58 (40.96)	79.3 (12.51)	633.72
Infrastructure (No.)	64.0 (16.89)	104.0 (27.44)	149.0 (39.31)	62.0 (16.36)	379
Homesteads (No)	30470 (47.89)	15967 (25.09)	14949 (23.49)	2245 (3.53)	63,631

Source: Field Survey, June, 2011 (Figures in parentheses indicates percentage)

Table 7 shows the final portrayal of the physical damage occurred by the delineated flood level according to vulnerability phase. It displays that during AILA most of the areas became flooded by different vulnerability level. It is evident that most of people and households remained flood affected and most of the damages occurred in medium vulnerability level.

4.4 DISASTER EFFECTS, WATER LOGGING AND LAND USE CHANGE

Water logging during post disaster period is responsible for land displacement. Due to water logging, a huge change has occurred in agricultural and shrimp cultivable land. Table 8 reveals that in 1985, the average land for homestead was around 7.5 *katha* and in 2009 it declined to 6.8 *katha* with a standard deviation of 4.6 and 3.6 respectively. When water logging affects homesteads, the waterlogged land is used for shrimp cultivation purpose. The standard deviation of land for homestead is decreasing which states that the gap between high and low land is decreasing. Due to water logging, larger homestead are squeezing day by day and it is used for shrimp cultivation purpose. Those households which have large areas of residential lands are now utilizing a part of their residential land for shrimp cultivation purpose. So the average area and standard deviation of homestead is decreasing.

Table 8. Land Use Pattern from 1985 to 2009

Land Use	Change in Land Area over the Decades (in *katha*)					
	1985		1995		2009	
	Mean	SD	Mean	SD	Mean	SD
Homestead	7.49	4.60	7.18	4.44	6.87	3.62
Agricultural land	37	66.19	28	54.53	22	27.76
Shrimp cultivation land	0	0	19	31.13	46	56.77
Others (Fellow land, etc)	26	65.84	17	42.71	8	29.59

Source: Upazila Land Office, Sarankhola: Data collected in 2011

Table 8 summarizes the land use change over the past 2 decades (1985-2009). It was found that in 1985, an average of 37 *katha* lands were classified as agricultural land, it decreased to 28 *katha* in 1995 as compared to 22 katha in 2009. It is evident from the observation that much of the low lying land is flooded by river water, although lower parts of the land submerged by rainwater under monsoon season. Because of this flood, the land area is subject to water logging which disrupt normal cropping patterns. For this reason, rice cultivable land is decreasing and shrimp cultivable land is increasing in the waterlogged areas. In 1995, the average shrimp cultivable area was 19 *katha*. Due to water logging the average shrimp cultivable land area in 2009 increased to 46 *katha*. The average shrimp cultivable area is increasing because it is suitable to practice shrimp cultivation in the waterlogged areas. Comparison between the standard deviation of shrimp cultivable land is increasing which proves that there is a variation among the land size. For example in 1985 no land was used for shrimp cultivation, and so the standard deviation of land size used for cultivation was zero, but it increased to 31.13 in 1995 and to 56.77 in 2009. This increasing standard deviation reveals that land size variation used for shrimp farming is widening over the years. The fellow lands are now used for shrimp cultivation purpose. For this reason, the average area of fellow land is decreasing.

4.5 SEASONAL CROPPING PATTERNS AND THEIR ASSOCIATION WITH NATURAL DISASTER (FINDINGS FROM FGD)

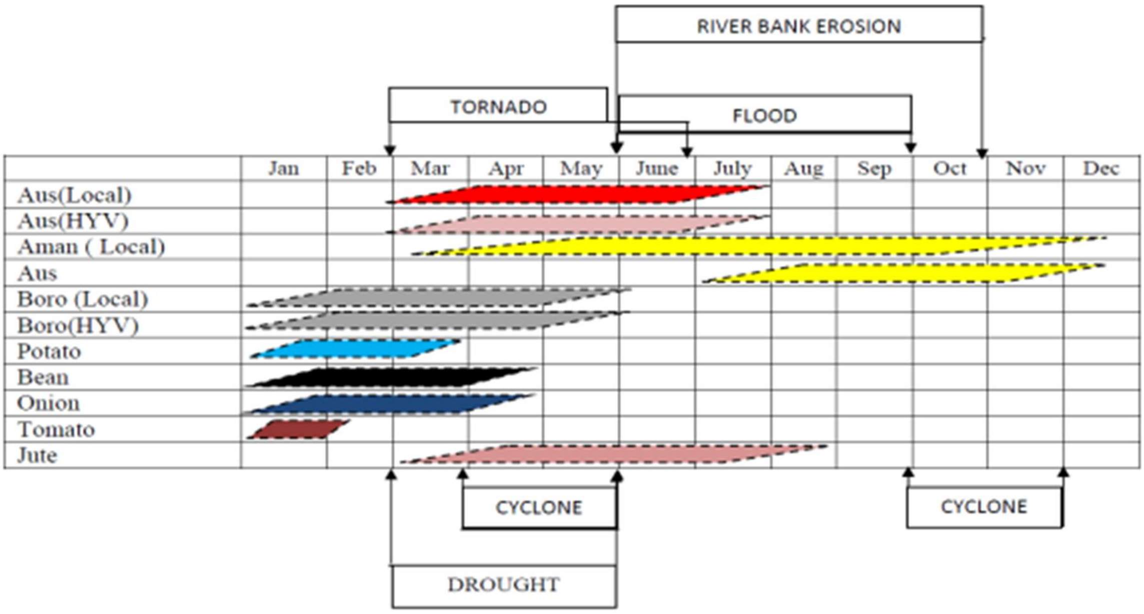

Fig. 2. International Journal of Innovation and Applied Studies

The figure shows that the growing seasons relate to seasonal flooding, tropical cyclone, drought and major kinds of natural disasters. In the study area most of the land produces three crops in a year. The figure illustrates that cyclone occurs in the pre monsoon season, mainly affects *Boro* and Aus as well as *Aman*. Jute is also a remarkably affected crop due to cyclone and drought. In addition, one or two weeks after a drought, cyclone occurs; particularly in the pre-monsoon season this region normally becomes flooded from the river water, and the flow of river water occurs more frequently, sometimes several times in a year. Seasonal flood (from April-May) generally causes most damage when the *boro* rice crop is grown. Obviously this process is a dilemma for double loss of agricultural land and further lead to long term abstention from cultivation promoting people for large scale permanent outward migration for securing alternative income.

The participants of FGD used the word *tufan* to describe cyclone and *ban* to describe flood. When they were asked about SIDR almost everyone replied that it was not a cyclone, it was *kayamat*[4], a *gazab*[5] for us. Some survivor of SIDR expressed their feelings that we miraculously survived and Allah saved us.

In response to a question about seasonal cropping pattern**, a 66-year-old man** who worked as share cropper **stated**:

Aus paddy ranked first in the cultivated area among the three types of rice. The seasonal calendar of Aus paddy is from March to July, *Aman* paddy from March to November, and *Boro* from January to May and evidently the greater possibility of the seasonal risk of tornado, flood, river bank erosion, cyclone and drought is during seasonal cropping time. Therefore, away from 3 years after SIDR I got significant drop in production due to increased salinity intrusion. Small farmers like me cannot

[4] *Doomsday or day of reckoning*
[5] *Curse of Allah*

change land use further because of lack of capital. Last year my only son Rahman (28) has gone to Dhaka for job still he did not return. I am waiting anxiously for his return.

Another 75 years old male stated the following:

In particular yield disparity has been recognized to high temperature during the *Aman* season and the crucial problem is infestation of pest insect and disease and their changes.

During the discussions, almost all participants agreed that, permanent loss of land leads to unemployment distinguished by its long or temporary duration, a significant loss of long-term earnings potential. Surprisingly enough it was reported by the discussion group that the inhabitants did not left their lands not for any intrinsic value it had, but purely emotional reason because this ownership of land mostly achieved through their descendent.

Female participants were asked to explain the land displacement, almost all the female participants reported that even at short timescales they are stigmatized to their livelihoods because of flood, drought, soil erosion, desertification, deforestation and other environmental problems. In addition female respondents perceived that due to frequent disasters cropping activities are reduced, shrimp is replacing crops in the field. While vegetables cannot grow due to saline water, the local women are hardly related with shrimp farming as traditionally women cannot contribute in earnings which ultimately reduced the economic activity of women and their mobility. A 45 year old woman stated that she had land which now turned to flooded arable land, she can neither cultivate water-logged fields nor can change land use in physical properties, so her 2 daughters migrated to Dhaka and working in a garments factory to bear family expenditure for last few years.

5 Conclusion

The foregoing analysis demonstrates that over the years the rate of landless households increased alarmingly due to frequent disasters such as floods, cyclone, and land erosion which significantly caused the declining availability of land. Similarly the number of petty land owners increased significantly, while the medium and high land owners decreased over the years. The surveyed data demonstrate that frequent disaster in every year compelled the farmers to sell their land consistently because these displaced lands became unusable due to its excessive salinity and long time water logging. Consequently life, livelihood and occupation of these vulnerable people were widely affected and force them to outward migration especially towards urban areas.

Future projection reveals that about 63 million and 78 million people will be displaced by 2015 and 2020 respectively [8]. The dire prediction is that a large number, closer to about half of the total population will be displaced by 2020 that reveals the extent of fatality of displacement. Hence sustainable mitigation strategy must be integrated into the development plans to address the issues of climatic displacement.

6 Recommendation

- We have to mainstream the climate change adaptation strategy into natural disaster policies and programs focusing on land displacement. With this end, in assessing the damage and compensation for the displaced people, the long term impacts of the disaster should be taken into account.
- Rehabilitation should include different measures for income and employment generating activities for the displaced population.
- 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,
- Arable and fellow land should be conserved and 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.

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