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CLIMATE CHANGE INDUCED VULNERABILITY ON LIVING STANDARD- A STUDY ON SOUTH-WESTERN COASTAL REGION OF BANGLADESH

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ABSTRACT

Ahsan MN, Ahmed MF, Bappy MH, Hasan MN, Nahar N (2011) Climate change induced vulnerability on living standard- a study on south-western coastal region of Bangladesh. *J. Innov. Dev. Strategy* 5(3), 24-28.

Climate change is the common phenomena for all over the world. Bangladesh is facing the most adverse impact of climate change. Especially in recent years, the country is facing the severe devastating impacts due to the changes of climate factors. 'Cyclones', the most likely devastating effects of climatic change is occurring in Bangladesh on a regularly basis (SIDR 2007 and AILA 2009). This study assesses the socioeconomic vulnerability of the households in the coastal community of Bangladesh in numeric values by using a vulnerability index consists of a number of indicators. Living condition of the people in the coastal region of Bangladesh becomes more and more vulnerable than the other areas of the country due to adverse effects of climate change. This study also tries to assess the impacts of climate change-induced vulnerability on the living standard of the coastal community. The study shows the worst living condition of the people in the study area where the value of different vulnerability index is Demographic 0.50, Social 0.44, Economic 0.54, Physical 0.47, Exposure to Cyclone 0.38 and Household Vulnerability 0.47. The results show the higher level of vulnerability in the study area.

Key words: climate change, cyclones, vulnerability, socio-economic, living standard

INTRODUCTION

As a complex phenomenon, climate change is a multifaceted, multidimensional, long-term, slow onset phenomenon with enormous impacts that touches many aspects of human society. The coastal areas of Bangladesh is different from rest of the country because of its geo-physical characteristics as well as for different socio-political consequences that often limits people's access to resources and perpetuate risk and vulnerabilities (Shamsuddoha and Chowdhury, 2007). Bangladesh coast is vulnerable to recurrent cyclones and the results creates such a situations where thousands of people may lose their lands, houses and vulnerable their livelihoods and ultimately push them lower income group. Poor communities are more vulnerable to cyclones; they have more limited adaptive capacities, and are more dependent on climate-sensitive resources such as local water and food supplies. The coastal areas of Bangladesh are particularly vulnerable to tropical cyclones and associated storm surges. The cyclone occurred in 1970, 1985, 1991, 1997, 2007 and 2009 caused huge losses and displaced millions of people in the coastal areas (Akter 2009). Between 1877 and 1995 Bangladesh was hit by week and strong 154 cyclones and in May 1997, May 1998, November 2007 and May 2009 hit the coast of Bangladesh (GoB 2009). As a consequence of devastating cyclone like *Aila*, *SIDR*, millions of people in coastal Bangladesh have lost their shelter (Anon. 2009). Frequency and intensity of tropical cyclones in the last 40 years can be attributed in part to global climate change, and it is responsible for the creating the community more vulnerable of the coastal region of Bangladesh.

This paper answers two associated questions: Firstly, the quality of life in the South- West coastal area vulnerable, or not? Secondly, to what extent climate change-induced vulnerability does affect living standard in the coastal region?

The adverse impacts of climate change are experienced most by the coastal region around the world (Ahsan 2010). Among the victim of climate change around the world, Bangladesh is in the most vulnerable position (Matthews 2009). Minor changes of climate variables induced major consequences on the environment (Matthews 2009). Matthews (2009) also found that, the effects of climate change continue to intensify the potential for social, economic, and overall living standard. Due to the sea levels rise and several floods in the coastal belt vast proportion of people of Bangladesh becomes homeless, many have no choice of living but to flee from their origin.

Climate change is expected to increase the frequency and intensity of current hazards and the probability of extreme events and new vulnerabilities with differential spatial and socioeconomic impacts (Sharma and Sharma, 2008). The study of UNFCCC (2007), climate variability can influence peoples' decisions with consequences for their social, economic, political and personal conditions and effects on their lives and livelihood.

MATERIALS AND METHODS

Study Area

This study covers one of the most vulnerable unions of Koyra Upazila; is situated to the South-West part of Khulna District. This Upazila occupies an area of 1775.41 sq km. It is located in between 21°45' and 22°32' north latitudes and between 89°14' and 89°31' east longitudes. This Upazila is bounded by Paikgachha Upazila on the north, the Bay of Bengal and the Sundarbans on the south, Dacope Upazila on the east, Assasuni and Shyamnagar Upazila on the west. For the purpose of conducting this study a union of Koyra upazilla named Bagali is selected which is one of the most vulnerable union under Koyra upazilla due to the proximity to the Bay of Bengal and which is frequently affected by various natural calamities.

Study Methods

This study follows both the descriptive and quantitative approach of research. To collect the primary data from the study place a random sampling technique is followed of 60 households. This study attempts to find out the level of vulnerability of living standard as well as to assess the impact of change in climatic characteristics on the living condition. The physical features of study area, their climatic condition and socio-economic factors are collected. The descriptive approach explains the causes of household living standard vulnerability as well as their socio-economic vulnerability. For the quantitative approach the vulnerability index is calculated to show actual physical living condition of the people living in the coastal Bangladesh.

Vulnerability analysis

With a view to identifying the household vulnerability, five domains are considered where each domain has some particular indicators. The domains are demographic, social, economic, physical and exposure to cyclone. The indicators are taken with the help of the process adopted by Bollin and Hidajat (2006) on their study and modified by Ahsan (2010) on his study. These studies give numeric values to the vulnerability domains through calculating the indicator index of the variables related to that particular domain. Indicators taken under the different domains (Table 1) for each household are used to get the real scenario of the household living condition of the coastal community.

Table 1. Indicator Index for Each Domain of Vulnerability

Domains	Indicators	
Demographic Vulnerability	<ul style="list-style-type: none"> • Dependency ratio • Male-Female ratio 	<ul style="list-style-type: none"> • % change in household structure • % of migrated
Social Vulnerability	<ul style="list-style-type: none"> • % of illiterate • Poverty level 	<ul style="list-style-type: none"> • % of adult member not voting • % of adult member not contributing free labor
Economic Vulnerability	<ul style="list-style-type: none"> • % of income from nature • % of unemployed 	<ul style="list-style-type: none"> • % of land lost (decomal) • % of asset destroyed
Physical Vulnerability	<ul style="list-style-type: none"> • % of non concrete house • % of non electricity 	<ul style="list-style-type: none"> • % of non tube well water source • Distance to local market index
Exposure to Cyclone	<ul style="list-style-type: none"> • % shifted to cyclone centre • % of household member not realizing warning system 	<ul style="list-style-type: none"> • % of members listening daily forecast • Provision of early warning system

Vulnerability index of the related indicators are calculated first. To get the index value for each indicator, the following formula adopted from a study on water poverty index (Lawrence and Meigh, 2002), is used;

$$\text{Indicator Index} = \frac{x_i - x_{\min}}{x_{\max} - x_{\min}}$$

Where,

X_i = original value of the indicator for the household

X_{\max} = the highest value of the indicator for the household

X_{\min} = the lowest value of the indicator for the household

The numeric value of indices of each indicator varies from 0 to 1. After making the average of the respective indicator index, the study gets the domain-wise vulnerability. The household vulnerability is calculated by making the average of all the domain-wise vulnerability values for each household.

To calculate the total vulnerability of living standard, twelve indicators (Table 2) is taken into account, as they are closely related to living standard. Thus the study shows the living standard vulnerability its value ranges from 0 to 1. The value close to 1 shows higher vulnerability.

Table 2. Indicator Index for Living Standard Vulnerability

Vulnerability	Indicator Index	
Living Standard	<ul style="list-style-type: none"> • Dependency ratio • % illiterate index • Poverty level • % income from nature • % unemployed index • Land lost (decimal) index • % asset destroyed index 	<ul style="list-style-type: none"> • % non-concrete house • % expenditure on electricity • % non tube-well water source • % change in household structure • % migrated index

Estimation of Living Standard Vulnerability

The vulnerability of the living condition of the people of the coastal region can be show by econometric analysis. For the econometric analysis, the following equation was used;

$$L_v = \alpha + \beta_1 D + \beta_2 S + \beta_3 E + \beta_4 P + \beta_5 E_x + \epsilon$$

Here, L_v = Living Standard Vulnerability, D = Demographic Vulnerability, S = Social Vulnerability, E = Economic Vulnerability, P = Physical Vulnerability, E_x = Exposure to Cyclone and Storm Surge, α = Intercept, β 's are the coefficient of the independent variables, ϵ = the error terms.

The above equation shows the relationship of living standard with the climate change-induced vulnerability where the independent variables show the phenomena of living caused by climate change and the dependent variable i.e. the living standard vulnerability shows the vulnerability of living condition of the people of coastal region. The result of the equation shows the dependence between living standard and climate change-induced vulnerability which satisfies the study objectives.

RESULTS AND DISCUSSION

Vulnerability is the characteristic of an individual or group in terms of the capability to anticipate, cope with, resist and recover from the impact of a natural hazard (Blaikie and Cannon, 1994). Due to climate change, vulnerability to the coastal community is increasing rapidly. The living standard of people is facing higher degree of vulnerability, especially; those who live in coastal region are very much vulnerable due to having the most endangered situation at the time of natural calamity like storm, tidal surge, erosion and many others. As the factor of the climate are changing day by day and it is creating impact on the human life and total environment, it very much necessary to understand the degree of relationship between climate change-induced vulnerability and the living standard of people of the South-West region of Bangladesh.

Living Condition of the Coastal People

The overall condition of the coastal area of Bangladesh represents an insecure future of this community which becomes more insecure when people left out from their means of living and lost their all types of living amenities (Basar 2009). This study mentioned that the coastal region of Bangladesh is very much vulnerable in terms of living standard. The living condition of the coastal people is focused by showing the use of living amenities of the people. It helps to understand the living condition and overall physical features of people.

Type of house

House is the most important element of human for living. A person needs a minimum standard house to live in, which can save him from all types of danger including, climatic vulnerability. But this study shows that in the South-West coastal area of Bangladesh 97% of the household (Fig. 1) are living in non-brick build house and the remaining 3% have brick build house; where brick build house shows well quality of living condition.

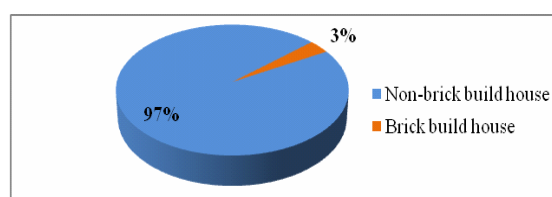


Fig. 1. Type of House Source: Field Survey, 2010

Source of water and Sanitation facility

Water, an important natural resource and an important element of human life, is easily available in the South-West region of Bangladesh due to its proximity to sea. But the source of drinking water is not well enough. Living standard without quality water can not be said well at all. Good water means water from a safe and pure source. But surprisingly 100% (Fig. 2) of the households of this study area use pond water for their drinking, cooking and bathing.

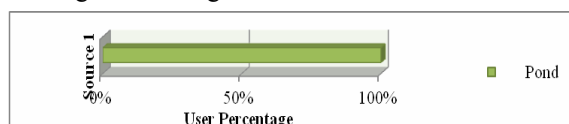


Fig. 2. Source of Water (Source: Field Survey, 2010)

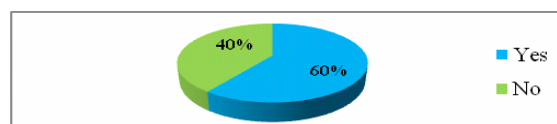


Fig. 3. Sanitary Latrine (Source: Field Survey, 2010)

It also is observed that lack of safe potable water during and after an extreme weather event causes sufferings to millions of people from water-borne diseases. Such usage of impure water for household affairs causes various health hazards. The problem becomes severe after cyclone, flood and other natural disasters (Adger *et al.* 2005). Scarcity of drinking water comes as an aftershock of natural disasters to the people. Sanitation is another vital indicator of showing the standard of living. Household having sanitary latrine shows less vulnerable one, because it indicates the quality of life. In the study area, 40% (Fig. 3) of the household have no access to sanitary latrine and another 60% have no sanitary latrine to use.

Household vulnerability

The study also seen the worst living condition of the people of the study area that describes the overall vulnerability of the people living at South-West coastal region of Bangladesh. The domain-wise vulnerability indices (Table 3) shows the overall vulnerability for each domain.

Table 3. Household Vulnerability (Average Index)

Vulnerability	Demographic	Social	Economic	Physical	Exposure to Cyclone	Household Vulnerability
Average	0.50	0.44	0.54	0.47	0.38	0.47

The result showed that the average vulnerability in case of demographic, social, economic, physical and exposure to cyclone vulnerability. It also shows average vulnerability rate of household 0.47 which is the average value of all individual household vulnerability for climate change at the South-West coastal region of Bangladesh. It shows that households in this region are facing a high rate of vulnerability for climate change.

Living Standard Vulnerability

Total household vulnerability shows the overall vulnerable condition for climate change of the South-West region of Bangladesh. The result of the different indicators of vulnerability of living standard shows the people living in the coastal region of Bangladesh are going towards a very vulnerable living condition. It describes how much the living standard of coastal people is affected by the climate change-induced vulnerability. There exists dependency between the existing domains and the living standard vulnerability. The study found the relationship among the domain-wise vulnerability which is the resultant of climate change and the vulnerability of living standard using the linear regression model. The dependent variable of this model is the 'living standard vulnerability' which is found from the calculation of average of the living standard related twelve indicator indexes. The independent variables for this model are the five domains of vulnerability index by which the household vulnerability is calculated. These are the variables which produce household vulnerability and it is the resultant from the climatic change. The study tries to find out the relationship between climate change-induced vulnerability with the living standard vulnerability. The average vulnerability of living standard of the people at the coastal region of Bangladesh is 0.49, which shows a high rate of vulnerable living condition.

The model of living standard vulnerability is run through SPSS, which gives the values of coefficients and other econometric indicators (Table 4).

Table 4. Estimated Living Standard Vulnerability Function with Different Vulnerability Index

Variables	Living Standard Vulnerability	Sig.
Demographic Index	0.255 (0.028)*	.457
Social Index	0.083 (0.037)*	.000
Economic Index	0.357 (0.030)*	.027
Physical Index	0.180 (0.031)*	.000
Exposure to cyclone	0.057 (0.027)*	.000
Constant	0.024 (0.032)*	.041
Observations	60	
R-squared	0.846	

*Standard error

Using living standard vulnerability as dependent variable the OLS estimate shown that, Living standard vulnerability is strongly related with all the explanatory variables in the model. The estimated R^2 of the living standard vulnerability function of the study area shows that about 85% of the total variation of living standard vulnerability is determined by the variation in demographic, social, economic, physical and exposure to cyclone

index vulnerability. The vulnerability influencing factors (demographic, social, economic, physical and exposure to cyclone), included in the mentioned function of living standard is significant and displayed the expected signs. The expected positive value of demographic, social, economic, physical and exposure to cyclone index vulnerability indicated the positive change in living standard vulnerability. This indicates that, a 1 unit increases in the in demographic, social, economic, physical and exposure to cyclone index vulnerability, the living standard vulnerability increases by 0.255, 0.083, 0.357, 0.180 and 0.057 unit respectively and for demographic, economic and physical index the level of significance is 1% and for social and exposure to cyclone the level of significance is 5%.

CONCLUSION

The devastating effect of climate change can be seen mostly in geographically vulnerable countries of the world. Every year, as a disaster-prone country like Bangladesh; loses much of its resources as a consequence of natural calamities. Major environmental problems such as rises of sea level, increasing salinity, floods and cyclones could make millions of coastal people climate refugees. Communities living in the South-West coastal region of Bangladesh are suffering severe environmental hazards which created huge obstacles for their livelihood options and socio-economic development. This scenario is threatening the food, shelter, health, drinking water and other living condition of poor communities and making them more vulnerable. Investments including strengthening polders, foreshore afforestation, additional multi-purpose cyclone shelters, cyclone-resistant private housing, and further strengthening of the early warning, give training to the coastal people to cope with the hazardous situation should be implemented for a better living condition in this vulnerable region. Though this study tries to give a clear picture of the vulnerable situation of the coastal region but the study suggests more intensive study on the adaptation options and coping mechanism related to the living standard of the vulnerable people living in the South-West coastal region of Bangladesh.

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