American Journal
In Quality, We trust

American Journal of Social Studies (AJSS)

Volume 1, Issue 1

ECONOMIC VULNERABILITY OF DISASTER IN LAND PRODUCTIVITY: A CASE FOR MONGLA UPAZILA, BAGERHAT DISTRICT, BANGLADESH

Md. Mujibor Rahman
Professor, Environmental Science Discipline, Khulna University, Khulna- 9208, Bangladesh

Abstract: The impacts of recurrent hazards like salinity intrusion, water logging, cyclone and tidal surges, flood, drinking water crisis and virus attack in the gher farming are directly or indirectly affect all segment of life in the coastal people of Bangladesh. The Mongla Upazila, a southwestern part of Bangladesh is facing these intermittent hazards and their effects over the way of life. Salinity problem identified as the most serious agent for economic vulnerability in this region causes the loss of agricultural production and economic thrashing. Sector wise economic vulnerability is determined through the questionnaire survey but especial emphasis is always given to the land productivity. The cost of decreased agriculture production is determined for assessing economic vulnerability. Only decreased amount of rice production is determined for the most ranked salinity (88 per cent respondent think salinity as a highest rank problem for decreased land productivity) problem. Decrease rate of crop production (rice kg/acre) of Mongla Upazila is about 360.26 kg/acre in considering the total cultivable land 27824.55 acre affected by the salinity problem. By using the use value of cultivable land the cost of decreased net production loss is determined where total cost for decreased land productivity per year is Tk 31, 07,44,950. Economic loss of land productivity from two consecutive years is Tk 32,13,82,645. Based on the existing adaptation practice and possible best management option using by the people of study area a strategy is developed for minimizing economic vulnerability of disaster in land productivity.

Keywords: Vulnerability, Disaster, Land productivity, Coastal region and Hazards.

Introduction

The consequences of disasters and the resulting environmental degradation pose a serious threat to the economic development of the country. Regardless of frequency, however, its damaging effects and consequent vulnerabilities to different group of people are different and can have a significant impact on the welfare of single household to the entire nation. Estimates for the impacts of a natural disaster can be expressed in terms of direct costs, indirect costs and secondary impacts and in unified term as economic vulnerabilities. The economic costs consist mainly of immediate damage assessments in order to provide governments and aid donors with estimates of the amount of funds required to address emergency and reconstruction needs. Long term indirect costs in the flows of goods and

services, reduced levels of production and non-market impacts such as environmental damage and psychosocial effects are frequently omitted from such assessments (Ali, A., 1999). Bangladesh, with a population of 143.8 million, is among the top three most disaster prone countries in the world, and vulnerable to cyclones, tidal surges, tornadoes, floods, droughts, earthquakes, and cold spells (Ali, A. 1999). It has been observed that all the coastal cultivable lands are not being utilized for crop production, mostly due to soil salinity. Increased soil salinity limits growth of standing crops and affects overall crop production, and also makes the soil unsuitable for many potential crops. Soil salinity has been considered a major constraint to food grain production in coastal areas of the country (Huq, *et al*., 1999). As land formation is a counting process even now, this region is a dynamic delta enriched by the huge quantities of detritus from the forest, both terrestrial and aquatic. Except this bounty of resource, the Southwest Coastal Region of Bangladesh has been identified as one of the regions that would be worst affected by various natural disaster as the effects of rising sea levels, water logging, flood, cyclone, poor drainage through river systems, siltation and saline intrusion. All these effects of disaster in this area affect the productivity of land an enhance people to choose alternative option. As a result, the economy of people has seriously been damaged are their land vulnerability increase day by day.

Objectives

The objectives of the study are:

- ✓ To assess the economic vulnerability of disaster in land productivity for the study area;
- ✓ To account the cost of disaster in land productivity for the selected area; and
- ✓ To develop a strategy for minimizing the economic vulnerability of disaster in land productivity for the selected area.

Material and Methods

The Mongla upazila occupies an area of 1461.22 sq. km of which 1083.00 sq. km of forest area(BBS, (2011),. It lies between 21^0 49́ and 22^0 33́ north latitude and between 89^0 32́ and 89^0 44́ east latitude. Total cultivable land of Mongla upazila 12565.76 hectares, fallow land 611.79 hectares; single crop 99.03%, double crop 0.86% and treble crop land 0.11% (Rahaman, A.1988).

***Environmental cost accounting and mathematical consideration*:** Under the headings of environmental cost accounting and mathematical consideration, tend to devise prerequisites for the model concept of determining economic vulnerability of disaster in terms of land productivity. Environmental cost accounting approach deals with the value of environmental changes whether the favorable or unfavorable cost which is major concerned as environmental cost benefit analysis. Besides the market value of an environmental asset there may be some hypothetical valuations has to be considered where no market price exists. Hypothetical valuation of an environmental asset is determined through the questionnaire survey as 'willingness to pay' for an environmental amenity or 'willingness to accept' compensation for an environmental loss. To determine total economic cost of land productivity, the economic value of affected resource related to land productivity need to be assessed. This cost accounting process needs to account these three categories of values:

i. Use value resources; Option value resources; and Existence value.

***Methods for accounting the cost of disaster in land productivity*:** Considering the major disaster of the area and its impact on land productivity, the methods were developed to account the cost of resource loss. For accounting the cost for resource losses, the general methodology followed was to estimate the Decreased Rate of Production (DRP) per unit area/person or the Decreased Rate of Number (DRN) per person [Bond, et al. (1992); Graff,

et al. (1998); Barg, (2005)]. The DRP or DRN is the ratio of change in production/number with and without the time of hazards considering the Environmental Depreciation Cost. The DRP/DRN is the difference between rates of production/number during the hazards or without the time of hazards.

The objective function of total cost of disaster in land productivity is as follows:

$$C = \sum_{i=1}^{n} (\text{Amount of resource depleted due to hazards}) \times (\text{market value of resources}) \quad \ldots\ldots\ldots\ldots 1$$

Where, n = total number of hazards considered for cost accounting. Which can be re- written as – $C = \sum_{i=1}^{n} Ci$ ……2

Methods for accounting the cost for decreased land productivity: Considering the use value (Cutter, S. L., 1996) of cultivable lands, cost for decreased land productivity is the product of 3 (three) factors. They are provided below:

i) Decreased Rate of Production (DRP) considering with or without hazards of the areas (Xh)

The rate of change in production (Xh) = (Production per unit area during the time without hazards) – (Production per unit area during the time with hazards)

Where, Production per unit area = (Production per unit area – Other maintenance cost for production)

ii) Monetary value of 1 (one) unit production (M_h)

iii) Total land area for agricultural production with hazards (L)

Thus the cost for decreased land productivity (Ca) would be-

$$C_h = (X_h * M_h * L) \text{ Tk.} \quad \text{---------- 3}$$

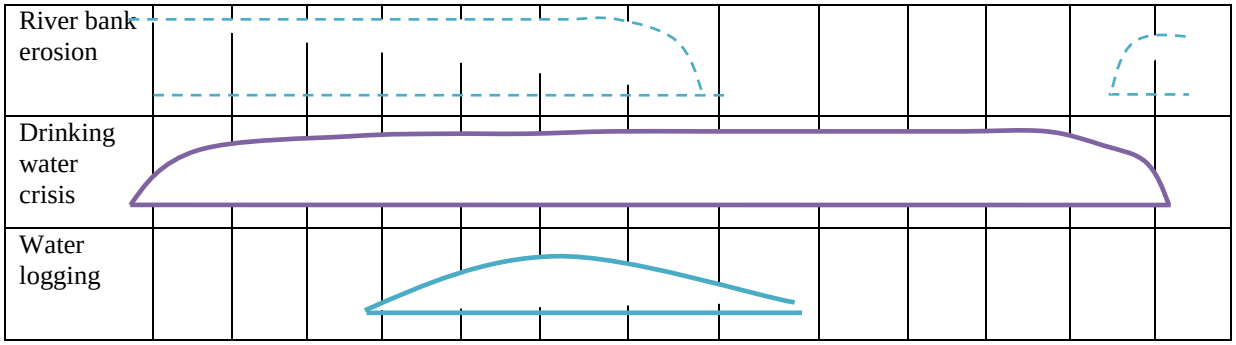
Where, C_h = Cost of decreased land productivity due to hazard ; X_h = Decreased rate of production, Kg/acre ; M_h = Monetary value of unit crop production, Tk ; L = Affected Land area, acre

Results and Discussion

Seasonal Hazards Calendar of Mongla Upazila: The Seasonal Calendar of Hazards has been prepared with the help of conducting information from the local people. Seasonal hazards calendar of Mongla Upazila is as follows:

Table 1: Seasonal Hazards Calendar of Mongla Upazila.

Hazards	Season												
	Boishakh	Jyostya	Ashar	Srabon	Badra	Aswin	Katrtik	Agrahyan	Magh	Poush	Falgun		Choitra
	Apr.	***May***	***June***	***July***	***August***	***Sept.***	***Oct.***	***Nov.***	***Dec.***	***Jan***	***Feb***	***Mar.***	***Apr.***
Salinity													
River bank siltation													
Shrimp Virus													
Cyclone													
Tidal surge													



From the seasonal hazards calendar, it shows that the timing and duration of different hazards occurring in this area. Sharing the views with local people it shows that with the change of weather and climatic conditions, the nature of hazards with their frequency and magnitude are different.

***Salinity*:** In this area the main hazard is salinity. The intensity of salinity is observed from the half of December and continuous up to first week of July. Though the rest of the time intensity of salinity is less but its effect on different sector remains steady.

***Water logging*:** Rivers have lost their navigation owing to the deposition of alluvia in the basins. Negative impacts of the coastal embankment, absence of river management, irregular maintenance and lack of good governance of water management including the sluice gates and side by side the use of river beds for the deposition of alluvial soil, the river silted up quickly and enhance water logging of vast area in rainy season. River bank siltation starts from April and continuous up to the month of October.

Tidal surge: Local people think that tidal surge is one of the great hazards in this area. The tidal surge is usually held in the month of mid June, September and up to mid November. Mongla Upazila falls under the zone of this hazard.

***Cyclone*:** Mongla Upazila falls under the zone of severe storm (Cyclone). The trend of occurring a devastating cyclone seems that every single decade interval on an average. The cyclone is usually held in the month of March, May, September and December.

***River bank erosion*:** The period of river bank erosion is from mid March to early September and mid September to October. Along two sides of the Pasur river of Mongla Upazila is mainly affected and eventually hampered seriously by the effect of riverbank erosion. The communication may be seriously hampered. If the river erosion continues the croplands may be eroded in this area.

***Drinking water crisis*:** The presence of extensive salinity in both surface and ground water makes the water unfit for human drinking and different domestic purposes. It is surprising that it is even not possible to set up deep tube well in this region. People are mainly depending on some specific fresh pond water and rain water for few months. Lack of source of pure drinking water in this Upazila may cause severe health related ailments and weakness to the local people.

***Shrimp virus*:** Shrimp virus is regarded as a great hazard in this area. This virus has been increasing the risk due to the import of virus carrying young fishes, and there being no method of planned draining of water from the shrimp gher area. The symptoms of shrimp virus are generally observed in the middle of March and continue up to the middle of May. Again it is observed in the middle week of September and continuous up to middle week of December.

***Seasonal Agricultural Practice*:** The total agricultural practices of Mongla Upazila has been categorized as Aman paddy, Rabi crops, fruits like guava, kul, mango and Boro and Irri. Maximum people are engaged in the agricultural works. Aman paddy is main contribution in this agriculture. Aman is planted in the mid-months of July and harvested in the month of January. On the other hand Rabi crops are practiced in the month November and harvested in

the months of February-March. Among the fruits in this region maximum people are practiced the cultivation of growing fruits like: guava, Kul, mango etc. Irri paddy also contributes in agriculture. Although it is cultivated in whole year mainly it is harvested in the months of March-April and December-January. Last two years the Agricultural departments of Mongla Upazila try to practice boro paddy in some selected fields. Except the agricultural practice major portion of people are engaged in various types of non-agricultural works. Among those some are carrying out almost through the year such as: Shrimp and fresh fish, cottage industry, poultry farm, day labor, van puller and nosimon driver, fisherman, small traders, mobile business, water business, bricks and silica business, rearing livestocks, service holders, carpenter, golpata collection, bawali, mowali etc.

***Ranking of Vulnerability to the Hazards*:** There are mainly five categories of vulnerability have been identified for the selected areas which shows by the Table 2. The categories of vulnerability for different socio economic variables are identified as severely vulnerable, highly vulnerable, moderately vulnerable, vulnerable and no vulnerable on the basis of their economic viability to different hazards. Under the socio economic variables of the table 2, identified those sectors all of which are concerned with the economic vulnerability. For agriculture sector Aman and Boro paddy are severely vulnerable with the hazards of salinity. Fisheries sector of the study area is highly vulnerable for shrimp, prawn and white fish due to the problems of salinity, virus attack, cyclone etc. Homestead plants under the forest cover of the area are highly vulnerable for the problems of salinity, water logged, and tidal surges. Most of the land area of Mongla upazila is now practiced for the gher farming. Thus the land area is occupied and there is no available fodder for the cattle's. For this reasons among the livestock's in this region cows are severely vulnerable for their existence. Among the occupational practice, farmers and agri-labors are severely affected due to the impact of salinity. The main cause of this severity is to extensive practice of gher farming and the total gher farming is controlled by some specific person. As a result the poor farmer and agri labor are in severe vulnerable situation.

Table 2 : Vulnerability Status to the Hazards of Mongla Upazila.

Major Hazards of Mongla Upazila: Salinity Intrusion, Water logging, River siltation, Cyclone and storm surge, floods, virus attack etc.	Vulnerability Status to the Hazards of Mongla Upazila			
	Socio-economic variables	Vulnerable elements	Ranking of Vulnerability	Most affected group
	Agriculture	Aman and Boro	++++	Aman and Boro
		Rabi crop	+++	
		Jute	++	
		Wheat	+	
		Vegetables	+++	
		Fruits	+++	
	Fisheries	Shrimp	+++	Shrimp farming
		Prawn	+++	
		White fish	+++	
		Crab	++	
	Forest	Forestry/ Trees	++	Homestead plants
		Homestead plants	+++	
	Livestock's	Cow	++++	Cow
		Goat	++	
		Poultry	+	
		Duck-hen	++	
	Occupation	Agri- labor	++++	Agri labor
		Business	+	
		Fishing	+++	
		Formal services	+	
		Informal services	++	

		Handicraft	++	
		Others	++	
	Infrastructure	Katcha road	++++	Katcha road
		Paka road	+	
		Office	+	
		Health care center	++	
		Religious institution	+	
		Educational Institution	+	
	Shelter	Paka house	-	Katcha house
		Semi-paka house	+	
		Katcha house	+++	
	Health	Physical/ mental health	+++	Physical and mental health
		Maternal health	++	
		Child health	++	
		Nutrition	++	
	Water supply and sanitation	Drinking water	++++	Drinking and irrigation water
		Water for domestic use	+++	
		Irrigation water	++++	
		sanitation facility	++	

Source: Field Survey, 2015

Notes: Ranking of Vulnerability ; ++++ = Severely vulnerable; ++ = moderately vulnerable; +++ = Highly Vulnerable; + = Vulnerable
- = No vulnerable

Economic Vulnerability with Respective Hazards: Peoples Perception in the Sense of Land Productivity: Among the selected hazards of Mongla upazila the main problem is salinity. In this region the problem of salinity is now going to disastrous condition due to horizontal expansion of shrimp firms. Drinking water crisis is another massive problem in this area. Due to higher rate of salinity in surface and ground water, the water of Mongla upazila is almost unfit for drinking and irrigation purposes. Cyclone is a regular phenomenon in this region and from the people's opinion every single massive cyclone comes within three years but moderately and normal strength cyclone may comes two or three times in a year.

The peoples opinion of their economic vulnerability with respective hazards of Mongla Upazila. Economically all group of people in the study area are directly or indirectly vulnerable with the problem of drinking water crisis. Thus, 100% of respondent says about their main problem as the scarcity of drinking water. Although, salinity is the major problem in this region but poses 93% of respondent selected it as the economically vulnerable hazards because some selected group of people are controlled most of the gher farming of this area. About 72% of respondent selected cyclone as their most economically vulnerable hazards. Virus attack cause the vulnerable group who are engaged with the gher farming and it poses 21% of respondent opinion. About 24% of respondent indicate flood causes them economically vulnerable group. Water logging and river bank erosion is the seasonal problem of this area which contains the respondent view of 17% and 14% as their economically vulnerable problem. The least amount of respondent views is about the problem of tidal surges and it says by the 10% of respondent as their economically vulnerable sector.

***Hazards Impact on Land Productivity*:** The Hazards of Mongla Upazila which are identified through the questionnaire survey and by reviewing secondary literature as Salinity intrusion, water logging, river siltation, cyclone and storm surge, floods, virus attack etc. The main cause of decreasing land productivity is the rapid expansion of shrimp farming over the area. By using tidal fluctuation enter saline water into gher area for shrimp farming. For extensive shrimp farming in present few years the salinity level of land has been increased and the productivity has been decreased gradually. The percentage of affected land productivity due to the effect of different hazards of the area. The most serious hazard for decreasing land productivity of the area is salinity which causes 88% of decreasing land productivity. But the

respective other hazards like water logging, tidal surges, cyclone and flood causes only 4%, 3%, 2% and 3% of respondent opinion for decreasing land productivity.

Account the Cost of Disaster in Land Productivity for the Selected Area: The first objective of the study reveals that economic vulnerability of the peoples in Mongla upazila causes for different disaster in this area. The second objective of the study aims at determining the cost of disaster in case of land productivity. Peoples opinion for affected land productivity in case of different hazards of Mongla upazila represents that 88% of economic vulnerability in land productivity is due to salinity in agricultural land. So, in this section for determining the cost of disaster consider only the salinity hazard and land productivity in terms of agricultural production (rice production).

***Land productivity of Mongla upazila*:** The agricultural production (rice production) per unit area is determined from the field survey and the data of total cultivable land is collected from the agricultural extension office of Mongla upazila. Preparation cost to cultivate rice from the field is determined by the questionnaire survey. The amount of production is decreasing gradually due to the various hazards effect of this area. In the year 2012, where the agricultural production is 41119.575 metric tones on the other hand the total amount of agricultural production in the year 2013 is only 3086.265 metric tones. The net loss of major production is decreased due to the effect of salinity which rapidly enhances by the horizontal expansion of gher farming in this region. With the cumulative effect of different hazards, rapid expansion of gher farming makes the area of cultivable land is scarcer and the productivity of land also decrease gradually. The collected from the Mongla upazila agriculture extension office in 2014 which reveals the area used for agricultural production. From 2010 to 2015, the amount of used agricultural land is more or less same but drastically changes in the year 2014. The rate of salinity expansion through the gher farming in the agricultural land is rapidly change by the two consecutive year 2013-2014. The total agricultural land used for the year 2013 is 27824.55 acre but in the year 2014 the cultivable land for agricultural production is only 10497.5 acre.

***Cost for decreased land productivity*:** The type of agricultural production in the selected area categorized into two types as rice production and Rabi crops. For determining the cost of the decreased land productivity it is necessary to consider all type of cost in production process but the production here considered is only for rice production, not the other crops (Rabi crops) that is cultivated. Thus, the costs for decreased land productivity shown by the following Table 3 consider only the minimum cost of hazard (salinity) due to disruption of rice production.

Table 3: **Cost for decreased land productivity of Mongla Upazila.**

Hazard	Production per unit area (Paddy in Kg/acre)*	Production per unit area (rice in Kg/acre)*	Preparation cost (Tk/acre)*	Other maintenance cost (Tk/acre)*	Equivalent Product (rice in Kg/acre)**	Net Production (rice in Kg/acre)
Without Hazard (Salinity)	900	630	7500	-	241.935	380.065
With Hazard (Salinity)	420	294	8000	500	274.194	19.81
Net rate of production loss (Kg/acre)*, $\mathbf{X_h}$						360.2585
Monetary Value of one unit production (in Tk/Kg)**, $\mathbf{M_h}$						31
Cultivable land affected by salinity (in acre)***, **L**						27824.55
Cost for decreased land productivity per year (Tk), $\mathbf{C_h}$						31,07,44,950

Source: *Field Survey, 2015

** TCB Report, 2015. (From the Daily Shamokal, 10 March, 2015)

***Agriculture Extension Office, 2015, Mongla upazila, Bagerhat

The Table 3 gives total cost for decreased land productivity of Mongla upazila which reveals that the total cost due to decreased land productivity in terms of rice production is Tk 31,07,44,950. For determining the cost of land productivity considering the values of Net rate of production loss (360.2585 Kg/acre), monetary value of one unit rice production (31 Tk/Kg), and the cultivable land affected by salinity (27824.55 acre).

***Economic loss due to decreased land productivity in 2013-14*:** From the data of Agriculture Extension office of Mongla Upazila in 2013 only 10497.5 acre of land is used for agricultural production on the other hand in the year 2013 the total area of land used for rice production is 27824.55 acre. The economic loss for agricultural production (rice production) of two consecutive years 2013 and 2014 is given below by using the following Table 4.

Table 4: Economic losses for decreased land productivity of Mongla Upazila in 2013-2014.

Year	Net Production (rice in Kg/acre)*	Total land area (in acre)**	Total Production (rice in kg)*	Monetary Value of one unit production (in Tk/Kg)***	Total economic return (in Tk)*
2008	380.065	27824.55	10575137.6	31	327829265.6
2009	19.81	10497.5	207955.475		6446619.725
Economic Loss in one year (in Tk)					32,13,82,645.8

Source: *Field Survey, 2015

* * Upazila Agriculture Extension Office, 2015, Mongla, Bagerhat

*** TCB Report, 2015. (From the Daily Shamokal, 10 March, 2015)

Economic loss of 2013-14 for decreased land productivity is Tk 32, 13, 82,645 by considering the economic return of the year 2008 and 2009. Monetary value of one unit rice production (Tk 31) is taken from the TCB report, 2015.

***Strategy for Minimizing the Economic Vulnerability of Disaster in Land Productivity*:** The study area is geographically prone to disaster. It is exposed to some common disasters in every year and resulted heavy damages in economic, social, and human life. Hazards are increasing day by day due to the direct and indirect effect of climate change. People of the study area are socio-economically vulnerable and their vulnerability is increasing day by day with the increasing frequency and magnitude of different hazards effect. Economic vulnerability in case of land productivity in this region is occurred due to the cumulative effect of different hazards. This section of study may divide into the following sub headings:

- Existing locally adaptation practice to cope with the economic vulnerability of different hazard.
- People's opinion in minimizing economic vulnerability of land productivity.
- Development of strategies as best option in reducing economic vulnerability.

Perception ranking in minimizing the economic vulnerability of land productivity: Depending on the types of impacts various adaptation techniques are practiced by the community in order to cope with the vulnerability, enhance resilience capacity and enforce changes to protect from exposure to adverse impacts. The perception level of adaptation option from the respondent is determined through the questionnaire survey. The data of this regard identify only three problems are mostly identified for land productivity induce economic vulnerability. Main adaptation option taken by the community level regarding this problem is like to change their agri-based occupation which poses 81% of respondent as their opinion to adapt with the salinity problem. The second rank of people's opinion is for salinity tolerant rice cultivation and it is 79% of total respondent. About 36% of respondent take loan for agriculture practice and only 14% of people think to migrate from the place as their adaptation approach for reducing land productivity induce economic vulnerability. To adapt with water logging problem 36% of population think to changes agricultural based occupation and canal cutting to drain out water. Delayed crop cultivation may be an adaptation practice in water logged situation poses by the 21% of respondent. About 14% of

populations want to take loan in this situation for agricultural practice. Only 7% of respondent think to migrate from the area as it is not suitable situation for them to cultivate. After taking place of a cyclone 45% of respondent take loan for agricultural production to cope with the economic vulnerability. In case of storm surge 43% of respondent views is to produce embankment around the agricultural land for protecting to entrance of saline water into the land. About 21% of population tries to changes their agricultural based occupation and 7% of respondent migrate to other place for reducing economic vulnerability.

Development of strategies as best option in reducing economic vulnerability of land productivity: After evaluation the secondary and field data, the strategies are taken in reducing economic vulnerability related to land productivity. Respondent were asked to determine the management priority of these hazard risks. The following Table 5 is the outcome selecting best alternatives in managing the risk of land productivity induced economic vulnerability.

Table 5: Strategies to Reduce Economic Vulnerability of Land Productivity.

Sl.	Strategies to reduce vulnerability of land productivity	The Risks that may be Reduced
1	Construction of sluice gate	- Agriculture may be saved from flood - Agriculture may be saved from water logging - Water logging may be avoided and rice production may increase
2	Use of modern techniques in cultivation of growing crops	- Crops may be saved from salinity - Crops may be saved from pest infection - Crops may be saved from virus - Agricultural crops may be saved from water logging - Agricultural crops may be saved from flood
3	Proper training of the farmers	- Know how to save crops from the attacks of insects - Know to apply proper manure to the lands - Prawn fish may be saved from the attack virus
4	Raising embankment	- Crops may be saved from river bank erosion - Agricultural lands and crops may be saved from flood
5	Roads including the WAPDA dam to be raised and strengthened	- Loss of crops due to water logging can be prevented
6	Consciousness about tree plantation	- Can be reduced intensity of cyclone as well as damage of crops - Fish farming may be saved flood and tidal surge
7	Give loan to the poor farmers without interest	- Poverty will be decreased
8	To enforce the reduction of shrimp culture	- Fresh fish may be saved from salinity - Salinity may be reduced and rice production (Boro and Aman) may increase - Forestry, fruit trees and medicinal plants may be saved from the high intensity of salinity and trees grown may increase
9	Implementation of India and Bangladesh water agreement	- Wide damage of crops due to flood may be prevented - Prevent the loss of fishes due to flood - Wide scale loss of trees and plant due to flood can be prevented - Damage to the houses due to water logging can be prevented
10	Produce of complimentary seed and fertilizer	- Production may increase with the increase of land fertility
11	Excavation of Pashur river	- Agricultural crops may be saved from flood - Crops may be saved from salinity - Wide scale loss of fish due to flood can be prevented
12	Give incentive in special situation to the farmers	- Attitude of changing of occupation
13	River, streams and khal to be re-excavated	- Crops may be saved from flood - Wide damage of crops due to flood may be prevented

Sl.	Strategies to reduce vulnerability of land productivity	The Risks that may be Reduced
		- Decrease the shortage of fish production - Water logging may be avoided and rice production may increase
14	Arrangement of supply of water by opening the sluice gates	- Save crops from drought - May enhance fish production - Water logging may not harm to cultivation and rice production may increase - Excessive rainfall may not cause any harm to paddy field
15	Pre- disaster warning and raising awareness to the local level	- Agricultural crops may be saved from water logging
16	Good quality insecticides may be introduced	- The crops of lands may be saved from the attacks of insects
17	Raising awareness to the local community/people	- Prevent the loss of fishes due to virus
18	Purification of surface water and supply service	- Irrigation water supply may be easier - Agriculture and Fish production may increased
19	Fish cultivation on scientific method	- Wide loss to shrimp can be prevented - Wide loss to the agric crops can be prevented - Extinction of natural fishes can be prevented
20	In proper planning of fish culture should be done	- Prawn fish may be saved from virus - Water logging may not harm to fish farming and fish production may increase. - May meet up the demand of satisfactory fish production - Fish may be saved from flood - Fish may be saved from tidal surge
21	Construction fish research centre	- Wide loss to shrimp can be prevented - Extinction of natural fishes can be prevented - Fish farming may be saved from virus

Conclusion

The cost of hazard in land productivity is determined in the study for assessing the economic vulnerability. Total cost of decreased land productivity for salinity as the most serious problem in this region is Tk 31,07,44,950 and the total economic loss of the year 2014-2015 is Tk 32,13,82,645. Most serious problem in this region is drinking water crisis but in the sense of land productivity salinity is the highest ranking problem and it poses 93% of the respondent view. Identifying economic vulnerability based on the cost determination will give the exact extent of vulnerable situation. With this aspect, the research study should account the total environmental cost of hazard in land productivity but it only give an overall resource depreciation cost of salinity hazard for agricultural productivity loss. Exact economic valuations needs to consider all sectoral cost affected by the hazards of the region. Apart from the lacking of the study, model used for calculating cost of decreased land productivity can be a tool of resource management and is important for policy decision.

References

Ali, A., 1999. Climate Change Impacts and Adaptation Assessment in Bangladesh, Climate Research, 12: 10-15.

Barg, S, Swanson, D. and Venema, H. D., 2005. Full Cost Accounting for Agriculture- Year 2 Report: Valuing changes in agri-environmental indicators. Agriculture and agri-food, Canada. pp 18-21

BBS, 2001. Community Series, Zila: Bagerhat. Bangladesh Bureau of Statistics. Planning Division, Ministry of Planning. Peoples Republic of Bangladesh, Dhaka.

Bond, W. K., Cox, K. W., Heberlein, T., Manning, f. W., Witty, D. R. and Young, D. A., 1992. Wetland Evaluation Guide. Paper No. 1992-1. North American Wetlands Conservation Council (Canada). Pp1-2

Cutter, S. L., 1996. Vulnerability to Environmental Hazards. Progress in Human Geography, **20** (4): 529–539.

Graff, R. G., Reiskin, E. D., White, A. L. and Bidwell, K., 1998. Snapshots of Environmental Cost Accounting. United States Environmental Protection Agency (US EPA). Date of retrieval: 26 November, 2009.Web (URL) address: <http://www.epa.gov./opptintr/acctg>

Huq, S. (ed), 1999. Vulnerability and Adaptation to Climate Change for Bangladesh. Kluwer Academic Publishers, Netherlands.

Rahaman, A., 1988. Bangladesh Coastal Environment and management. Coastal area resource development and management. Part 2. CARDMA, Dhaka, October pp 3-4.