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Economic Losses and Damages Induced by Climate Changes on Rural Livelihood of Northern Part of Bangladesh: An Exploratory GIS Based Study

TanjinulHoque Mollah[1], Jannatul Ferdaush[2], Hasan Md. Faisal[3], Palash Chandra Karmaker[4]

[1]Tanjinul Hoque Mollah, Lecturer, Department of Geography and Environment, Jahangirnagar University, Savar, Dhaka- 1342.

[2]Jannatul Ferdaush, Lecturer, Department ofUrban and Regional Planning, Jahangirnagar University, Savar, Dhaka- 1342.

[3]Hasan Md. Faisal, Graduate Student of Department of Economics and Business, Lehman College of CUNY, NY-10467.

[4]Palash Chandra Karmaker, Ex studentof Department of Geography and Environment, Jahangirnagar University, Savar, Dhaka- 1342.

ABSTRACT: Bangladesh have generally a sub-tropical monsoon climate and maximum rainfall is recorded in the coastal areas of Chittagong and northern part of Sylhet district, whereasSundarganjUpazila of Gaibandha district is positioned in northern part belongs to the drought prone area in Bangladesh. Due to climate change agricultural land affected by drought, water scarcity and temperature variation. GDP growth rate of Bangladesh mainly depends on the performance of the agricultural sector [5]. Due to natural calamities like drought,losses of production crops are almost a regular phenomenonwhich induces sufferings of economically and environmentally. From field observation total area of SundarganjUpazilla is about 410.83 sq. kmwhere total agricultural land is 298.38sq.km or 29838 hectares and total drought prone area is 113.23 sq. km/11323 hectares which is the 27.56% of total land area [8]. In 2006 there main crops was Boro rice, Aman rice, wheat, potato and can but in 2012 observed that all crops production are decreases for temperature rise and water scarcity by drought[8].This paper aims at bringing up the reality of climate induced economic losses and damages mainly on agricultural crops in the SundarganjUpazila of Gaibandha district.

Key Issues: *Livelihood, Crop-Calendar, Agricultural Economic Loss and Damages*

BACKGROUND OF THE RESEARCH

Drought is the most complex but least understood of all natural hazards in Bangladesh. Timely information about the onset of drought, extent, intensity, duration and impacts can limit drought related human suffering and decrease damage to economy and environment. Gradually increasing the temperature and lack of irrigation facilitiesit infertile the land area and displaced thousands of population. For that reason there are approximately thirty one millions of populations permanently displaced and destroying the economic condition within the 21st century. In this study an attempt has been made to apply RS and GIS techniques for identify the economically more vulnerable area.

DEFINITON OF LIVELIHOOD

The unseen complexity behind the term “livelihood” which moves toward when governments, civil society, and external organizations attempt to assist people whose means of making a living is threatened, damaged, or destroyed. From extensive learning and practice, various definitions have emerged that attempt to represent the complex nature of a livelihood [2,3]. This document embraces the definition suggested by Chambers and Conroy: Required for a means of living, a

livelihood encompasses the capabilities, assets including both material and social resource and activities. A livelihood is sustainable when it can cope with and recover from stress and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base [4]. Assets may be a food stores and cash savings, as well as trees, land, livestock, tools, infrastructure and other resources. Assets may also be intangible such as claims one can make for food, work, and assistance as well as access to materials, information, education, health services and employment opportunities.
Another way of understanding the assets, or capitals, that people draw upon to make a living is to categorize them into the following five groups: human, social, natural, physical, financial, and politicalcapitals [1, 7, 10].

Table 1: Livelihood Assets

Human capital	Skills, knowledge, health and ability to work
Social capital	Social resources, including informal networks, membership of formalized groups and relationships of trust that facilitate co-operation and economic opportunities
Natural capital	Natural resources such as land, soil, water, forests and fisheries
Physical capital	Basic infrastructure, such as roads, water & sanitation, schools, ICT; and producer goods, including tools, livestock and equipment
Financial capital	Financial resources including savings, credit, and income from employment, trade and remittances

1. AIM AND OBJECTIVES

The main aim of the research is to mapping about the climate induced economic losses and damages on rural livelihood mainly agricultural crops at Sundarganj Upazila of Gaibandha District of Bangladesh. To fulfill this aim there are some objectives, are shown below:

1. To know the current land use and land type and to identify the different agricultural yield which was affected by drought in the study area.

2. To mapping and analysis the current situation on the basis of economic losses and damages on rural livelihood mainly agricultural crops

DATA AND METHODOLOGY

Two types of data mainly used in this research paper. One is primary and another is secondary data. GPS data overlapped on the satellite image for detecting the current land use. The bellow figure shows the current land use pattern of Sundarganj Upazila in Gaibandha district. The study used primary data and secondary source to meet up the objectives of the study. The study mainly depends upon primary data which has been done through GIS based exploratory observation. Secondary data such as Google earth image, census, Districts Maps, Upazila Maps and Union Maps were used for detailed analysis of the current land use and land type of the study area as well as different agricultural yield which are being affected by drought. The secondary data and literature helps to mapping and analysis the each vulnerable agricultural area on the basis of economic losses and damages on rural livelihood of the study area.

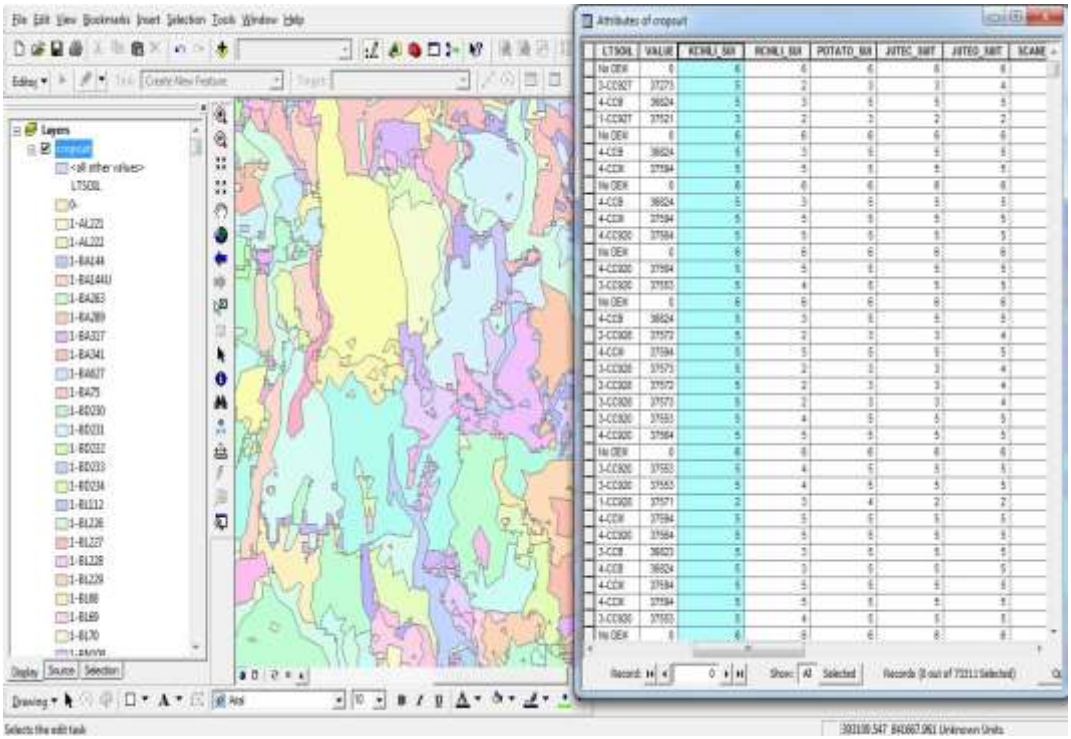

Figure 1: Using Google earth image for detecting current land

The figure 2below shows the how to database development on agricultural crops, current land use and land types of the study area. According to this maps crop calendar will be generated whereas total number of crops, their growing period, high labor period, demand selling period, diseases affecting period and most productive period will be accentuated.

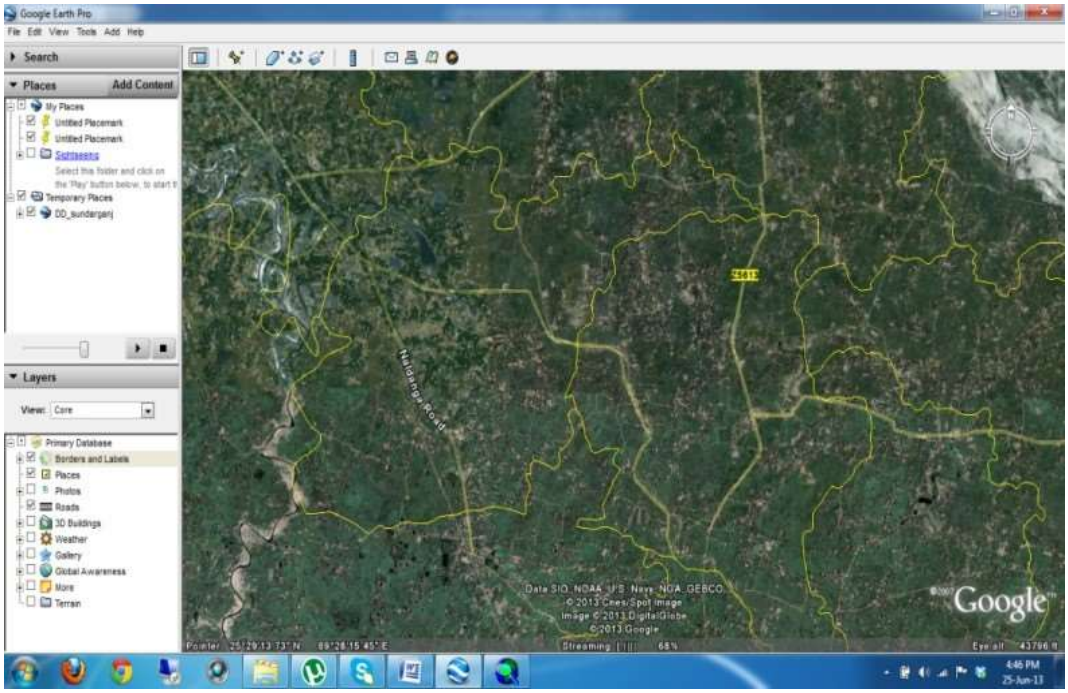

Figure 2: GIS and RS based data development on agricultural crops

SELECTION OF THE STUDY AREA

Three study areas have been selected for the research. These areas are mainly exposed to riverbank erosion, drought and sea level rise.

1.5.1 Drought of Sundarganj Upazila in Gaibandha District

Sundarganj Upazila is situated between 25°22'00" and 25°38'00" north latitudes and between 89°22'00" and 89°42'00" east longitudes. Sundarganj Upazila with an area of 426.52 sq km is delimited by Pirgacha Upazila and Chilmari Upazila on the north, Gaibandha Sadar and Sadullapur Upazila on the south. Main rivers are Tista, Bhramaputra and Ghaghat. The figure below shows the how to database development on agricultural crops, current land use and land types of the study area. According to this maps crop calendar will be generated whereas total number of crops, their growing period, high labor period, demand selling period, diseases affecting period and most productive period will be accentuated [9].

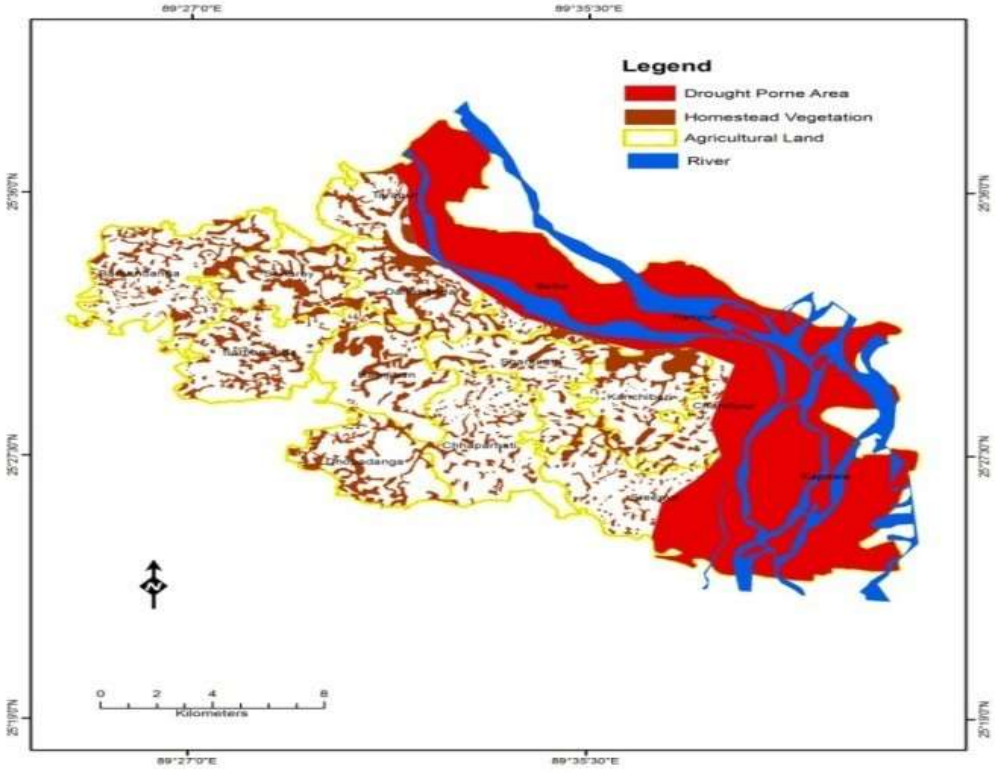

Figure 3: Study area (Sundarganj Upazila of Gaibandha district, Bangladesh)

Figure 4: Land use pattern of Sundarganj Upazila

DATA ANALYSIS AND FINDINGS

Change of Temperature Pattern of Gaibandha during 1976-2011: The analysis of monthly average maximum and minimum temperature shows that monthly average maximum temperature has increased at the rate of 0.010C per year, whereas monthly average minimum temperature increased at a rate of 0.040C per year. Therefore, changing pattern of monthly average maximum temperature is significantly higher than minimum temperature. On an average, the total change of monthly average maximum and minimum temperature for the particular months has increased about 10C during this period. Moreover, yearly average maximum and minimum temperature has increased at the rate of 0.030C and 0.010C, respectively [8].

Table2: Land features showing different parameters

	Area in Hectares	Area in sq km	Total Area in sq km	Percentage (%)
Settlement	6790	67.9	410.83	16.53
Agricultural Land	29838	298.38		72.63
River	4455	44.55		10.84
Total				100
Total Drought Prone Area In recent year				
Drought Prone Area	11323	113.23	410.83	27.56

At the household level, drought bring misery, suffering, and substantial loss of crops and at the national level, drought not only disrupt economic activities but also significantly reduce future growth potential. The market value of the land of the first grade is Tk 7500 per 0.01 hectare and the third grade is Tk 3000 per 0.01 hectare. Land value of Drought prone area was according to the local people perception approximately Tk 3000 per 0.01 hectare.

Figure 5: Local Crop Calendar for Sundarganj Upazila of Gaibandha District

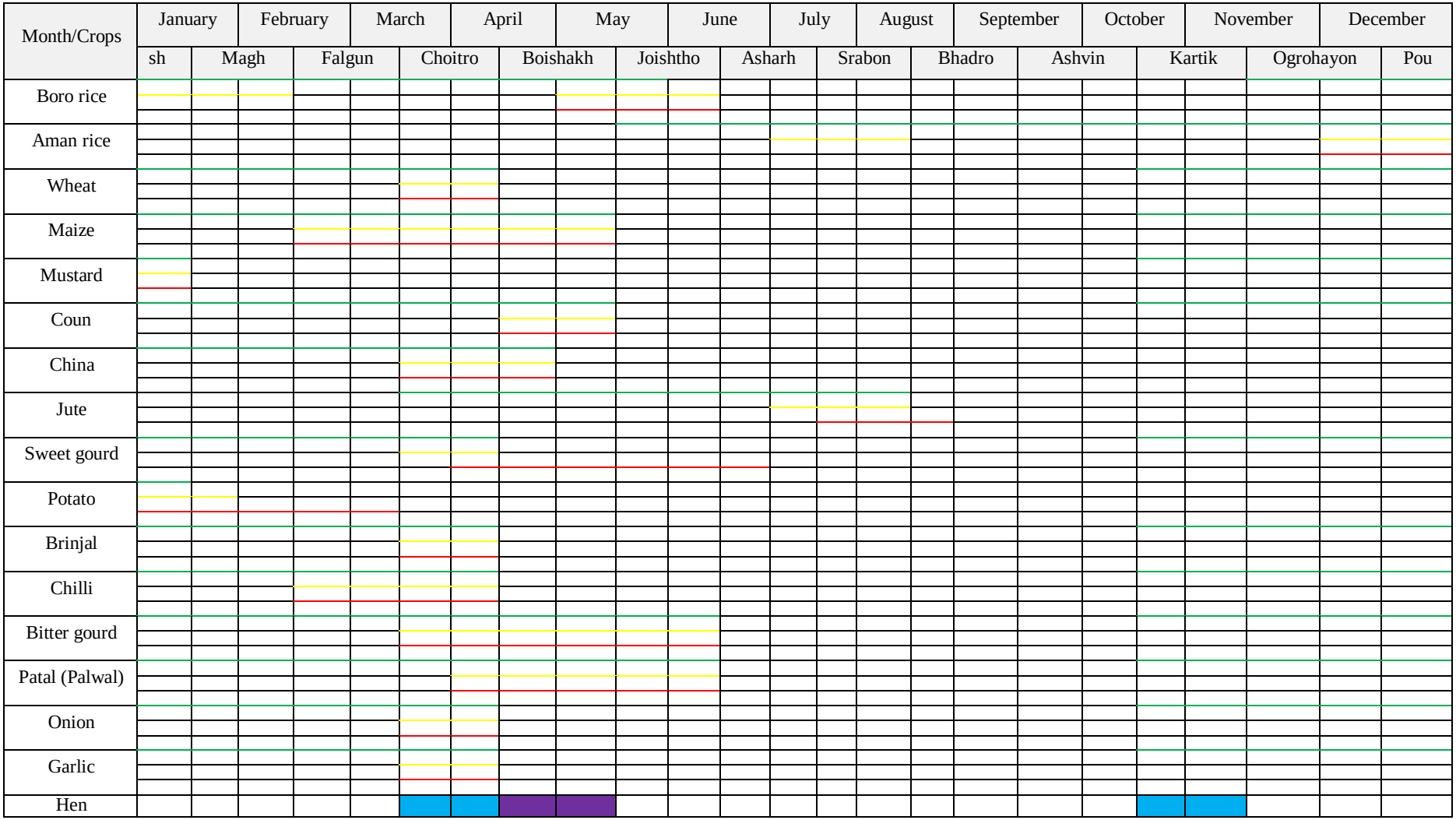

Figure 5: Local Crop Calendar for Sundarganj Upazila of Gaibandha District

Indicators:

- Growing Period
- High Labor Demand
- Selling Period
- Diseases affecting period
- Most productive period

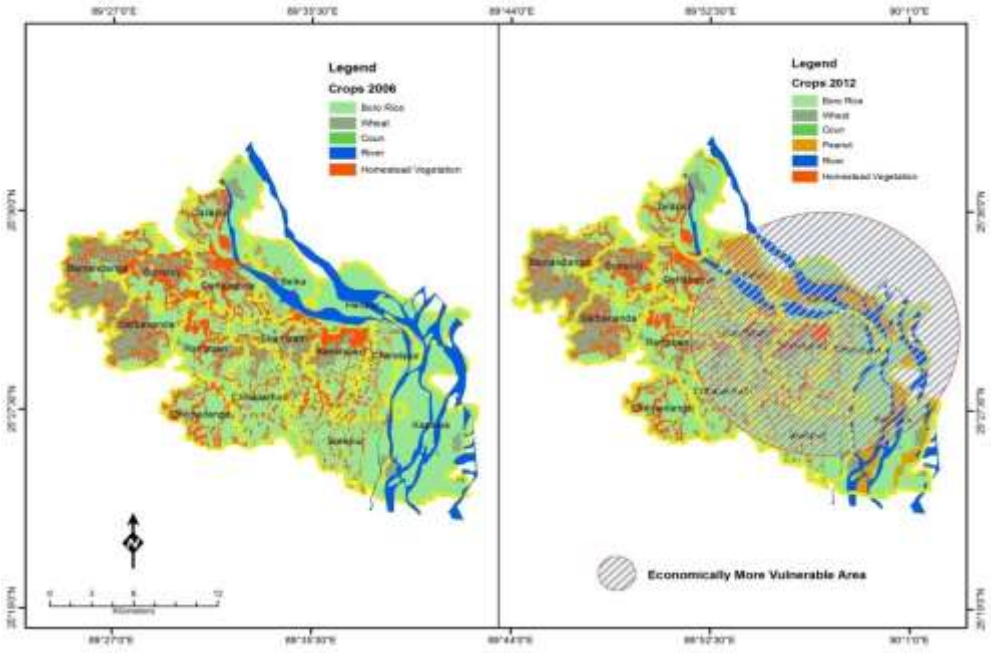

Figure 6: Economically vulnerable yield of the study area

Table 3: Increase or decrease of agricultural yield

	Crop Types	Area in sq km	2006 Area in sq km	2012 Area in sq km	Current Cropland (reduce or increase)	Area in Hectares	Total Area in sq km	Percentage (%)
Settlement		67.9				6790	410.83	16.53
Agricultural Land		298.38				29838		72.63
	Boro Rice		198.1	147.1	-51	-5100		
	Wheat		90.18	95.18	5	500		
	Coun		10.1	5.1	-5	-500		
	Peanut		-	51	51	5100		
River		44.55				4455		10.84
Total								100
Drought Prone Area		113.23				11323	410.83	27.56

Total area of SundarganjUpazilla is about 410.83 sq. km. Eastern part of this area is surrounded by river which covers the area of 44.55 sq. km. which is 10.84% of total area and total settlement area is 67.90 sq. km. 16.53% 0f total area. The above table representing total agricultural land 298.38 sq. km. or 29838 hectares covering major parts of total area as 72.63% and total drought prone area is 113.23 sq. km/11323 hectares which is the 27.56% of total land area [8]. From field observation it is noticed that the main crop types of this area are Boro rice, Wheat, Caon, Peanut etc. But because of water scarcity (caused by change of river flow) and temperature rise some of this crops cultivation rate is increasing and decreasing. The crops which are suitable in high temperature and drought prone area are cultivating more and the crops which need more water and less temperature are cultivating less. The above table representing us various crop cultivated area at two different years respectively 2006, 2012. The ascending and descending of cultivation rate are described here:

Boro rice: Here in 2006 Boro cultivated area was 198.10 sq. km. which decreased at the area of 147.10 sq. km. in 2012, because of being water suitable crops Boro rice cultivation area decreased at the rate of 5100 hectares.

Wheat: In 2006, 90.18 sq. km. area was cultivated with wheat crops. Wheat can grow well in dry area, for that reason drought is not the major obstacle of wheat production. It is observed that wheat cultivated land increased at 9518 sq. km. area in 2012. The increment rate is about 500 hectares.

Peanut: Dry area is suitable for peanut cultivation. With the rise of temperature and heat and change of river flow the area.

Caon: Caon cultivation area was 10.10 sq. km. in 2006 and 5.1 sq. km. in 2012. The cultivation area vastly decreased here with almost half of the total area 500 hectares. Caon is turning into dry area and the local people concerned in peanut cultivation. From field observation it is estimated that, in 2012 peanut was cultivated at the area of 5100 hectares.

Table 4: Increase or decrease of agricultural yield

	Crop Types	Area in sq km	2006 Area in sq km	2012 Area in sq km	Current Cropland (reduce or increase) sq km	Area in Hectares	Total Area in sq km	Percentage (%)
Settlement		67.90				6790	410.83	16.53
Agricultural Land		298.38				29838		72.63
	Aman Rice		250.28	150.18	-100.10	-10010		
	Potato		48.10	38.10	-13.13	-1000		
	Drougt Porn area		113.23			11323		
River		44.55				4455		10.84
Total								100
Drought Prone Area		113.23				11323	410.83	27.56

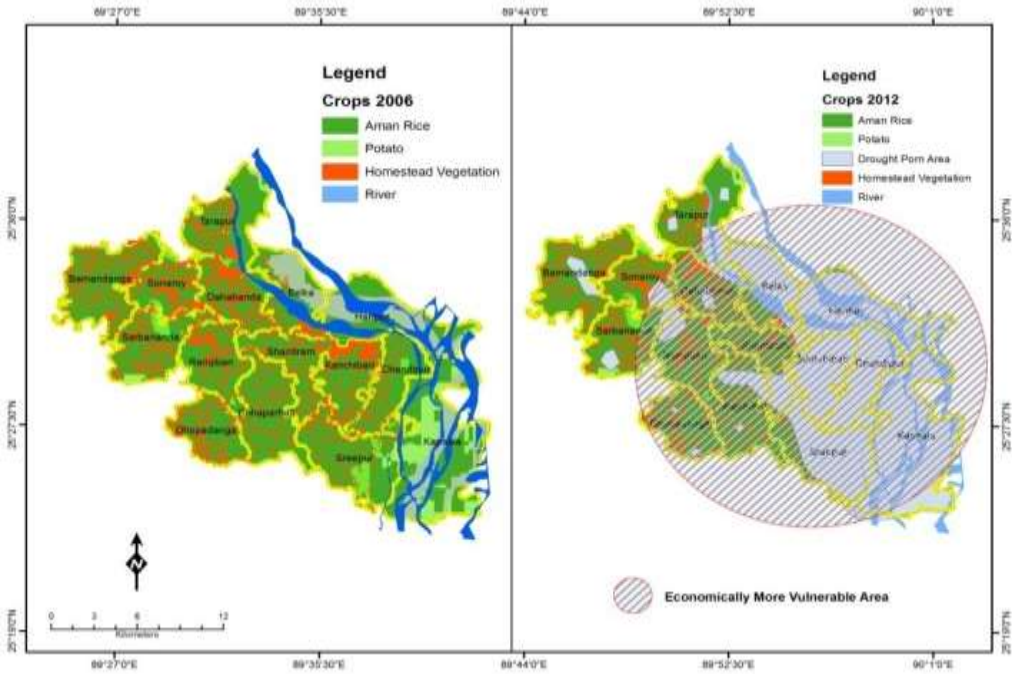

Figure 7: Economically vulnerable yield of study area

Amon rice: The growing period of Amon rice is May-December. Amon was cultivated at 250.28 sq.km area of land in 2006 and 150.1 sq.km. in 2012. The production decreased at 100.10 sq. km. area. The growing period of Amon is showing that it is a dry seasonal crop.

Table 5: Economic losses and damages on agricultural crops

Type of crop	Production Per acer (in mon), 2006	Production Per acer (in mon), 2012	Increase or decrease	Market Price per mon (in taka)
Boro paddy	75	68	-7	500-700
Aman paddy	40-45	38	-7	700-800
Jute	30-35	15	-20	1800-2200
Mustard	18	12	-6	2000-2400
Potato	80	65	-15	400-500
Paul (mushur dal)	8	6	-2	3000-3200
Lades finger	20-25	17	-8	800-1000
Green chili	45	36	-9	1500-1800
peanut	1.45 metric ton	1.15 metric ton	-.30	3500-4000 mon

Now a day's Science and technology have great impact on agricultural sector. Farmers use this technological method in their cultivation sector and upgrade the production rate and quality of product. But this technological enhancement has not reach in all the area of the country and some area are still nowlag behind. Although having all of this facility the main factor which pulling us back is the environment. For temperature rise and scarcity of water the production rate are decreasing and farmers are becoming unwilling to cultivate those types of crops. On the above table the decreased rate of several crops production are shown. The table also showing us the increase or decrease of production rate between two years as 2006 and 2012.

Boropaddy: In 2006 the production rate of Boro paddy was 75 mon per acre, but in 2012 the production rate decreased at 7 mon which was estimated 68 mon per acre. The market price of Boro paddy is 500-700 taka per mon.

Amanpaddy:The above table representing that the production rate of Amon paddy was 40-45 mon per acre in 2006. The production amount decreased in 2012 which stands 38 mon per acre, and the market price is 700-800 taka per mon.

Jute: Jute plays a vital role in our economy which called "Golden Fiber" to earning foreign currency. But today the cultivation rate is decreasing. In 2006 the production rate of jute was 30-35 mon per acre which decreased with an amount of almost 20 mon in 2012 estimated that 15 mon per acre. The market price of jute is 1800-2200 taka per mon [9].

Mustard: Mustard production rate was 18 mon and 12 mon per acre respectively in the year of 2006 and 2012. This estimation showing that production rate is lowering gradually. Market price of mustard crops is ranging from 2000-2400 taka per mon.

Potato:Potato production rate in 2006 was 80 mon per acre which is the highest produced crops among others crops. But with the next 6 years the production rate decreased at the rate of 15 mon per acre which estimated as 65 mon per acre in 2012. The market price of potato is 400-500 taka per mon which is the lowest price among all other crops.

Paul (mushur dal): From the above table it is noticed that, Paul production rate was very low in 2006 and 2012 respectively at the amount of 8 and 6 mon per acre. Market price is high comparing with production rate. Price is 3000-3200 taka per mon.

Lades finger: In 2006 the production rate of Lades finger was 20-25 mon per acre and in 2012 production rate was 17 mon per acre, the decrease amount is 8 mon per acre. Market price of Lades finger is 800-1000 taka per mon.

Green chili: The production rate of Green chili was 45 and 36 mon per acre respectively in the year of 2006 and 2012. The price of chili is 1500-1800 taka per mon.

Peanut: Peanut production rate was 1.45 metric ton in 2006 and 1.15 metric ton in 2012 which amount decreased at the rate of .30 metric ton. Among all other crops the market price of peanut is highest price as 3500-4000 taka per mon.

CONCLUSION: Wrestling with force of nature is illogical but with the consequences of natural disaster is our human ethics. Livelihood of rural poor people remains poor and getting below standard with a recurrent timeline. Sundarganj Upazila of Gaibandha district is one of the most vulnerable Upazila which prolongs drought. Lack of irrigation facilities and ground water scarcity makes agricultural yield gradually descending and its impact on our countries economy. In this paper, it is estimated that there are 11323 hectare agricultural yields are facing water scarcity whereas the total number of agricultural yields is about 29838 hectres [9]. Moreover various strategies aimed at reducing extreme vulnerabilities of drought might be seed selection, planting regimes, emergency preparedness, proper land use management and disaster preparedness. Local

authority should have special budgetary allocation for mobilizing community resources, improving rural livelihood and ensuring sustainable rural development.

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