Impact of Climatic Degradation on the Socio-Economic Condition of Kakdwip, Basanti and Gosaba of Sundarbans

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Abstract: *Sundarbans is the world's largest mangrove forest. The Sundarbans are experiencing multidimensional threats by land-use pattern change. The present study aimed to find out the dynamic change of different land use patterns and land cover for the greater Sundarbans region of some blocks (Basanti, Gosaba, Kakdwip) from 1990 to 2022. The analysis revealed that the Sundarbans mangrove forest changed very insignificantly. The change between 1990 and 2008 was approximately 1.2% (i.e around 26.2 km2) and the change between the years 2008 to 2020 was approximately 1.28% which consists of 28 Square km. The human habitat and aquaculture were found as the most rapidly expanding land use type in this landscape of the Sundarban area human habitat has increased by approximately 80% i.e around nearly 654 km2 between 1990 to 2020. The expansion of nonagricultural lands in the last two decades was found to be related to the growth of the new settlement, tourism, infrastructure, and facilities. This transformation was attributed to the shifting of local people's interest from traditional forestry and subsistence farming towards alternative occupations like shrimp culture, coastal tourism, and commercial fishing although environmentally hazardous livelihood activities like collection of prawn seeds along the river bank were still persistent.*

Keywords: Mangrove, Threats, Aquaculture, Decads, Fishing, Hazardous

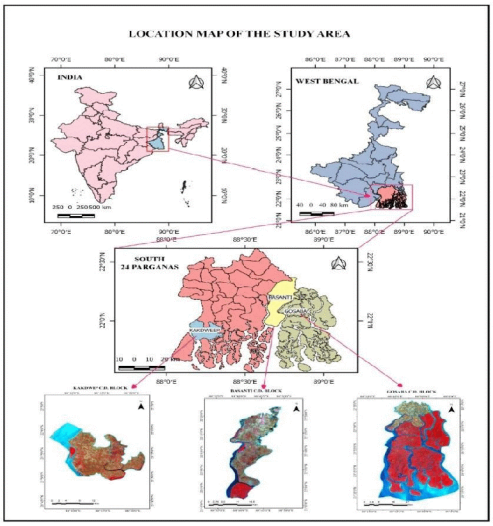
The detection of land-use pattern change is one of the most important indicators for environmental change that affects the ecological balance of

nature and the socio-economic impact on human life. These changes are often non-linear and might trigger feedback to the system that distresses the living condition and threats the vulnerability of people. Recent studies of the land use pattern change in the Sundarban's blocks (Basanti, Gosaba,& Kakdwip) showed the transformation of agricultural land into fisheries is the most dominant aspect of land-use pattern change. Since the 1990s a trend has been found to convertagricultural land into fisheries. Especially in the coastal Sundarbans three blocks (Basanti, Gosaba,& Kakdwip). In fact, due to the problem of saltwater inundation agricultural lands have lost their efficiency and it becomes unless and until the salinity is washed down by the rainwater. To combat this frequent inundation local people have adopted a new Strategy.

Study Area:

The present study is in Sundarbans' three coastal blocks (Gosaba, Basanti, and Kakdwip). Gosabaand Basanti lies within the canning sub – Division of south 24 Paragana, district of west Bengal, India, and Kakdwip block under the Kakdwip subdivision of south 24 PGS district of west Bengal, India.

- The area extension of Gosaba Block is 21^{0}54′00"N to 22^{0}09′36"N and 88^0 29' 00" E to88^{0}47′60"E. The region is bounded by the river Bidya in the west and the gomar andRaimongal river in the east. The total area of Gosaba block is 296.43 sq/km and the population density is 830 people/sqkm(CensusOfIndia2011).
- The area extension of the Basantiblock is 22^{0}11′20"N and 88^{0}40′14"E the region is bounded by the river Matla and Vidydhari rivers. The total area of the block is 402.2 sq/km. The population density of the Basanti block is 830 people/sqkm.
- The area extension of the Kakdwip block is 21^{0}52′45"N and 88^{0}11′29"E.Total area of the block252.7sq/km.and the population density is 1100 person sq/km.



Objectives:

1. To show the recent changes in the cropping pattern and agricultural and use pattern of Sundarbans (Gosaba, Basanti, Kakldwip block).
2. To determined the land use changing impacts of croppatterns and coast a laqua culture in Sundarban.

Methodology:

The present study is based on primary and secondary data. The complete objectives of the study the whole work have been divided into three stages:

1) **Pre-Field Study**: We have collected information from various purposes i.e newspapers, and various reports published b different government and non-government organizations were studied, I had a prior idea of the area from others to survey the coastal area of the Sundarbans region (Gosaba, Basanti, and Kakdwip).
2) **Field Study**: in this case collecting information about the amount of production, type of land use pattern, and irrigation system from the farmers on the field, 50 to 60 questions were constructed for data collection.
3) **Post-Field Study**: In this phase collected data has been properly reviewed soil samples were tested using a soil kit to determine the soil pH and organic carbon. Then I collected the data from Gosaba B.D.O, A.D.O., B.L.R.O. Panchayat office and I collected the land use data from the Kakdwip B.D.O Office I faced a lot of problems during the data collected because I had to visit one administrative office three or four time

Primary Data Analysis and Interpretatior

Table No.-1

Occupational Structure (before)

OCCUPATION	FREQUENCY	PERCENTAGE
UNEMPLOYED	7	28
DAYLABOUR	5	20
OUT SITE WORK OF THE STATE	4	16
AGRICULTURE	8	32
STUDENTS	1	4
TOTAL	25	100

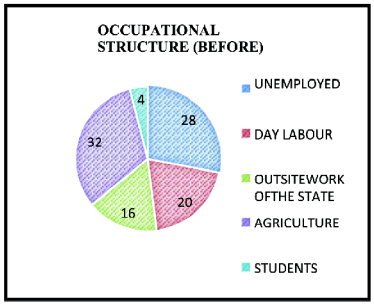


Figure No. -1Occupational Structure (before)

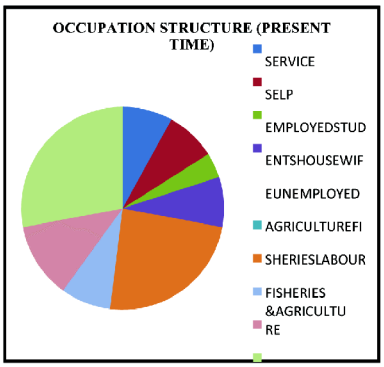
Source: field survey

Figure No.1 – shows the occupational structure of the Sundarban's coastal area in some blocks (Gosaba, Basanti, Kakdwip). In three blocks major people are connected to agriculture purposes (32%), 28% are unemployed, 20% are day laborers, 16 % working the population works out of the state and 4%

are students.

Table No.-2

Occupational Structure (Present Time)



OCCUPATION (PRESENT TIME)		
OCCUPATION	**FREQUENCY**	**PERCENTAGE**
SERVICE	2	8
SELF-EMPLOYED	2	8
STUDENTS	1	4
HOUSEWIFE	2	8
UNEMPLOYED	0	0
AGRICULTURE	6	24
FISHERIES	2	8
LABOUR	3	12
FISHERIES & AGRICULTURE	7	28
TOTAL	25	100

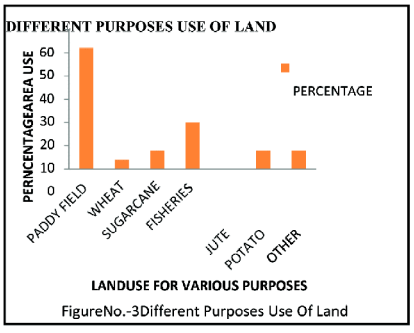
Source: field survey

Figure No.-Occupational Structure (Present Time)

Figure: 2 shows the occupation structure (present time) of the Sundarban coastal area. The major people are connected to fisheries and agriculture (28 %), 24 % are only to agriculture, 8% are service and 8% are self-employed, 8% are housewives, and 12% of day labour.

Table No.-3

Different Purposes Use of Lan



FigureNo.-3Different Purposes Use Of Land

PURPOSE	FREQUENCE	PERCENTAGE
PADDYFIELD	13	52
WHEAT	1	4
SUGARCANE	2	8
FISHERIES	5	20
JUTE	0	0
POTATO	2	8
OTHER	2	8
TOTAL	25	100

Source: Field Survey

Figure no 3: shows the land use for different purposes in Sundarbans coastal areas some blocks (Basanti, Gosaba, Kakdwip) which are mainly affected by land use pattern change. in this region, 52% of people use their land in paddy fields, 4 % in wheat, 8% in sugarcane 20%land use in fisheries. Fisheries are the 2nd largest activity in the coastal region, potato, and other

purposes of land8%.

PERCENTA GEIF DRINKING WATER USE

Table No:4 Source Of Drinking Water

DRINKING WATER SOURCE	FREQUENCY	PERCENTAGE
HAND PAMP	13	52
TAP	9	36
WELL WATER	1	4
RAIN WATER	0	0
OTHER	2	8
TOTAL	25	100

Source: Field Survey

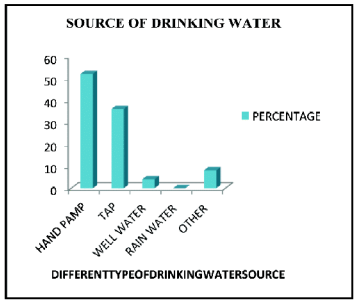


Figure No:4 Source of Drinking Water

Figure no 4 shows the drinking water sources in Sundarbans coastal regions (Basanti, Gosaba, Kakdwip). More people collected their drinking water from the hand pump 52% and 36% of people collected their drinking water from the tap, 4 % people get their water from a well, and 8% collect drinking water from other places. the people of this region face a lot of problems with drinking water during the flood.

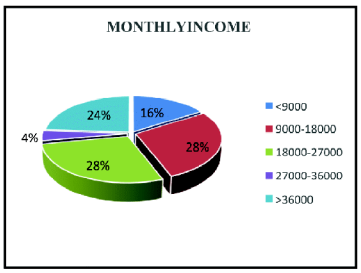


Table 5 : Monthly Income

MONTHLY INCOME	FREQUENCY	PERCENTAGE
	MONTHLY INCOME	
<9000	4	16
9000-18000	7	28
18000-27000	7	28
27000-36000	1	4
>36000	6	24
TOTAL	25	100

Source: Field Survey

Figure No: 5 Monthly Income

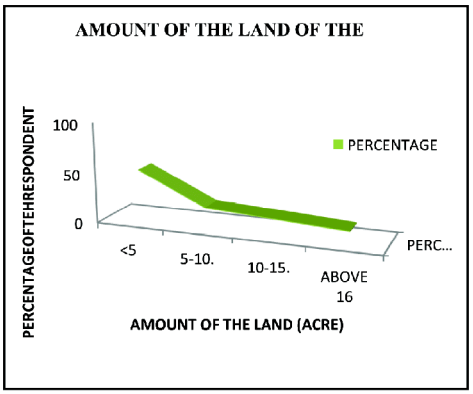
Figure no 5, shows the monthly income of some coastal blocks in the Sundarban region. Since India is a third-world country, people are dependent on agricultural work, which is why monthly income is much less. 16% of people have a monthly income of less than Rs 9000, 28% of people have a monthly income of Rs 18000 to Rs 27000, 4% of people monthly income of

27000 to Rs 36000, and 24% of people

Table No: 6

Amount Of the Land of Owner

AMOUNT OF THE LAND OF OWNER AMONUT OFTHE LAND	FREQUENCY	PERCENTAGE
<5	13	52
5-10.	5	20
10-15.	4	16
ABOVE16	3	12
TOTAL	25	100



Source: Field Survey

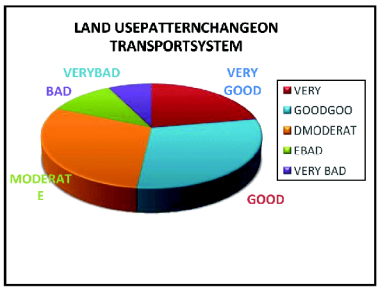
Figure No: 6 Amount of The Land Of Owner

Figure:- 6 This diagram shows the total amount of land of the owner in the coastal region of Sundarbans in three blocks (Basanti, Gosaba, Kakdwip). 52% of owner land is less than 5 acres, 20% of owner land is between 5 to 10 acres, 16 % of own land is between 10 to 15 acres, and 12%ownerland above. The amount of land of Sundarbans farmers is less.

Table No. 7

Impact of Land use Pattern Change on Transport

IMPACT LAND USEPATTERN CHANGE ON TR IMPACTON TRANSPORT	FREQUENCY	PERCENTAGE
VERYGOOD	4	24
GOOD	8	32
MODERATE	8	32
BAD	3	12
VERYBAD	2	8
TOTAL	25	100



Source: Field Survey

Figure No. 7 Impact of Landuse Pattern Changeon Transport

Figure 7 shows the impact of land use pattern change on the transport system. transport is the outline of the development. 24%people say that the land use pattern change has had a good effect on the transport system, 32% people say that good and moderate effect on transport, and

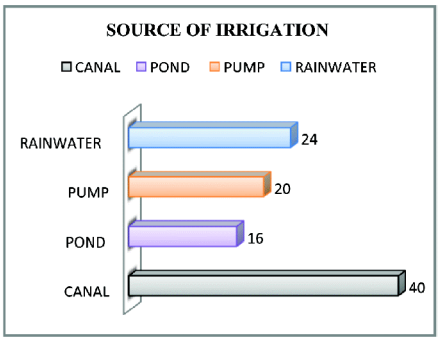
12% say that bad and 8% say that land use pattern change has a very bad

effect on the transport system.

Table no7: Source of Irrigation

SOURCE OF THE IRRIGATION

SOURCE OF THE IRRIGATION	FREQUENCY	PERCENTAGE
CANAL	10	40
POND	4	16
PUMP	5	20
RAINWATER	6	24
TOTAL	25	100



Source: Field Survey

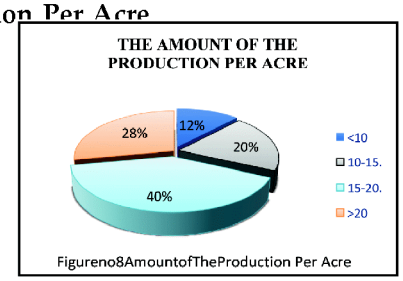
Figure no 7: Source of Irrigation

In this diagram showing (fig7) Canals are the main source of irrigation for 40% of the people in the Sundarbans regions (Basanti, Gosaba, Kakdwip) canal water is used in agriculture with the halo of pumps. 16% of people depend on pond irrigation for agricultural work, 20% of people depend on pump water for agricultural work, 24% of people depend on rainwater for agriculture work.

Table no. 8 Amount of The Production Per Acre

What Was the Amount of The Production Per Acre

Production quental (Before)	Frequency	Percentage
<10	3	12
10-15.	5	20
15-20.	10	40
>20	7	28
TOTAL	25	100



Figureno8AmountofTheProduction Per Acre

Source: Field Survey

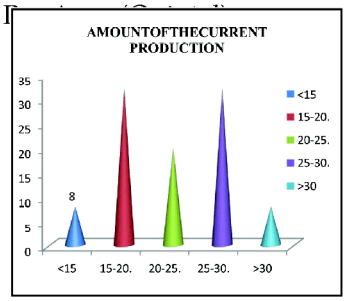
Figure no 8 Amount of The Production Per Acre

This figure shows that the amount of production (before 1990), 12% of farmers say that the production was less than 10 quintals, 20 % of people say that their production was 10- 15quintal,40% of people say that the production was 15-20 quintal and 28% people say that their production was more than 20 quintal.

Table no. 9 Amount of Current Production I

CURRENT PRODUCTION/ACRE (QUINTEL)

CURRENTLY PRODUCTION	FREQUENCY	PERCENTAGE
<15	2	8
15-20.	8	32
20-25.	5	20
25-30.	8	32
>30	2	8
TOTAL	25	100

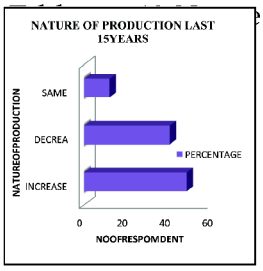


Source: Field Survey

Figure no. 9 Amount of Currently Production Per Acre (Quintel)

This diagram represents the amount of the present production in the Sundarbans coastal region (Gosaba, Basanti, and Kakdwip). 8% of people say their production is less than 15 quintals, 32%people say their production is 15-20 quintals per acre, 20 % of people say their amount of production is 20-25 quintals per acre 32% of people say their production is per acre 25-30 quintal and 8% people say their production more than 30 quintals per acre.

NATUREO FPRODUCTION



of the Production of the Last 15 Years

PRODUCTION NATURE	FREQUENCY	PERCENTAGE
INCREASE	12	48
DECREASE	10	40
SAME	3	12
TOTAL	25	100

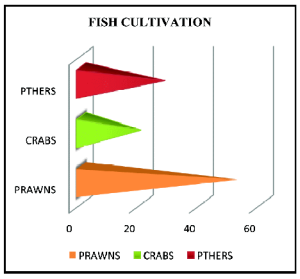
Source: Field Survey

Figure no. 10 Nature of the Production of the Last 15 Years

Figure no 10 represents the nature of the production last 15 years. It will be understood by looking at the production trading of the last 15 year production has increased slightly out of 25 people 12 peoples say their annual production increased 10 peoples say their annual.

Production decries and 3 people annual production same. The overall increase in production is due to the adequate use of chemical fertilizers, the use of high-yielding seeds, etc.

Table no. 10 Ideal Fish Cultivation For Salt Water



Which Fish Is Ideal for Saltwater

Ideal Fish for salt Water	Frequency	Percentage
PRAWNS	13	52
CRABS	5	20
PTHERS	7	28
TOTAL	25	100

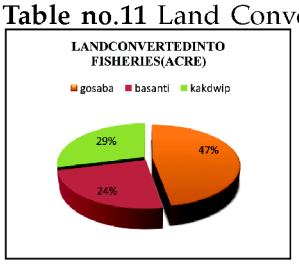
Source: Field Survey

Figure no.10 Ideal Fish Cultivation For Salt Water

This diagram shows the different fish cultivation in Sundarrban coastal region. 52% of people cultivated prawns, 20 % of people cultivated crabs 28% of people cultivated others to fish(Vatkei, Paersha , Telapiya, etc). Crabs are ideal for saltwater and second crabs. Prawns and crabs are commercial

export for Sundarban.

Table no.11 Land Converted Into Fisheries



HOW MUCH LAND CONVERTED IN TO FISHERIES (ACRE) DUE TO SALINITY		
Block	Area in Acre	Percentage
Gosaba	70	47
Basanti	35	24
Kakdwip	43	29
Total	148	100

Source: Field Survey

Figure no. 11 Land Converted In to Fisheries

This diagram (18) Represent the how much land convert

This diagram (11) Represents how much land is converted into fisheries. Yearly 3 or 4-time cyclone attract in this region. Gosaba block is 47% of land converted from agriculture to fisheries the 2nd Kakdwip block converted 29% of agricultural land into Fisheries, and in the last Basanti block, 24% of land converted into fisheries.

Result and Discussion:

Effect Of Aila on Landuse Pattern Change:

The land use pattern in Sundarbans changed after cyclone *Aila* in 2009 due to high salinity concentration in surface soil (Ghose.S and Mistri. B., 2020). Aila is one of the harmful natural disasters of Sundarbans. During the disasters, the embankment was breached and high tidal saline water started to flow to the entire parts of the Sundarban's coastal regions. Agricultural lands convert into a wasteland and infertile land caused of the continuous flow of high tidal saline water to agricultural land (Samanta. B, 2018). Humans gradually started converting all those infertile land into fisheries. Water was logged for 4-5 months creating uncultivable land and temporary fisheries. Almost more than 2500 water bodies were affected by the *aila*'s saline water. Huge amounts of freshwater fish or sweetwater fish damage are affected due to the resultant effects.

Pre-Aila Land Use Pattern Change in Sundarbans Region:

Before *Aila*, most of the land of the Sundarban's coastal region is used for agricultural land and the second position use category is in a housing estate. Other land uses are water bodies, fisheries, wetlands, and purpose. Before *Aila* Sundarban's coastal region most of the land was mono-cropland. Crop productivity type was very high, such as Aman (paddy), Boro (paddy), and chili, crops like Moog, Khesari, Sunflowers, Brinjal, Tomato, Mustard, Sugarcane, groundnut, etc. cultivated in a very small area.

Post Aila Nature of The Land Use Pattern Change:

After *Aila*, the character of the land use pattern changed. People used

agricultural land for aquaculture purposes. The time of aila (2009) rice cultivation has not been done because saline water stays agricultural and, for 2 to 3 months. Agricultural activity disappeared due to the high salinity of sail. After 2011, agricultural work started again, but agriculture has not become suitable as before (2009).In the post aila period, people gave up farming altogether due to the increasing number of natural disasters (Yaas , Bulbule, Fani, etc). So people gave more importance to aquaculture instead of agriculture for livelihood.

Suggestions:

After 1990 the land use pattern is extensively changed. That's why some suggestions are needed so that the people can use the land properly. Farmers are expected to benefit from this advice. To know how to use the land and what method is best. The suggestions are below:

The new mangrove may protect the embankment from destructive waves in high tidal and floods time. For that lot of trees have to be planted.

Immediate need for a strongly constructed river embankment with the help of proper scientific and modern technology help which will protect agriculture from saltwater floods. The new embankment should have 16 feet, a base of 130 feet, a river site slope of 1:5, and an opposite side slope of 1:3.

Any farming activity be it paddy cultivation, various type of vegetables, or fisheries require proper training from B.D.O's Office, Panchayat Office, and other governmental institutes. As a result, you need to use it properly and get a suitable production.

The communication system should be improved so that the products can be sold not only in the domestic market but also out site the state. As a result of this, the produced product can be sold in the foreign market as well as the production will increase due to cultivation with more improved types of seeds from the outside.

Instead of using large amounts of chemical fertilizers on the land in the hope of more crops, the fertility of the land should be maintained through the use of organic fertilizer.

The people of Sundarbans are more interested in fisheries than agriculture because they think fisheries are more profitable than paddy cultivation. The main reasons directly observed behind this are the high salinity of the agricultural land.

An adequate drainage system should be provided for the drainage of excess water from agricultural and or fisheries. In saltwater fisheries, there must be suitable arrangements for the inflow of water from rivers.

The main aim of this study is to the changes in land use patterns in the Sundarbans coastal region from 1990 to 2022. On how natural disasters (Aila, Bulbul, Yaas, etc) affect land use change in Sundarbans coastal region (Gosaba, Basanti, Kakdwip, etc). As a result of land use pattern changes, we have seen that agricultural farms that used to be farmed are no longer suitable for farming as a result of saline water intrusion due to the natural disaster. Those

agricultural farms have been converted into fisheries and commercial fisheries are cultivated here. Sundarbans coastal areas (Gosaba, Basanti, Kakdwip) apart from these other coastal regions (Kultuli, Sagar, canning I) all these areas are highly vulnerable to natural calamities and cannot be properly planned for land use. The mangrove area on the island getting decreased considerably which may require prime attention as it contributes to the ecological balance in the Sundarbans delta. Currently, research shows that high–resolution satellite imagery through Google earth made it much easier to map land use pattern changes and changes in land features. Due to the inclusion of the Sundarbans "World Heritage Site, "appropriate land use planning is gradually being adopted by the government and it is expected that suitable land use will be implemented in the future.

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