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A Study on the Changing Characteristics and Elements of Surface Soil of Coastal Plain Areas in Digha, West Bengal

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Abstract

The Digha coastal belt of east Midnapore district in West Bengal enjoys a unique landscape, which is the result of combined action of marine, fluvial & aeolian agencies. The coastal tract is formed of unconsolidated clay, silt and sand of marine origin together with some fluvial and aeolian Sediment. The changing pattern of land use is also noticed in study area, which has direct and adverse influences upon the surface soil. This paper attempt to discuss the changing characteristics and elements of surface soil of coastal plain areas in digha and how it affects on the surface soil; that is its properties and elements variation. The study is based on field works done in different parts of coastal digha and extensive laboratory observation.

Keywords: Aeolian, Fluvial, Sediment.

Introduction:-

Soil is the collection of natural bodies on the earth surface, in places modified or even made by man of earth materials, containing living matter for supporting plants. Soil in its traditional meaning is the natural medial for the growth the of land plants, whether not in has disenable soil horizons. Although there are many uses of soil, the people of the world are more concerned with soil because it supports plant that supply food, fibres. Drugs, and of her wants to men then for any reason.

Object of the study:-

- To study soil profiles, particularly the distribution of various soil properties.
- To examine the characteristics of surface soil of the study area to enable us to understand the fertility status of the soil
- To examine the intricate relationship between the micro topographic forms and the prevailing land-use patterns.
- To explain the changing land use patterns in the study area and their impact on the surface soil.
- To study the existing patterns of pisci-culture in the coastal belts & an assessment for a better planning for re expansion of pisci-culture area of digha & sankarpur coastal belts.

Date sources and Methodology:-

The study is primarily based on Secondary data and group field observation. Necessary Secondary data have been obtained from various Governmental Organization is like Land Record & Revenue, Digha Development Authority, Ministry of Forestry and Environment and other relevant publications. Basic cartographic materials like Geological & Geomorphological Maps (1:50000) of GSOI, Toposheet-73O/6, 73 O/10, 73 O/14 (1931-'32 & 1968-'69).

These have also been used for preparing the details programmer of present research work, especially the surveys plan the layout of cross-sections & test pits. The chronological depletion of the natural resources has been followed by comparing the old documents with newer ones.

For the purpose of this study, group researches have been also been utilized in collecting

Information of the study area. The information regarding characteristics and properties of soil, drainage & tidal impacts, beach erosion has been collected from intensive field investigation and extensive laboratory observations. The methods of soil survey have been based on the conventional teaching use (Soil survey staff, 1951, 1960 & 1975)^[8]. Four soil pedon has been studied in details & tabulated. In addition to this 15 soil samples have been studied analysed for the identification of various soil properties of the study area.

All these information have been analysed to study the pedogenic characteristics, pedo-classification, soil fertility status & this land use impact in the study area. Survey has been done to find out the relationship between micro reliefs, drainage & the existing land use patterns & pisci-culture in the coastal belts.

Location of the study area: - Digha is situated nearly midway along the relatively straight shoreline between huge Ganga-Brahmaputra delta on the east and the joint Mahanadi-Brahmani delta on the west. From a Geomorphological point of view, Digha Township is located along the eastern fringe of Subarnarekha delta along the south-western shoreline of West Bengal; situated under Digha planning area. Digha Township comprises 42 mouzas under Contai sub-division. It is a coastal tract adjoining the Bay of Bengal and appears to be a leaf of 80 sq. Km, bounded by the latitude of 22°30'36"N to 21°45'00"N and the longitude of 87°36'00"E to 87°36'00"E, failing in the district of East Midnapore, in the south west of West Bengal (Figure No-1).

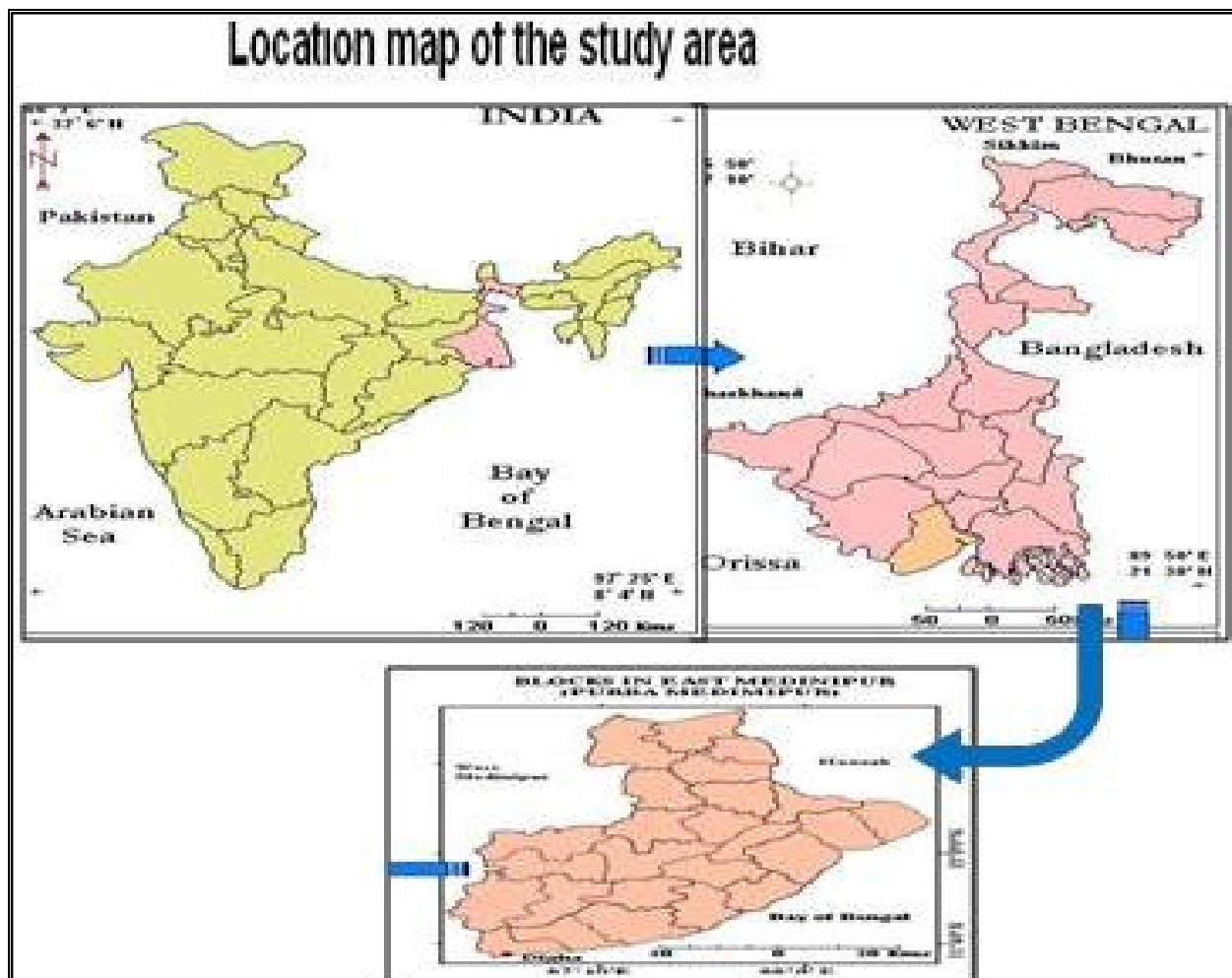


Fig1: Location Map of the study area.

Geomorphological setting of Digha area:-Digha along with its adjoining areas shows a superficial cover of quaternary sediments of an unconsolidation nature belonging to Holocene age, underline in the subsurface relatively shallow depth by upper Pleistocene unconsolidated sediments (S.Sengupta, 1970).

The digha coastal belt of east Midnapore district in West Bengal enjoys a unique landscape, an interface of strong marine and inland influences. It is formed of unconsolidated

clay, silt & sand of marine origin together with some Fluvialite and Aeolian sediment. The surface materials of the beach consist of 67% of fine sand (0.2 to 0.06 mm), 16.4% of silt (0.06 to 0.002 mm) and 7.6% of clay (below 0.002 mm).The general surface is more or less flat with a gentle gradient towards the Bay of Bengal, of course due to the sand dunes and the terraces the slope is slightly higher in the west than that of east(Fig No:-2).

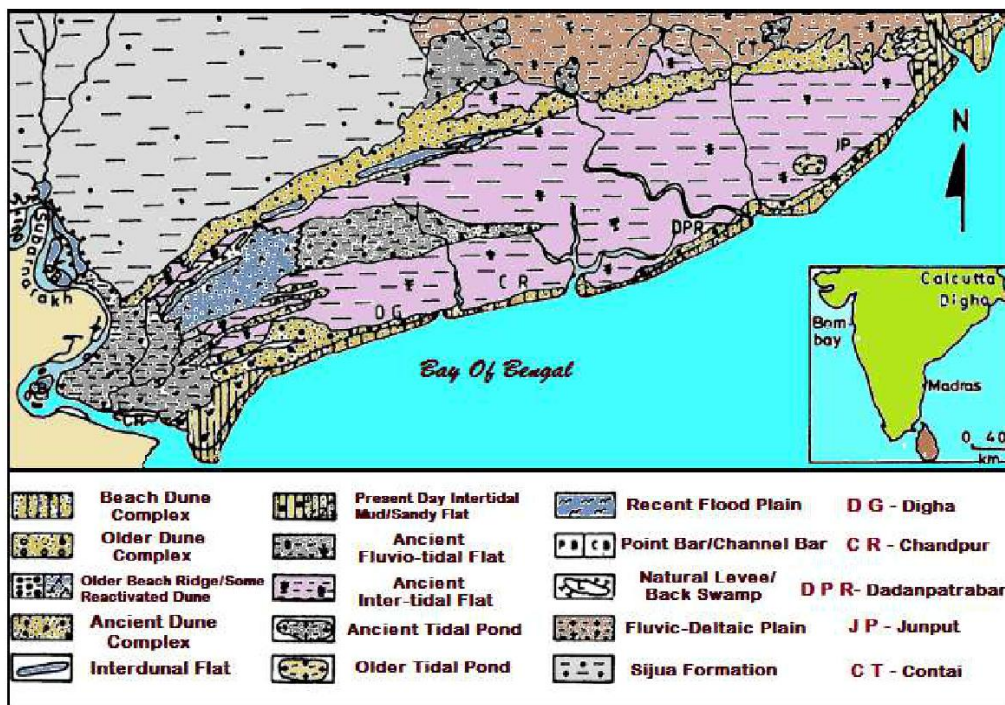


Fig2: Geomorphological Map of the study area.

Properties of surface soil in Digha:-

Analysis of various soil properties, their characteristics and quantitative determination of soil in Digha and its surrounding have been done from 18 soil samples. Such analysis has been carried out for the surface soil only. Among the various soil properties, the following are account for –

- 1) Soil Mechanical Analysis
- 2) Nitrogen Content
- 3) Phosphorous Content
- 4) Organic Matter Content
- 5) Soil Reaction Zone

- 6) Base Exchange Capacity

For the purpose of soil analysis Kit box has been used and directions are followed accordingly.

1) Soil Mechanical Analysis: - Soil texture is the relative proportions of sand, silt and clay. The soil mechanical analysis includes the analytical result of distribution of sand (%), silt (%) and clay (%). The following diagram depicts spatial variation of the different soil fraction in the Digha (Triangular diagram).

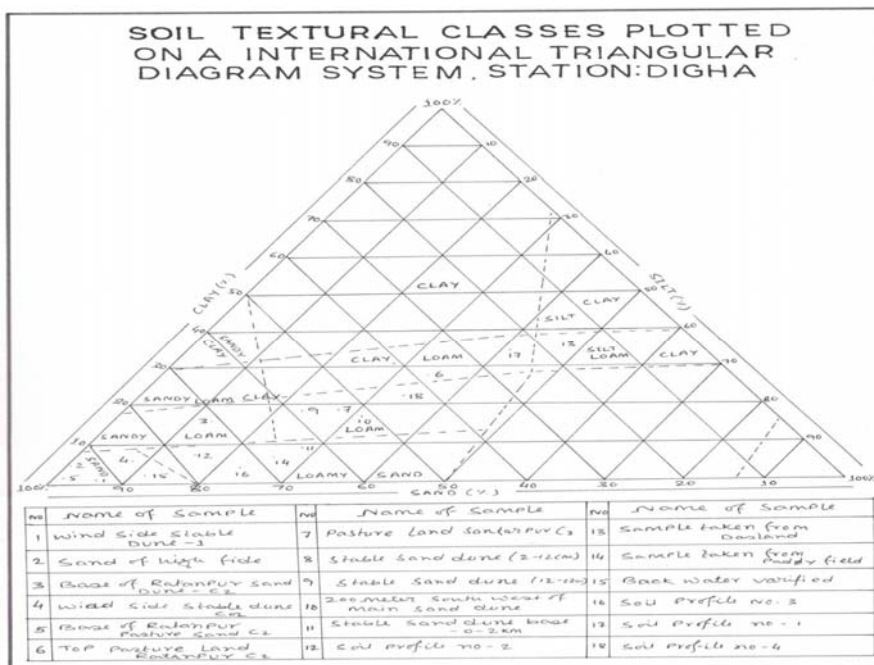


Fig 3: Triangular diagram

Sand content in the surface soil of the study area has been depicted in the table no. I; it has been found that percentage of sand in surface Digha is externally high. More than 85% of sand in soil has been identified along the coastal areas of this region. Particularly in Digha and Sankarpur coast, while the lowest sand content (40%-50%) has been observed in Alankarpur areas. The percentage of sand in surface soil is increasing towards southern part (more than 80%). North Western and Northern part of the study area have been less sand (40%) in its soil surface.

The distributions of clay content in the surface soil in Digha and its surrounding have been described in the table no. I. It has been noticed that the percentage of clay in the surface soil of Digha coast is extremely Low. Because, here the percentage of sand in soil high. More than 30% of clay in

soil has been noticed in few areas in Digha, particularly in Alankarpur & North Western part. Less amount of clay percentage has been identified in coastal areas of Digha & Sankarpur. Sand content in soil is highest along the coastal areas. While the percentage of clay content is low along the coastal areas and increase towards the interior or away from the coast.

The percentage of silt content in the surface soil of Digha has been depicted in the table no. I and has been identified from the analysis that the percentage of the silt in the coastal track like Digha and Sankarpur is 10%, because there the soil is sandy character in nature. In the North Eastern part of the study area, the percentage of silt is moderate and ranges between 20% to 30%. In Alankarpur part of Digha 73% of silt is found and soil is suitable for cultivation.

Table 1: Properties of surface soil in and around Digha

Soil Sample No	Sand %	Silt %	Clay %	PH	Organic Matter %	Nitrogen %	Phosphorous %	Base Exchange Ma/GM
1.	83.5	3.0	3.5	0.05	N.A	0.05	0.05	2.5
2.	91.4	2.5	6.1	7.2	0.13	0.01	N.A	4.9
3.	70.5	15.0	14.5	5.2	0.08	0.04	0.01	15.2
4.	85.5	9.0	5.2	6.0	0.12	0.01	0.03	2.8
5.	95.5	1.5	3.0	5.2	0.05	N.A	0.04	1.5
6.	83.0	35.0	3.0	5.1	0.85	0.07	0.05	14.7
7.	59.0	21.5	19.5	5.4	0.90	0.12	0.08	19.20
8.	51.0	36.5	12.5	6.0	0.58	0.08	0.12	21.05
9.	72.0	19.5	8.5	6.4	0.38	0.31	0.31	13.5
10.	15.0	49.1	35.9	5.4	1.35	0.15	0.13	34.2
11.	84.0	12.6	3.4	7.0	0.04	N.A	0.08	1.9
12.	20.0	49.5	30.5	5.8	1.29	0.13	0.31	28.9
13.	94.5	2.5	3.0	5.4	0.08	0.01	0.02	3.2
14.	80.6	21.4	18.1	5.8	0.82	0.07	0.08	17.3
15.	40.1	34.5	25.5	6.3	1.31	0.15	0.36	26.3
16.	61.5	20.0	18.5	5.7	0.81	0.07	0.03	17.8
17.	34.5	30.4	35.1	6.2	0.72	0.08	0.08	19.2
18.	38.0	31.5	30.5	6.4	1.02	0.90	0.17	20.3

Sources: - Pedology Laboratory (Dept. of geography & Applied Geography), University of North Bengal.

2) Nitrogen Content: - The percentage of nitrogen in the surface soil of Digha and Sankarpur coast is comparatively low than the percentage of Alankarpur in the table no. Due to maximum concentration of sand, this coastal region gets only 0.025% of nitrogen, where the growth of plants is comparatively low. It is comparatively high in the interior region than the coastal tract.

3) Phosphorous Content : -From the table no. 1, it is has been observed that the percentage of phosphorous in the surface soil of Digha coast and Sankarpur coast varies from 0.25% to 0.05%, which indicates that here phosphorous content in the surface soil is comparatively low due to high percentage of sand concentration. In the interior region like Alankarpur it varies from 0.075% to 0.128 %.

4) Organic Matter Content: - As shown in table no. 1, the percentage distribution of soil organic matter varies from place in Digha and surrounding areas. It has been found that the percentage is slightly higher in the Northern part than the southern part. In the Northern part particularly in Alankarpur region it ranges from 1.0% to 1.25% in the coastal part of Digha, it ranges 0.5% to 1.0% less than 0.5% of soil organic matter has been identified in the Digha & Sankarpur region, somehow it may be nothing to 0.25%.

5) Soil Reaction Zone: - The PH value of soil of the study area has been depicted in the table no. 1. It has been identified that the most of the study area acidic in nature due to low PH value (6.0). In the coastal areas of Digha & Sankarpur. The PH value ranging from 5.0 to 6.0.

6) Base Exchange Capacity: - The Base Exchange capacity of soil in Digha & Sankarpur is low in comparison with the interior part of the study areas. In the coastal tract the Base Exchange capacity varies from 0.5 M.e lons/100 grams of soil of the study are, the region in unsuitable for cultivation. Away from the coast, the Base Exchange capacity varies from 20 to 30 M.e lons /100 grams of soil.

Land Use Pattern

The history of the soil deposits in and around Digha coast is a complex one. Forests and shrubs had to be clear in many place to make room for the production of food for growing human and animal population. Such alteration of the natural environment had its effects on the original soil and certainly brought about consequent changes in its nature. In many case soil have actually undergone more than one cycle formation, the records of this part history have been mostly obliterated either by formation of a new soil on the truncated top the soil or b complex removal of the original soil by erosion(Figure No:- 4).

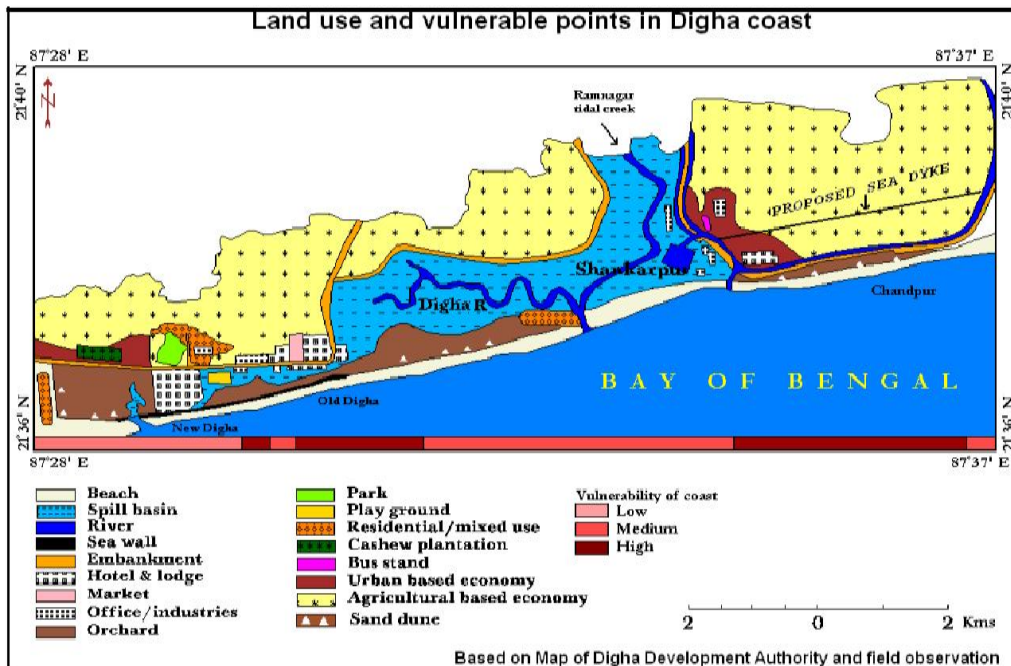


Fig 4: Land use pattern of study area

Environmental degradation and associated problems are the most pervasive of natural problems that undermine the economic and cultural development of study area. Consequently, coastal erosion, shifting of sand dunes and the encroachment of saline water land into the arable land is found to be most rampant in Digha coastal area. More and More land are found to transformed from arable land to

pisci-culture area, with the rampant use of pesticides, insecticides, along with the monoculture of prawns are found to be detrimental to the local aqua-ecosystem (Table No:- 4). This has also found to be detrimental to the indigenous aquatic lives & perhaps, the most serious problems are that gradually destroying the biodiversity of this once highly productive aqua-ecosystem.

Table 2: Showing the Changing land use pattern of Digha Planning Area(From 1995-2015)

0	Functions	DPA: 1995IN %	DPA: 2000IN %	DPA: 2005 IN %	DPA: 2010 IN %	DPA (*):015 IN %
1	Residential	7.50	10.25	13.55	17.35	18.50
2	Commercial & Hotels	1.00	5.00	10.25	15.25	17.40
3	Industrial	N.A	1.25	1.75	8.60	9.00
4	Institutional	1.00	5.00	7.25	8.60	9.00
5	Transformation	1.70	15.00	16.45	17.50	18.00
6	Vacant & open spaces, water bodies	5.30	2.50	1.75	1.00	0.50
7	Area For conservation	25.00	25.00	25.00	20.00	20.00
8	Agriculture	50.00	27.50	15.50	9.60	5.60
9	Under Sea	7.80	7.80	7.80	7.80	7.80
10	In surveyed	0.70	0.70	0.70	0.70	0.70
	Total	100	100	100	100	100

(*) projected Figure.

Sources: Digha Development Authority & Anonymus.

Pisci – Culture: - The exiting pattern of Pisci-culture in the costal bells is highly productive aqua ecosystem. The area under pisci-culture is 56.37 hack tore, which occupied in the south & Eastern part of the Digha.

The coastal area comprises variety of different factor from beaches & sand dunes to mudflats & salt marshes. The population of coastal water, the increasing demand for coastal spaces & problems of coastal erosion are relate to the coastal zone. Apart from coastal erosion caused by marine agencies and storm deliberate removal of sand for the construction of roads, hotels, rather less exploitation of casuarinas trees on the dune tops for the purpose of fuel and

for building the temporary huts of fisherman also cuse the destruction of sand dunes and erosion of the beach. At some place artificial method of beach protection also accelerate erosion of the coast elsewhere. Pollution by the tourists & by the fisherman due to their unscientific and careless method of fishing in the lake.

A part from the changes of the soil covered by deforestation and primitive & early method of cultivation, the exposed & slopping lands where in many cases, subjected to wind & water erosion. Drifting & shifting of sand dunes & the re-deposition of sand on fertile land also caused many unfortunate results in the regional soil, its productivity & Characteristics.

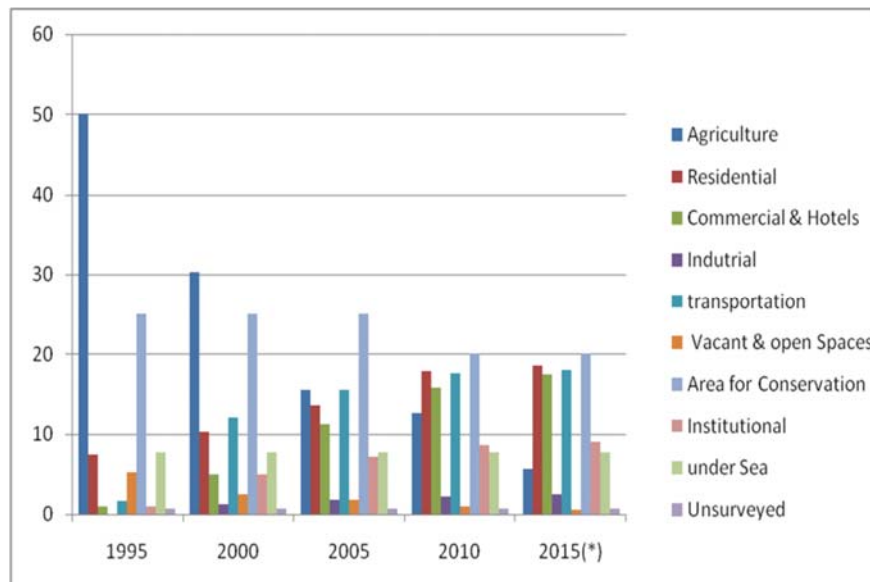


Fig 5: Changing land use pattern of Digha Planning Area

Environmental Management

The coastal tract is being crowded by the Sea resulting in lowering of the beach and also recession of the bank. Based on the study of the several researchers it is found that 970 meters area of the beach has been eroded during the period from 1877 to 1985, the rate of erosion of the beach is about 17 meters per year at some ports. Beside erosion beach lowering by about 15 to 20 cms per year appears to continue unabated.

In addition to the erosion and lowering of beach other environmental problems caused by natural agencies of this region are sand blowing and dune migration. The fine sands of the coastal dune also are being eroded by wind especially in the dry month's i.e. January to May & sometimes more about 150 meters inland causing damage to agricultural lands, houses & Ponds.

Beside the natural harrows, human interference has also caused a great damage to the environment of this region. The sand sheet, dunes of this region has largely been demolished for the construction of roads, houses and building purposes. The vegetation covers of the dunes were also removed by those people requesting in the exposure of the tops of the dunes to the wind to a great extent. In planned constructions of hotels in new Digha township area also threatens the existence of coastal swamps on important

landforms trace of the region, polluted by the township & by me fishermen due to their unscientific and careless unload of fishing.

These have also detrimental impact on the local soil system, soil characteristics of this marginal areas are also been found to be changing. In many cases, soil pruning, soil contamination & changes in soil structures are also found. These much have detrimental effects on the soil productivity.

Conclusion

Out of the long list of nature's gift to man, none is perhaps so utterly essential to human life. In this decade of population explosion, pressure on land and associated problems is matter of great concern.

For the proper management of soil and its properties in the coastal areas, a better knowledge is necessary to know the coastal environment entirely & attempt has been made to study how the coastal region alters in response to natural hazard and human interference and to suggest proper & efficient guidelines for management of it.

Human beings have always made decision regarding the use of land. At this moment, therefore, suggestion of remedial measure and their active implementation is of vital concern to the nation as whole for on it depends, ecological balanced and socio-economic stability of the region.



Plate 1: Collection of Soil Sample.



Plate 2: Casuarine shrubs



Plate 3: Casuarine shrubs converted into ground nut culture



Plate 4: Ground nut culture converted into Aqua-culture



Plate 5: Aqua-culture affected by cyclone Alia



Plate 6: A panoramic view of digha coast

Findings

- 1) Properties & characteristics of the surface soil elements are changing from coastal part to interior part.
- 2) Most part of the Digha coastal area, the soil is sandy in nature & fertility state of the soil is very low.
- 3) And also changing land use pattern of Digha development authority effects on the surface soil.

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