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STUDY ON EFFECTS OF EROSION AND ACCRETION AROUND NAGAPATTINAM PORT IN TAMILNADU –INDIA

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ABSTRACT

A shore is the zone between the water edge at low tide and the land ward limit of wave action. Increasing world population, the industrialization of nations and the re-shaping of national boundaries have caused substantial increase in the volume of ocean commerce. The world oceans contribution as a source of food, minerals and energy as the medium of sea borne international trade and as the basis for ocean dependent tourism, the global economy is much more significant than is generally realized. The environmental impacts of port operations affect water, soil, air and all types of flora and fauna and humans. The types of local problems that may occur include accelerated erosion or accretion. The study of area of Nagapattinam port is in the Eastern side of Tamilnadu. This area is one of the vulnerable sites affected by Tsunami on 26th December 2004, which caused great damages. India has a long coastline of about 7500 km including it's island territories. Ports handle about 95% of India's foreign trade by weight/volume through maritime transports. Harbour environment can be divided into four components –sea surface, shoreline, ocean, floor and the body of the ocean composed of water columns and suspended sediments. Ports and harbour create local environmental problems Nagapattinam port is one of the minor port among 185 ports in India. They import cement and export edible oil and coconut cake. Now Government has sanctioned rupees fifty crores to extend the port. It plays important role for supply of diesel to Sethusamudram project. In this present study shoreline changes and the sediment dynamics were analyzed using toposheets, beach slope measurement and sample characteristics. The sediment transport directions during monsoon and post monsoon seasons were found. The results were compared with variation of monsoon.

KEYWORDS: Erosion, Accretion, Shoreline, Port, Sediment and Vulnerable sites.

INTRODUCTION

The shoreline is one of the most unique features on the earth surface. India has a coastal line of around 7517 km and rational development of coastal areas, which form the habitat of 25% of the countries population, living within 60km of the shoreline. Tamil nadu with coastal length of 980km is second largest coast in India. This state experience two monsoon periods one is active from mid June to mid September(Southwest monsoon) and the other is active from mid October to mid January (Northwest monsoon) and post monsoon, pre monsoon. A shoreline is defined as the line of contact between land and a body of water. It is easy to define but difficult to capture since the water level is always changing. The factors responsible for shoreline changes are waves, currents and tides. The major requirements of planning coastal protection work is to understand coastal processes of erosion, deposition and transport of sediments which occur due to natural processes, anthropogenic activities as well as episodic events like cyclones, storm surges, floods etc.

Erosion causes direct and indirect damage to the national economy, coastal roads, buildings and valuable agricultural land have been destroyed. Simultaneous and continuous monitoring of beach erosion and/or accretion is necessary for coastal management. Human activities in the littoral zone where primarily the causes for accretion on the windward side and erosion on the leeward side. Sediments on beaches are constantly in motions onshore, offshore and along shore, waves carries material up to a certain size to the beach, if it is a large wave relatively little water infiltrate into the beach and most of the sediment is carried back with backwash. A harbour is a partially enclosed area of water that serves as a place of refuge for ships, whereas the term port refers to a portion of a harbour. Over 90% of world's international trade by volume and over 80% by value is transported by sea. World wide, both the developed and developing countries provide support for constructing harbours along their coastal region to provide shelter to the ships from external wave disturbance. A shoreline is defined as the line of contact between land and a body of water.It is easy to define but difficult to capture since the water

level is always changing. The factors responsible for shoreline changes are waves, currents and tides. The major requirements of planning coastal protection work understand coastal processes of erosion, deposition and transport of sediments which occur due to natural processes, anthropogenic activities as well as episodic events like cyclones, storm surges, floods etc. Erosion causes direct and indirect damage to the national economy, coastal roads, buildings and valuable agricultural land have been destroyed. Simultaneous and continuous monitoring of beach erosion and/or accretion is necessary for coastal management. Human activities in the littoral zone where primarily the causes for accretion on the windward side and erosion on the leeward side.

SCOPE OF STUDY

The study of shore line dynamics will provide a management tool for rapid assessment of natural hazard risk potential and it is important for such activities as economics, development, tourism, planning research, science and education etc. There are 12 major ports and 185 minor/ intermediate ports are situated along the coastline of India. Nagapattinam port is one of the minor ports in India. The port area was affected by Tsunami in December 2004 which caused great damages. Now the Government has allotted Rs. 50 corers to extend the port. The study will through light on the impacts on shoreline changes, beach slope, sediment transport and analysis of water sample.

OBJECTIVES

- To analyze beach slope
- To analyze beach Material –sand
- To find out the pattern of seasonal sediment transport.
- To delineate the shoreline changes during monsoon, pre-monsoon, post monsoon and demarcating the eroding and accreting regimes.

STUDY AREA

Nagapattinam port is situated between 10° 16 N latitude and 79° 39 E longitude in Central East Coast of Tamilnadu and at a distance of 348 km from Coimbatore. There are two breakwaters in North and South of the port. The length of the breakwater is 200 to 400 m. Shoreline is extend 300m N and 600 m S. They importing cement and exporting edible oil and coconut cake through sea. The Government has planned to extend the port area for supply of diesel to the Sethusamudram project

METHODOLOGY

beach slope were measured using clinometer compass around 8 stations for three seasons and sand was collected from 10 stations during monsoons and post monsoon around the coastal area particles size were analysed by sieve analysis based on that erosion and accretion and sediment transport and skewness were calculated.

ANALYSIS OF BEACH SLOPE

- Beach slope was observed from 8 stations of the study area during monsoon, pre-monsoon and post monsoon to understand the slope morphology.
- Observations were made with the help of clinometer compass. The compass has two parts such as flat horizontal scale and a circular dial with a needle.
- The circular dial is mounted on the horizontal scale in which angle is graduated from 0° to 360° and slope of the beach was readily measured by the needle fluctuating in the circular dial.
- Slope of the beach was compared between the stations during each season and from the steepness or flattening of the shore accretion and erosion were identified.

ANALYSIS OF BEACH SAMPLE COLLECTION

- Beach samples were collected from 10 locations around the port of Nagapattinam. The sampling locations were identified with a hand held GPS. At each sampling location about 2kg of unconsolidated wet sand were collected and packed in polythene covers.
- In grain size analysis, the moisture content from collected samples was removed by oven drying.
- Then these dried samples were weighed for finding initial weight and then sieve process had been carried out in single stack through seven sieves for 20 min using Ro-Tap sieve shaker.
- The sand retained on each sieve was carefully removed and again weighted which was converted into cumulative weight percentage retained.

RESULTS AND DISCUSSIONS

The development in coastal area and subsequent population growth have given rise to problems such as erosion, sedimentation, saltwater intrusion, degradation of natural resources, etc. Coastal zone is very dynamic, being the meeting place of land and sea water. sampling stations were located using GPS is presented in Table 1. Slope was measured around 10 locations during pre monsoon, monsoon, post monsoon as given in Table 2. It is observed that the beach slope during monsoon and post monsoon is greater than the pre monsoon period. This trend is clearly shows that the beach is continuously eroded.

TABLE 1. LOCATION OF SAMPLING STATIONS

Sampling stations	Latitude (deg)	Longitude (deg)
1	10.4523N	79.5128E
2	10.4532N	79.5129E
3	10.4540N	79.5134E

4	10.4551N	79.5161E
5	10.4551N	79.5164E
6	10.4553N	79.51341E
7	104554N	79.51499E
8	10.4554N	79.5140E
9	10.4553N	79.5140E
10	10.4553N	79.5140E

TABLE 2. ANALYSIS OF BEACH SLOPE

Stations	Slope in degree			
	Pre monsoon	Monsoon		Post monsoon
1	2	2	3	2.5
2	2	2	3	2
3	1.9	2	3	3.5
4	3.5	3	4	3
5	Inside jetty	Inside jetty	Inside jetty	Inside jetty
6	Inside jetty	Inside jetty	Inside jetty	Inside jetty
7	3	3	3	2.5
8	1.5	1	3	2.5
9	1.5	1	4	3
10	4	3.5	5	4

TABLE 3 CUMULATIVE % OF SAND SAMPLES 1 & 2 STATIONS

Sieve Size	Location -1			Location -II		
	Monsoon		Post monsoon	Monsoon		Post monsoon
4.78	0	0	0	0	0	0
2.38	0	0	0	0	0	0
1.410	0	0	0	0	0	0
0.710	0.2	1.1	1.3	0.2	0.6	0.4
0.50	0.5	3.7	3.8	0.4	1.2	1.5
0.211	73.5	89.3	89.0	91.7	92.6	93.9
0.075	99.3	99.9	99.9	99.8	99.9	99.9
pan	100	100	100	100	100	100

TABLE 4 CUMULATIVE % OF SAND SAMPLES 3 & 4 STATIONS

Sieve Size	Location -III			Location -IV		
	Monsoon		Post monsoon	Monsoon		Post monsoon
4.78	0	0	0	0	0	0
2.38	0	0	0	0	0	0
1.410	0	0	0	0	0	0
0.710	0.1	1.1	1.4	0.5	0.3	0.6
0.50	0.25	3.7	3.4	0.95	0.8	1.2
0.211	92.25	89.3	96.6	87.45	78.6	96.3
0.075	99.98	99.9	99.8	99.8	99.9	99.9
pan	100	100	100	100	100	100

TABLE 5 CUMULATIVE % OF SAND SAMPLES 5 & 6 STATIONS

Sieve Size	Location -V			Location -VI		
	Monsoon		Post monsoon	Monsoon		Post monsoon
4.78	0	0	0	0	0	0
2.38	0	0	0	0	0	0
1.410	0	0	0	0	0	0
0.710	0.1	1.1	1.4	0.5	0.3	0.6
0.50	0.25	3.7	3.4	0.95	0.8	1.2

0.211	92.25	89.3	96.6	87.45	78.6	96.3
0.075	99.98	99.9	99.8	99.8	99.9	99.9
pan	100	100	100	100	100	100

TABLE 6 CUMULATIVE % OF SAND SAMPLES 7 & 8 STATIONS

Sieve Size	Location -VII			Location -VIII		
	Monsoon		Post monsoon	Monsoon		Post monsoon
4.78	0	0	0	0	0	0
2.38	0	0	0	0	0	0
1.410	0	0	0	0	0	0
0.710	0.125	0.5	0.5	0.25	0.1	37.1
0.50	2.85	1.5	1.4	0.5	2.6	91.7
0.211	96.17	95.8	95.9	94.25	95.1	99.3
0.075	99.8	99.9	99.9	99.8	99.9	99.8
pan	100	100	100	100	100	100

TABLE 7 CUMULATIVE % OF SAND SAMPLES 9 & 10 STATIONS

Sieve Size	Location -IX			Location -X		
	Monsoon		Post monsoon	Monsoon		Post monsoon
4.78	0	0	0	0	0	0
2.38	0	0	0	0	0	0
1.410	0	0	0	0	0.5	0
0.710	0.25	0.5	1.7	0.15	2.2	1.0
0.50	2.9	0.1	15.7	0.3	4.0	3.0
0.211	96.25	90.2	95.7	90.35	85.4	93.0
0.075	99.9	99.8	99.9	99.8	99.7	100
pan	100	100	100	100	100	-

TABLE 8 PREDOMINANT DIRECTION OF THE SEDIMENT TRANSPORT

Location	Sediment Source								Parameter	Inference
	S_1	S_2	S_3	S_4	S_7	S_8	S_9	S_{10}		
S_1		F B +	F B +	F P -	F B -	F B -	F P -	F B -	Mean Sorting Skew ness	$S_1 \rightarrow S_4, S_9$
S_2	C P -		C P S	F P -	F P -	F P -	F P -	F P -	Mean Sorting Skew ness	$S_2 \rightarrow S_1$ $S_4, S_7, S_8, S_9, S_{10}$
S_3	C P -	F B S		F P -	F P -	F P -	F P -	F B -	Mean Sorting Skew ness	$S_3 \rightarrow S_1$ S_7, S_4, S_9, S_8
S_4	C B +	C B +	C B +		F B -	F B +	S B +	S B -	Mean Sorting Skew ness	———
S_5	C P -	F B S		F P -	F P -	F P -	F P -	F B -	Mean Sorting Skew ness	$S_3 \rightarrow S_1$ S_7, S_4, S_9, S_8
S_6	C B +	C B +	C B +		F B -	F B +	S B +	S B -	Mean Sorting Skew ness	———
S_7	C P +	C B +	C B -	C P +		C B -	C P +	C B +	Mean Sorting Skew ness	$S_7 \rightarrow S_1$ S_4, S_9
S_8	C P	C B	C B	C P	F B		C P	C B	Mean Sorting	$S_8 \rightarrow S_1$

	+	+	+	+	+		+	+	Skew ness	S_4, S_9
S_9	C B +	C B +	C B +	S P -	F B -	F B -		S B -	Mean Sorting Skew ness	———
S_{10}	C P +	C P +	C P +	S P +	F P -	F P -	S P +		Mean Sorting Skew ness	$S_{10} \longrightarrow S_1$ S_2 ,S_3, S_7,S_8

The result of this trend show that predominant direction of the sediment transport during the monsoon is from north to south. And is reversed during premonsoon, post monsoon. Major source for sediment locations is observed from this isS_3, S_{10}.

TABLE 9 SKEWENESS INDEX OF SAND

Sl.No	Period	Major Source	Major Sink
1	Premonsoon	S_9 ,S_3, S_{10},	S_2 ,S_1
2	Monsoon	S_1 ,S_2, S_3,S_8, S_{10}	S_9
3	Post monsoon	S_3 ,S_9, S_{10}	S_7 ,S_{10},

CONCLUSION

In the present study, shoreline changes were determined, beach slope was observed from the 8 stations during three seasons, identified as monsoon and post monsoon is greater than premonsoon. This trend shows that the beach is continuously eroded. The result of this sediment transport was observed during monsoon is from north to south. and is reversed during other season major sediment locations is observed from this study is station 3and station 10.The water quality parameters were analyzed and compared with 3seasons most of parameters increased during post monsoon. As per water quality data during the seasonal variations it come under SW-II class (mariculture, shell fishing, saltpans)

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