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SPITS OF COROMANDAL COAST IN TAMIL NADU

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ABSTRACT: The present paper aims at studying the spits of coromandal coast in Tamilnadu in respect of their morphological change, zone of accretion and erosion using topographic sheets of Survey of India of 1919, 1969 and IRS 1A LISS I FCC image. About 9 spits are indentified and their characteristics, growth, formation and causative factors are discussed. The suitable areas for developmental activities are also suggested.

INTRODUCTION

Coastal zone is a domain where the fluvial, marine and the fluvio-marine dynamic forces are operative all the time. Various landforms are therefore formed all along the coastal zone. Such landforms bear the imprints of past fluvial, marine and fluvio-marine environments under which they are formed. From a careful study of morphology and distribution of the coastal landforms, the forces operative along the coastal zone can be modelled. Spits are a landform, directly exposed to the marine environment, which signifies the pattern of littoral currents, the tectonic framework, the sediment supply, the coastal erosion and also the phenomenon of emergent shoreline. The spits have not attracted much attention from the geoscientists they deserve, however.

Along the coastal zone of Tamil Nade, a spectacular array of spits is observed (Figure 1. Modified after Ramasamy, 1989), with varying sizes, shapes, orientation and patter. An attempt has therefore been made to study them along the Coromandal coast of Tamil Nadu in respect of their morphological changes, zone of accretion and erosion and the causative factors in their formation.

METHODOLOGY

Topographic maps (1:63,360) of Survey of India of 1919 (survyed between 1916-1919), 1969 (1:50,000), and IRS-1A LISS I False Colour Composite of 1989 form the base of the study. By comparision of the data from these sources the patterns of growth or destruction of the spits and morphological changes are brought out. This has also helped in bringing out the present day marine forces in the making of landforms too. As an additional outcome of the study, the areas suitable for developmental activities along the coast have also been identified.

REGIONAL SETTING

The coastal zone of Tamil Nadu is bounded by the Precambrian group of metamorphics in the west, which, regionally, exhibit a NE-SW trend, the sediments of Gondwana, Cretaceous and Tertiary groups in the central areas and the fluvial and marine landforms in the east. Fluvial landforms are dominated by a network of deltas such as those of the Proto-Cauvery, Palar, Ponnaiyar, Kallar, Vellar and Tamiraparani rivers. The Proto-Cauvery forms the northernmost and the Tamiraparani the

southern extreme of the Tamil Nadu coast. All deltas have their apex at 10-100 Km to the west of the present day shoreline. The marine landforms, conspicuously developed in the area, are the beach ridges, swales, backwaters, baymouth bars, off-shore bars and spits. Among the landforms, the spits exhibit long and linear but bright sand bodies with one end attached to the mainland.

STATE OF KNOWLEDGE OF SPITS

As part of regional studies, several workers have made references to spits and their growth. Schwartz (1972) states that the spits are depositional sand bodies formed above the high tide. Chapmen (1964), Hepburn (1952) and Tansely (1939) have indicated that the spits are a shingle or sandy structure with extremely mobile sub-strata.

Barnes (1977) has expressed the idea that the spits normally form where there is an abrupt change in the direction of the coast, which may have an irregular outline with frequent changes of direction. Such formations have one or several recurved hooks and recurved distal end. He has also observed that the spits can develop across the mouth of an estuary and become a bar or barrier and, subsequently, they may get connected to the mainland. Thornbury (1984) has suggested that the spits can be attributed commonly to movement and deposition of materials by longshore currents.

Black (1986) has described that wherever and whenever the longshore currents reach the land the water becomes deep and the currents disperse and lose their velocity. At this point, the sediments get deposited and form a permanent above-water landform called spits. Gilbert (1980) has indicated that when the coastline possesses some abrupt bay, the longshore currents cannot strictly follow the bay configuration and, as a result, they dumped the sediments at the edge of the bay as spits. The deposition in any one of the edges of the bay depends upon the direction of the littoral currents. Although the currents contribute sediments to the spits, they grow in the predominant direction of longshore sediment flow caused by waves and their outlines are shaped largely by the wave action. Heyes (1975) has suggested that if the tidal range is less than 2 metres, it may be assumed that the wind waves accounted for the dominent coastal processes, and beaches and the spits become the dominant features of the coast. The evolution of many spits has been modified or even halted by the addition of artificial structure (Bird, 1984). In India, Sambasiva Rao and Vaidyanadhan (1979) and Sambasiva Rao (1987) have brought out the patterns, configurations and growth rates of the Gauthami Godavari and the Vasishta Godavari spits. Ramasamy (1989) has indicated that most spits in Tamilnadu coast are found to have been developed only along the noses of the Pleistocene faults. He has also demonstrated that when the notherly littoral currents cross the noses of the land formed by the faults, they dump the sediments which develop into spits. Results and Discussion

Through the study, about 9 spits along the east coast of Tamilnadu have been identified and analysed. The details of thesespits are given in Table 1. The morphology of each of the spits, growth, its formation, causative factors and characteristics are discussed in the succeeding paragraphs.

MANAPAD SPIT:

It is a sandy spit, located at the mouth of the Karamaniyar river at the southernmost end of the study area. It is developed for a length of 1.3 km with a width of 0.25 - 1 km. The topographic map of 1919 and IRS-1A LISS I FCC image of 1989 show that the southern rim of the spit is subjected to accretion by the eroded sediments, brought from the coast of

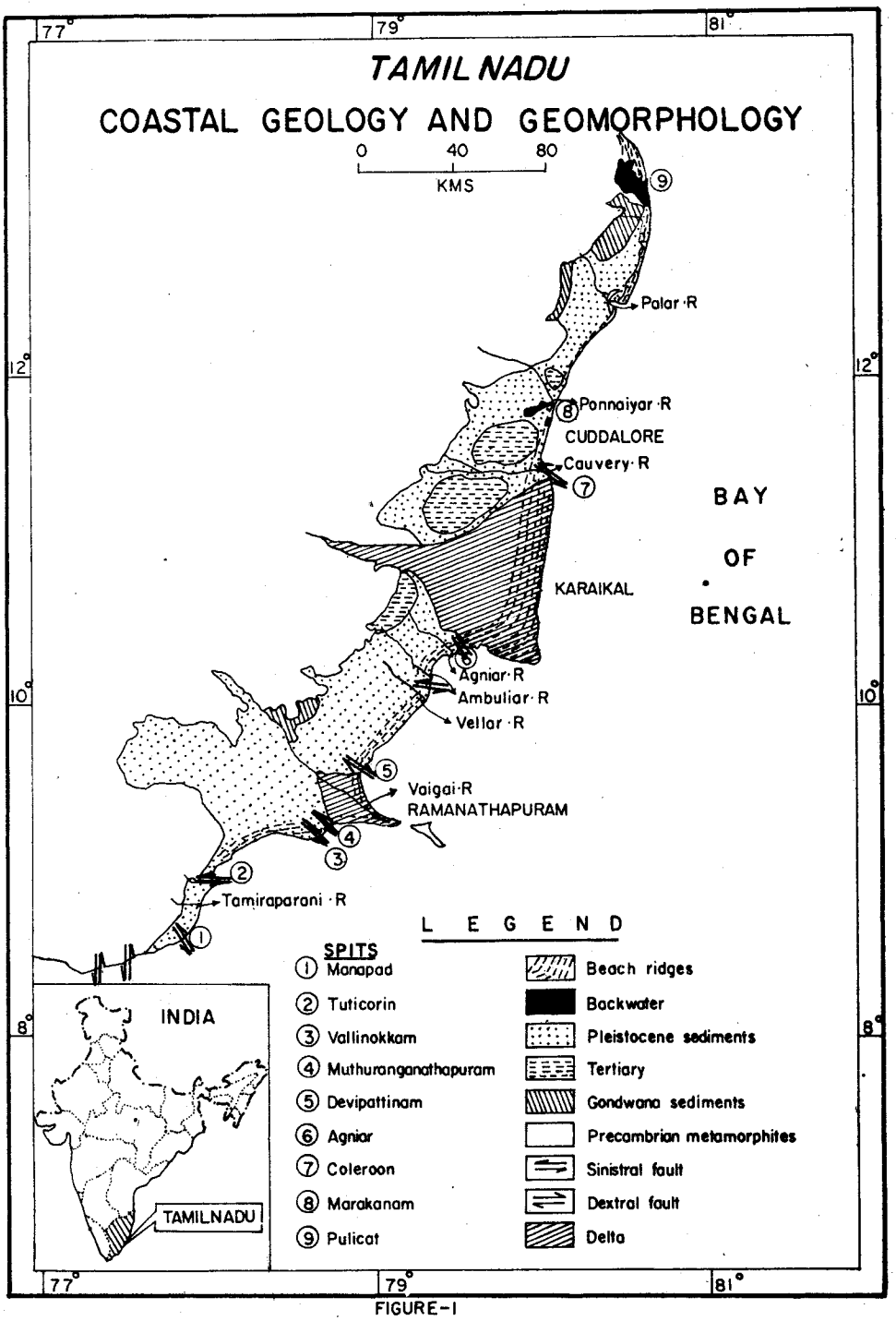

TAMIL NADU
COASTAL GEOLOGY AND GEOMORPHOLOGY
0 40 80
KMS
77°
79°
81°
12°
10°
8°
Palar R
Ponnaiyar R
CUDDALORE
Cauvery R
KARAIKAL
BAY
OF
BENGAL
Agniar R
Ambuliar R
Vellar R
Vaigai R
RAMANATHAPURAM
Tamiraparani R
INDIA
TAMILNADU
LEGEND
SPITS
1 Manapad
2 Tuticorin
3 Vallinokkam
4 Muthuranganathapuram
5 Devipattinam
6 Agniar
7 Coleroon
8 Marakanam
9 Pulicat
Beach ridges
Backwater
Pleistocene sediments
Tertiary
Gondwana sediments
Precambrian metamorphites
Sinistral fault
Dextral fault
Delta

FIGURE-1

TABLE 1

S No.	NAME OF THE SPIT	LENGTH	WIDTH	ORIEN-TATION	CURR-ENT DIR. (EFF.)	MON-SOON (EFFE-CTIVE)	SEDIMENT SOURCE	DEPOSI-TION	EROSION
1	MANAPAD	1.3Kms	.25 TO 1 Km.	ENE	NE	SW	COASTAL EROSION	SOUTH-ERN SIDE	—
2	TUTICO-RIN	EW-3 Kms NS-3 Kms	EW-2.5 Kms NS-.5 Kms	EW & NS	NNE	SW	TAMARA-PARANI RIVER	SOUTH-ERN SIDE	NORTH-ERN SIDE
3	VALLI-NOKKAM	1 Km	.25 Km	EW	ENE	SW	GUNDAR, VAIPPAR RIVER	NORTH-ERN SIDE	SOUTH-ERN SIDE
4	MUTHU-RANGA-NATHA-PURAM	1 Km	1 Km	EW	ENE	SW	GUNDAR, VAIPPAR RIVER	NOTH-ERN SIDE	SOUTH-ERN SIDE
5	DEVIPA-TTINAM	1.5 Kms	.5 T0 .25 Km	NS	ENE	NE	VELLAR & AMBU-LIYAR RIVER	NORTH-ERN SIDE	NORTH-ERN SIDE
6	AGNIAR	1.5 Km	.25 Km	NS	NS	SW	AGNIAR RIVER	NORTH-ERN SIDE	SE FRINGE
7	COLE-ROON	1 Km	.5 Km	NS	NS	SW	COLEROON RIVER/ COASTAL EROSION	NORTH-ERN SIDE	SOUTH-ERN SIDE
8	MARA-KANAM	1 Km TO .2 Km	.15	NS	NS	SW	COLEROON & VELLAR SEDIMENTS	NORTH-ERN SIDE	-
9	PULICAT	3.5Km TO .5 Km	.15	NS	NS	SW	PALAR RIVER COASTAL EROSION	NORTH-ERN SIDE (AFTER 1969)	SOUTH-ERN SIDE

Uvari and Kanyakumari by the littoral currents during the south west monsoon period. The Uvari and Kanyakumari coasts are often subjected to erosion at the rate of 0.86 m and 1.74 m per year and have lost 5.52 acres and 3 acres of land respectively within ten years from 1978 - 1988 (Kaliasundaram et.al, 1988). In contrast, in describing the coastal geomorphology of southern Tamil Nadu, Loveson and Victor Rajamanickam (1987), suggest that the present day small river might have been a major river in the past or had brought enough sediment load to cause a quick deposition due to littoral currents for the growth of Manapad spit. However, it is still doubtfull because there is no sign of Paleo-environment (old flood plains, and paleo channels, for example) evidences adjacent to the present small river noticed in recent remotely sensed data.

TUTICORIN SPIT

The spit observed near Tuticorin is a recurved sandy spit (Figure 2b) which extends from the mainland for 3 Km eastward into the sea and takes a northerly turn and runs for another 3 Km. its width varies between 0.5 Km and 3 Km. The sediments which are brought by the Tamiraparani river and transported by the littoral current is the main source for the growth of this spit. As indicated by Carter (1979), the origin of the recurved spit is in the changes in the wave direction, which is perpendicular to the coast. Towards the proximal end of the spit, the wave is approaching parallel to the shore. As the recurve begins, the approach angle of the wave begins to increase and sediments move towards the distal end of the spit. Simultaneously, however, the wave height begins to decrease along the shore due to increase in refraction. These are the reasons for the recurved nature of the Tuticorin spit. In 1919, the same spit was very thin and narrow in its north-south alignment with frilled boundaries. About half a kilometre north of it, there was an island called Hare Island (Ahmed, 1972).

The study of 1969 toposheet showed that there has been a conspicuous growth in the spit extending narrowly towards north with an almost smooth eastern boundary. The frilled western boundary is connected to the Hare Island forming a Tombolo. But IRS 1A LISS I FCC of 1989 showed that the incursions have been filled to a great extent. However, a comparison of 1919, 1969 and 1989 data showed that an appreciable sediment accretion has taken place in the southern part , and the western portion of the northern part of the spit and erosion in the eastern rim of northern tip of the spit. Such an accretion and erosion is exhibited in the IRS 1A LISS I FCC image in the form of brighter and vegetal cover free in the zone of accretion and ever floating suspended sediments in the region of erosion. It should be mentioned that an east-west trending jetty was constructed by the 1960's in the eastern rim of the sourthern segment of the spit, which protects against the longshore currents so that the sediment is deposited against the structure and a more conspicuous growth of the spit has taken place on the southern side of the jetty while halting it in the northern side during the south west monsoon period. As against this the eastern rim of the northern part of the spit is eroded and accreted in the western rim due to the action of anti-clockwise littoral current during the northeast monsoon period.

VALLINOKKAM AND MUTHURANGANATHAPURAM SPITS

Both the spits are extended for 1 Km towards the east into the sea with a width of 0.25 Km - 1 Km. Extensively eroded materials of black cotton soil from Vaippar and Gundar river basins are debouched into the sea

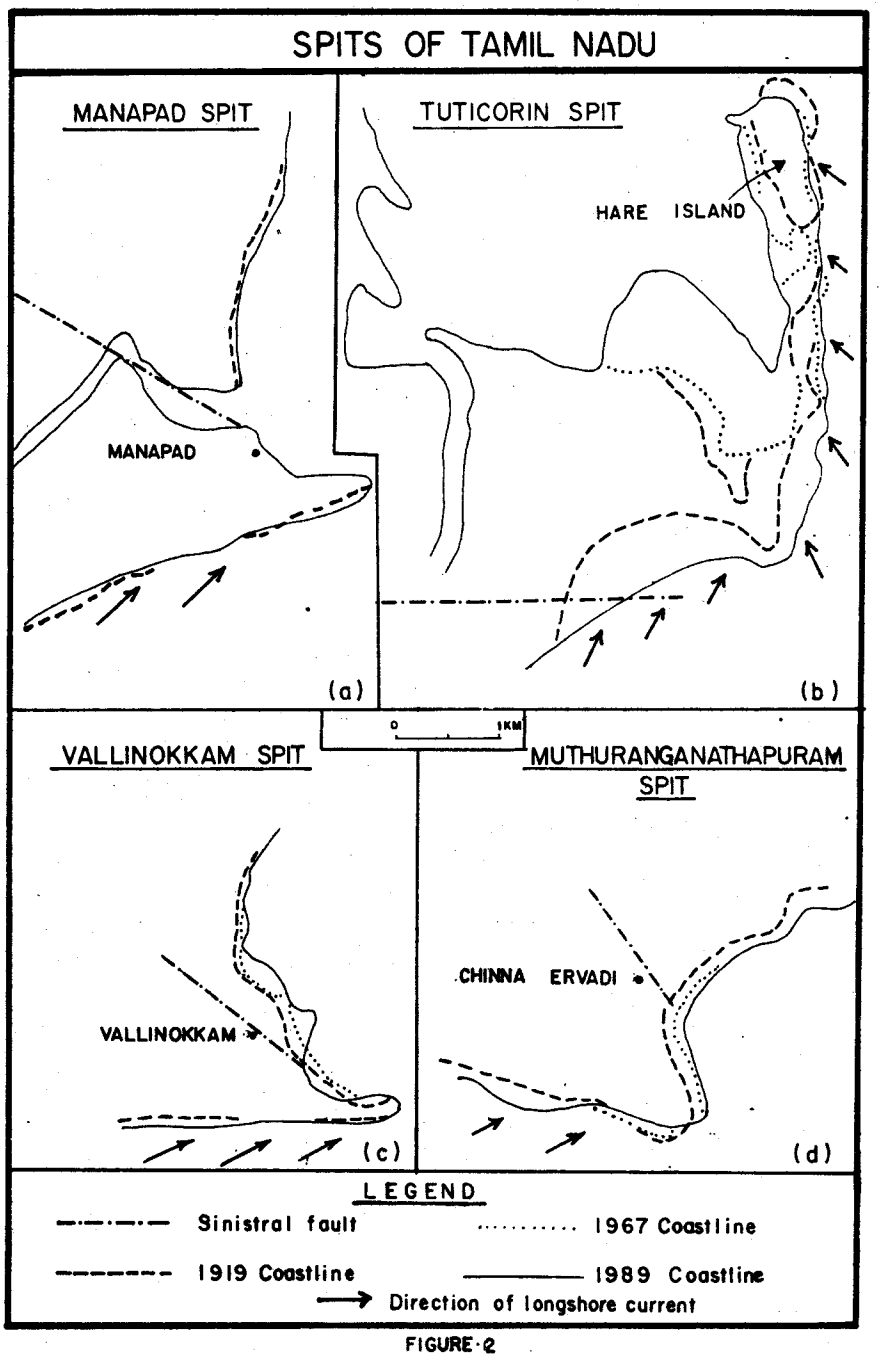

SPITS OF TAMIL NADU
MANAPAD SPIT
MANAPAD
(a)
TUTICORIN SPIT
HARE ISLAND
(b)
0
1KM
VALLINOKKAM SPIT
VALLINOKKAM
(c)
MUTHURANGANATHAPURAM SPIT
CHINNA ERVADI
(d)
LEGEND
Sinistral fault
1967 Coastline
1919 Coastline
1989 Coastline
Direction of longshore current

FIGURE-2

through these rivers. The sediments are carried and accumulated by the littoral currents during the southwest monsoon at the nose of sinistral faults where both the spits are located at Vallinokkam and Muthuranganathapuram. The cementing character of the sediments is from the black cotton soil while the hardness of the spit terrain is from the coastal sands. Hence, the two spits are made up of hard sands. However, both the spits are similar in character. The combined occurrence and alignment of the two spits with a parallelism and off-setting typically signify the zetaform bays as described by Carter (1988). It consisted of a down coast 'hook' passing laterally into an upcoast opening bay. Hence, long shore variations desplay a transition from dissipative to reflective beach stages (Short and Wright, 1980). Because of this trend, it is concomitant with coarsening grain size and steepening beach slope.

The integration of data interpretated from 1919, 1969 toposheet and 1989 IRS 1A LISS I image showed that the Vallinokkam spit has become considerably eroded in the northern part and grown in its northeast and southern rim. The sequence is reversed in Muthuranganathapuram spit.

DEVIPATTINAM SPIT

In contrast to all other spits of Tamil Nadu coast, Devipattinam spit is the only spit, located along the nose of a dextral fault (Figure 2C) just north of Rameswaram projection and exhibits a southerly hooking shape. It is sandy in nature with the length and width of 1.5 Km and 1 Km. This spit is formed due to the action of anti-clockwise eddies produced by the southerly littoral current during NE monsoon. It is also observed that just south of Agniar - Ambuliar and Vellar river mouths a lot of sediments which are debouched into the sea which in turn develops the protruding deltas, too. The study of sequential data shows that the northern side of the spit is eroded and the southern side has considerably grown for a kilometre in between 1919 and 1989.

AGNIYAR SPIT

The Agniyar spit is observed almost at the outer rim of the Agniyar protruding cuspate delta (Ramasamy 1991). The present study further shows that the outermost rim of the cuspate zone is developed into a new spit especially after 1969 with an orientation of NE-SW. By 1920 there was a shoal (Figure 2F) trending NE-SW near the northern bank of the mouth of Agniyar. The study of IRS-1A LISS I image of 1989 has shown that there has been a conspicuous growth of the spit extending for about 3 Km from the mouth of the Agniyar river to the present tip of the spit in the north, with a smooth eastern boundary, but frilled western boundary, probably due to whirly action of littoral current. A similar formation of the spit is noticed in the east coast at Gauthami Godavari river (northern spit) confluence by Sambasiva Rao and Vaidyanathan (1979).

COLEROON SPIT

The spit observed in the mouth of Coleroon river with a N-S orientation has a dimension of 1 Km length and 0.5 Km width. The study of 1919 and 1969 toposheets did not reveal any spit. But on the contrary, it is observed in 1989 IRS 1A LISS I image. There are also considerable changes in the shoreline configuration. The shoreline was almost straightt in 1919 and bulged in 1969 but in 1989 it exhibited embayment in the south and protrusion in the north and on the northern protrusion, this newly developed coleroon spit is observed. However, a thorough enquiry with local people indicates that the spit has started to grow only after 1969.

MARAKANAM SPIT

The Marakanam spit is located at the mouth of the northern most chain of Marakanam backwaters and developed to a length of 1 Km and width of 0.2 Km. with NNE-SSW orientation. Though the study of 1919 and 1969 data has not shown any changes in the spit growth, it is observed that this spit has grown only after 1969. It is interesting to note that from January to September, the spit has grown northward and connected the mainland, making the Kalveli backwaters closed for 9 months, as against erosion during northeast monsoon (Oct - Dec) period due to the effect of southerly directed littoral currents.

PULICAT SPIT

The Pulicat spit also grows for 9 months and gets eroded for 3 months as indicated in the previous case. In 1919 there was a big spit trending NW-SE and almost eroded in 1969 of which a small portion protruded towards north from the mainland. After 1969, there was a rapid growth in the spit as big as the size of older one. The sediment supply is from eroded material of Royapuram coast which is located south of Pulicat Spit (Data of Kalia Sundaram, 1989).

CONCLUSION

The conclusions that emerge from the study are as follows :

All the spits show parallelism with the coastline and connect the mainland in their southern ends. They exist at the nose of sinistral fault except in Pulicat, Marakanam and Devipattinam. In contrast, Devipattinam spit connects the mainland in the northern end and located at the nose of a dextral fault.

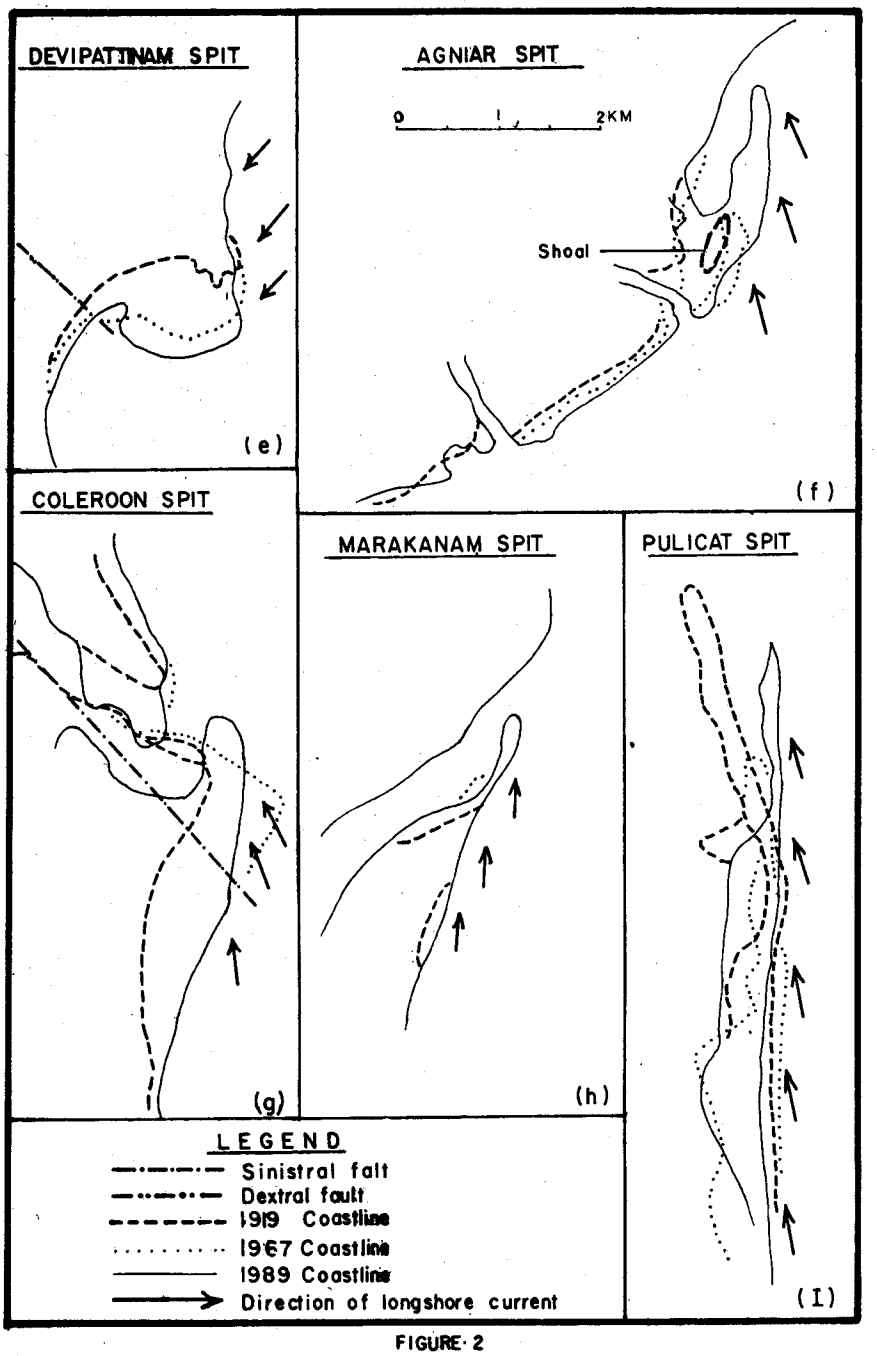
The spits between Cape comorin and Rameswaram island with an orientation of ENE nad N suggest that the clockwise littoral currents are active during SW monsoon. Hence, any constructional activity in the form of piers/jetties is expected to cause rapid sedimentation in the south and agressive costal erosion in the north of piers/jetties. Even at present littoral currents cause erosion in the southern part of the spits and accretion in the northern part during SW monsoon. Further the zeta form bays are observed along this coastline between Vallinokkam and Muthuranganathapuram spits. The absence of southerly hooking effects of the spits further suggests that the southerly moving litteral currents of NE monsoon period may not reach this coast due to the obstruction caused by Rameshwaram island.

The southerly hooking effect of Devipattinam spit suggests that the anti clockwise littoral current is moving in a southerly direction in the area between Vedaranyam noe and north of Rameswaram islands during NE monsoon. The northerly hooking effect of the Agniar spit which is located north of Devipattinam spit, on the contrary, suggests a northerly movement of littoral current during SW monsoon from the east coast of SriLanka.

The absence of spit in the Coleroon mouth during 1969 and the presence of one in 1989 IRS-1A image indicates that the fluvial erosion of river Coleroon has substantially come down after 1969 (probably due to the excessive construction of dams), and in turn , has aided the littoral current in dumping the sediments along the sinistrally projected nose of the land on the southern bank of coleroon.

The northerly hooking effect of Marakanam and Pulicat spit suggests that the northerly directed littoral currents are active during the SW monsoon and at the same time it is growing during the SW monsoon. But during the NE monsoon the spits are getting eroded because of the southerly directed littoral current.

Further, the Coleroon, Marakanam, Pulicat


DEVIPATTINAM SPIT
(e)
AGNIAR SPIT
0 1 2KM
Shoal
(f)
COLEROON SPIT
(g)
MARAKANAM SPIT
(h)
PULICAT SPIT
(I)
LEGEND
Sinistral falt
Dextral fault
1919 Coastline
1967 Coastline
1989 Coastline
Direction of longshore current

FIGURE· 2

and Agniyar spits are in bright while without any vegetation in the satellite imagery which indicate that they are recent.

The morphology of spits between Rameshwaram and Vedaranyam show that the southern part of the coast is affected by the southerly moving littoral current of NE monsoon (Oct - Dec) where as the northern part is a safe littoral current region. Hence this zone is suitable for establishing small harbours and ports and holiday resorts.

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