Available online at www.scholarsresearchlibrary.com

Scholars Research Library

Archives of Applied Science Research, 2013, 5 (2):52-57
(http://scholarsresearchlibrary.com/archive.html)

ISSN 0975-508X
CODEN (USA) AASRC9

Morphological changes in the river mouth caused by Tsunami in Cuddalore, East Coast of India

J. Senthil[1]*, K. Indhira[1], S. Vadivel[1] and J. Murugesan[2]

[1]Department of Geography, Govt. Arts College (A), Kumbakonam, TamilNadu, India
[2]Department of Geography, Periyar EVR College, Tiruchirappalli, TamilNadu, India

---

ABSTRACT

The proposed research would study the Morphological Changes along the East coast river mouth which are widened due to impact of Tsunami. East coast is severely affected due to Tsunami of 26th December 2004 and several morphological changes along the coast happened. There are numerous Major and Minor rivers that mixes with the sea in this region. All the mouths of the rivers are affected due to Tsunami . River mouths are usually covered with sand, Mangrove forest, and Vegetation cover, Swamps and in some cases settlement. The river mouth, which could not resist the force of Tsunami wave, had suspected greater changes. This necessitates a several changes along the coast and various destructions by using optical remote sensing technology. The GPS would used to map the changes at the river mouth through survey method. The study would suggest measures to overcome the problem due to changes in the river mouth due to Impact of Tsunami.

Key words: Tsunami, Mangrove forest, GPS

INTRODUCTION

The present study is about the impact of December 2004 Tsunami waves, destructing the coastal landscape with particular reference to the sand erosion and deposition of river mouths along the rivers in the Nagapattinam coast. Field investigation in this region reveal that huge quantity of sand particles were removed by the giant waves and deposited on the lee ward side of the coast which ranges from 300 meters to 1 kilometer. Majority of the shrimp aquaculture farms, which are present inside the river as well as near the vicinity, have been severely affected due to the tsunami impact. The estuary's which confluences with the Bay of Bengal, particularly the river mouth which is close to the sea has been widened and though which the surface sea level intrusion have been wide spread prevalence in almost all the river confluence segments in this coastal region. This would also affect the economic activity such as aquaculture farming, coastal agriculture, coastal forestry and so on. The present study has been focused to analyze the problem of pre and post tsunami conditions of river estuaries along the specific rivers, which are existence along the Nagapattinam coast using spatial information technology.

The Tsunami event of December 26, 2004 in the Indian Ocean that rocked the Sumatra Island in Indonesia had a profound impact on the south-eastern coast of India. In general, the state of Tamil Nadu in India suffered maximum damage in terms of life and property [1] the prevention of natural disasters is not feasible but the destruction it conveys could be minimized at least to some extent by the postulation of reliable hazard management system and consistent implementation of it. [2] In the Suffolk coast around Dunwich and Sizewell has experienced major

changes during the past 2000 years, with significant loss of land caused by marine erosion. Against a background of projected acceleration in sea level rise and storminess resulting from global climate change, concern has been expressed that present coastal defences may become unsustainable in the medium to longer term, and that the survival of internationally important wildlife habitats is under threat. This paper examines the past coastal evolution in the light of natural processes, and provides a discussion of future management options. [3] The effects of Medu (naturally elevated landmass very close to the seashore and elongated parallel to the coast) and coastal topography on the damage pattern during the deadliest Indian Ocean tsunami of December 26, 2004 is reported**.** [4] The Tamil Nadu margin, in particular the Nagapattinam–Cuddalore shelf was the worst affected by the tsunami surge and inundation caused by the great Sumatra earthquake of 26 December 2004 (*M*w 9.3). Surge heights in this part were of the order of 2 to 5 m, with inundation of the order of few hundred metres into the interior coast, thus causing huge loss of human life and property. Several reasons were attributed to the unusual surge in this part of the Tamil Nadu margin, the main reason being its relative proximity to the origin of the event, apart from the concave nature of the shelf with a gentle gradient. **(**5) the tsunami generated by the December 2004 Sumatra-Andaman earthquake had a devastating effect on some parts of Kerala coast, which is a coast located in southwest India. Results of post-tsunami field surveys carried out to understand the changes in coastal morphology and sediment characteristics in the worst affected Kayamkulam region of Kerala coast are documented.[6] Analysis of offshore bathymetric data indicates the shifting of depth contours towards shore, indicating erosion of sediments and deepening of inner shelf due to the tsunami. Depth measurement along the backwater (T-S canal) in the hinterland region indicates siltation due to the inundation of the canal. [7] Describes a methodology that relies upon digital processing of remotely sensed satellite images to detect coastline changes in Cukurova Deltas, south east Mediterranean coast of Turkey. Two winter images of Landsat MSS and ETM+, acquired in 1972 and 2002, were clustered into “water” and “non-water” classes using the ISODATA algorithm prior to pixel-based comparison of land and water areas in two dates. The results of the study showed that significant changes occurred especially around river mouths, in the form of accretion and erosion. More than half of the total erosion along the seacoast, 153 of 347 ha, was detected to have occurred at the mouth of river Seyhan. [8]The use of conventional survey methods to monitor large, gravel river beds has traditionally led to a reliance on repeat measurements of cross-sections which, unless very closely spaced, may give unreliable information about three-dimensional channel morphology and morphological change. Provided certain technological limitations can be overcome, remote survey techniques, such as digital photogrammetry and airborne laser scanning, remove the spatial and temporal constraints typically associated with ground-based surveys, allowing high spatial resolution, distributed, elevation mapping of gravel river beds. This paper develops the use of digital photogrammetry for the survey of a 3.3 km reach of the braided Waimakariri River, New Zealand, which, when combined with image analysis of water colour to infer water depth, provides a Digital Elevation Model (DEM) of the entire river bed.

The present study has the following objectives: To study the morphological changes along the five river estuaries during the December 2004 Tsunami impact, based on the IRS P6 LISS III digital data for the 5 river estuaries which confluences with the Bay of Bengal along the parts of Cuddalore and To assess the transformation of sand particles/load due to the impact of violent wave characteristics and to study the destruction of coastal economic activity in this region.

METHOD OF ANALYSIS

To assess the problem along the estuaries (5 rivers) Indian Remote Sensing Digital Data for the pre and post tsunami periods, dated 17-4-2004 (Pre-tsunami) and 19 March 2005 (Post tsunami) for Cuddalore coast and for Nagapattinam the digital data pertaining to the time period of 18-12-2004 (Pre-tsunami) and 6-1-2005 (Post-tsunami) have been obtained from the National Remote Sensing Agency, Hyderabad. The data covers 16 river estuaries and the digital data were cropped for in-depth analysis. The data were analyzed using ENVI 4.1 to find the morphological changes along the river mouth using the pre and post tsunami data. The analysis performed to find the change is the unsupervised classification method with GPS field checks to identify the samples. The results were categorized into major sand dunes, sea sand, vegetation, huts, settlements, major water bodies and so on. The processed data have been tabulated by calculating pixel-by-pixel method and derived the values of changing character of the region of interest.

NATURE OF EAST COAST

The Eastern Coastal Plain is a wide stretch of land lying between the Eastern Ghats and the Bay of Bengal. It stretches from Tamilnadu in the south to West Bengal in the north. Deltas of many of India’s rivers form a major portion of these plains. The Mahanadi, Godavari, Kaveri and Krishna rivers drain these plains. The region receives

both the Northeast and Southwest monsoon rains with its annual rainfall averaging between 1,000 mm and 3,000 mm. The width of the plains varies between 100 to 130 km. The plains are divided into six regions: The Mahanadi delta; the Southern Andra Pradesh plain; the Krishna Godavari dealtas; the Kanyakumari coast; Coromandel Coast and sandy littoral. East coast is the second largest coastal area in the World. The length of the coastal line is about 2700 km. The plains are divided into six regions: The Mahanadi delta; the Southern Andra Pradesh plain; the Krishna Godavari dealtas; the Kanyakumari coast; Coromandel Coast and sandy littoral. In the above explored East coast the area taken for study areas of Cuddolore district

TSUNAMI AND ESTURAIES

In the present study the 5 river estuaries (Figure1) have been selected to assess the impact of tsunami with particular reference to the pre an post tsunami impact and they are: Along the Cuddalore Coast: Gingee river and Vellar river, Uppanar river, Coleroon river and Uppanar river**.**

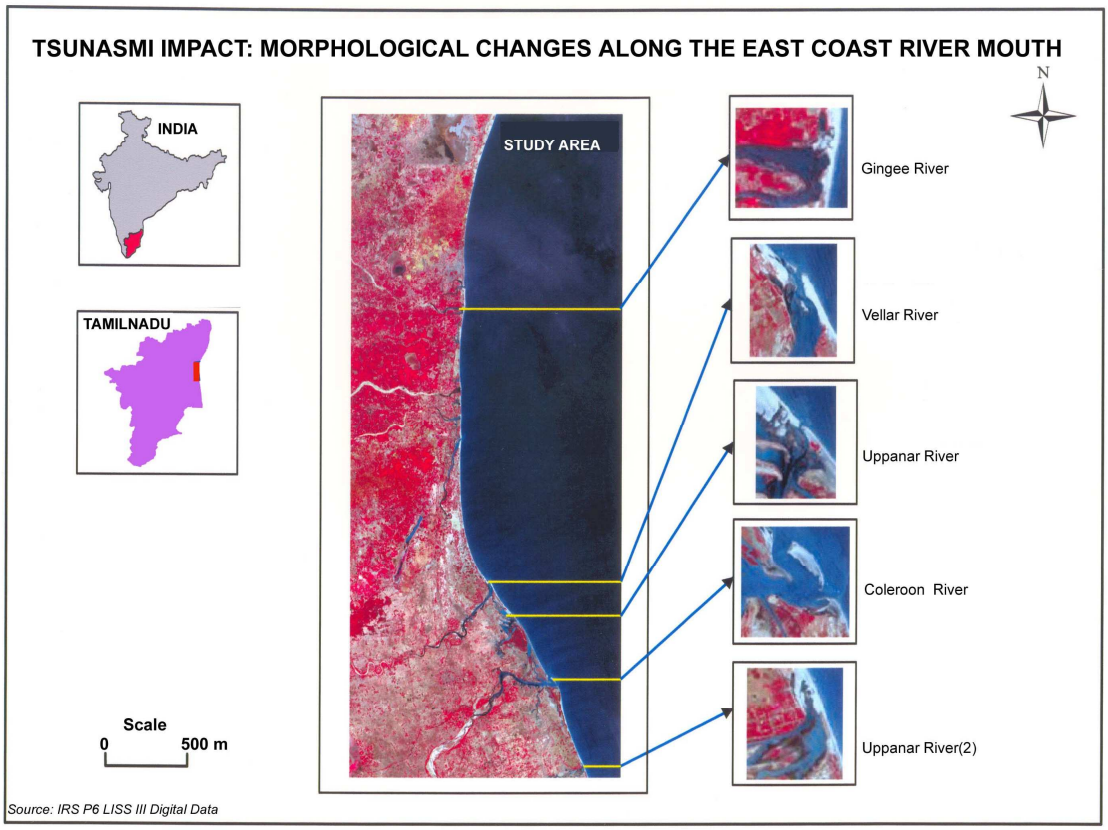

Fig - 1

Figure 2 has been digitally converted from the ENVI image analysis and the respective variable has been tabulated for analytical interpretation. Table 1 shows the impact of tsunami near the Gingee River mouth. There is four major classes were found in this part of the river and they are: sand dune, coastal sand, water bodies and palms. During the pre tsunami conditions the sand dunes are present 11.69 per cent of area has been increased to 12.22 which indicates that the sand particles along the river month have been forcefully

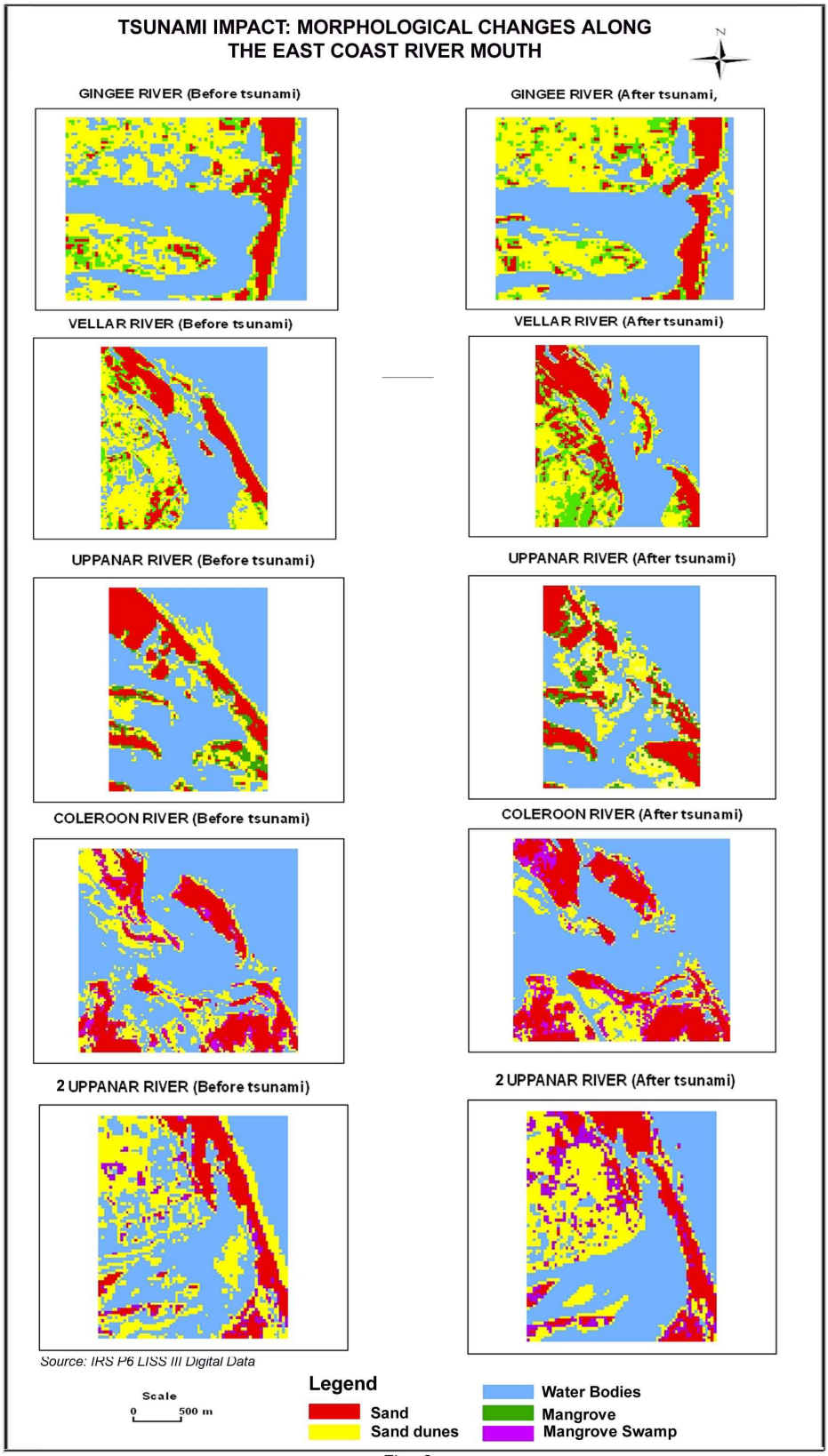
TSUNAMI IMPACT: MORPHOLOGICAL CHANGES ALONG THE EAST COAST RIVER MOUTH
N
GINGEE RIVER (Before tsunami)
GINGEE RIVER (After tsunami,
VELLAR RIVER (Before tsunami)
VELLAR RIVER (After tsunami)
UPPANAR RIVER (Before tsunami)
UPPANAR RIVER (After tsunami)
COLEROON RIVER (Before tsunami)
COLEROON RIVER (After tsunami)
2 UPPANAR RIVER (Before tsunami)
2 UPPANAR RIVER (After tsunami)
Source: IRS P6 LISS III Digital Data
Scale
0 500 m
Legend
Sand
Sand dunes
Water Bodies
Mangrove
Mangrove Swamp

Fig - 2

brought from off the coast. The coastal sand, which was present in the coast zone of 32.31per cent, has increased to 34.24 per cent. The water bodies had been reduced to 45.83 percent from 49.66 and it is a clear indication that the turbulent waves have dismantled the coastal landscape features. The destructed palm trees were scatted in this region.

Table 1 Tsunami Impact on Gingee River

GINGEE RIVER						
S.No.	ROI	Before (Area)		After (Area)		Change (Area)
		(in sq.mts)	in (%)	(in sq.mts)	in (%)	(in sq.mts)
1	Sand dune	366694	11.69	383262	12.22	-16568
2	Coastal sand	1013379	32.31	1074126	34.24	-60748
3	Water bodies	1557897	49.66	1437506	45.83	120391
4	Destructed palms	198810	6.34	241886	7.71	-43076

Source: IRS P6 LISS III ENVI Image Analysis Result.

Table 2 Tsunami Impact on Vellar River

VELLAR RIVER						
S.No.	ROI	Before (Area)		After (Area)		Change (Area)
		(in sq.mts)	in (%)	(in sq.mts)	in (%)	(in sq.mts)
1	Sand dune	768180	15.33	982453	19.61	-214273
2	Coastal sand	1360192	27.15	1011722	20.19	348470
3	Water bodies	2552500	50.95	2412780	48.16	139719
4	Destructed palms	329141	6.56	603057	12.03	-273916

Source: IRS P6 LISS III ENVI Image Analysis Result.

The table 2 clearly indicates the Vellar River confluences near the Cuddalore coast and the destruct ional activities are more when compared with the Gingee River. The table also shows the migration of sand dunes and coastal sand to violent waves are higher in percentage. Destructed water bodies are little and the destruction palms in this region are very high.

The following table-3 displays the pre and post tsunami conditions of the Uppanar River in the Cuddalore coast. It shows that migration of sand particles from the river mouth to the interior of the coastal landscape in less and the destruct ional water bodies have increased considerably.

Table 3 Tsunami Impact on Uppanar River-1

UPPANAR RIVER-1						
S.No.	ROI	Before (Area)		After (Area)		Change (Area)
		(in sq.mts)	in (%)	(in sq.mts)	in (%)	(in sq.mts)
1	Sand dune	582624	18.52	569922	18.11	12702
2	Coastal sand	504757	16.05	620177	19.71	-115420
3	Water bodies	1883173	59.86	1750633	55.66	132540
4	Mangrove	175063	5.57	204885	6.52	-29822

Source: IRS P6 LISS III ENVI Image Analysis Result.

Table 4 is derived from the digital image analysis and implies that along the river mouth the sand particles have been removed at higher percentages with a little change in the water bodies. Mangrove swampy area has been affected little and they were considered to be an added feature along with other destruct ional features.

Table 4 Tsunami Impact on Coleroon River

COLEROON RIVER						
S.No.	ROI	Before (Area)		After (Area)		Change (Area)
		(in sq.mts)	in (%)	(in sq.mts)	in (%)	(in sq.mts)
1	Sand dune	1055902	16.86	1321534	21.09	-265632
2	Coastal sand	1105052	17.64	922258	14.73	182795
3	Water bodies	3738733	59.69	3566983	56.95	171750
4	Mangrove swamp	363933	5.81	452845	7.23	-88912

Source: IRS P6 LISS III ENVI Image Analysis Result.

Table-5 shows the details about the impact of tsunami near the river mouth of Uppanar River(2) which is in the Cuddalore coast zone. The migration of sand particles from the river mouth has considerable percentage and the presences of water bodies are high. This area consisting of more settlement particularly the coastal huts were highly damaged near the river estuary due to its high presence.

Table 5 Tsunami Impact on Uppanar River(2)

UPPANAR RIVER-2						
S.No.	**ROI**	**Before (Area)**		**After (Area)**		**Changes(Area)**
		(in sq.mts)	**in (%)**	**(in sq.mts)**	**in (%)**	**(in sq.mts)**
1	Sand dune	400381	13.13	435173	14.27	-34792
2	Coastal sand	948213	31.11	859301	28.19	88912
3	Water bodies	1539673	50.51	1437507	47.16	102166
4	Settlement	160153	5.25	316439	10.38	-156287

Source: IRS P6 LISS III ENVI Image Analysis Result.

CONCLUSION

This sample study selecting 5 river convergence zone of land and sea implies that the greater quantities of sand particles were transported and shattered on the lee ward side as and when the velocity decreases. Due to this reason, the river mouth has widened and this allows sea water to enter the coastal interior zone wherein several economic activity like the aquaculture farms, coastal agriculture and coastal forestry. The satellite data processed indicates and justifies empirically. The planners in this part of coastal region should keep in mind about this problem before rejuvenating the economic activity plans.

REFERENCES

[1].N. Chandrasekar, S. Saravanan, J. Loveson Immanuel, M. Rajamanickam, G. V. Rajamanickam **(2006)** The *International Journal of The Tsunami Society* Volume 24 Number 1
[2] Pye, Kenneth; Blott, Simon J.**(2006)** *Journal of Coastal Research*;May2006, Vol. 22 Issue 3, p453
[3] J. P. Narayan, M. L. Sharma and B. K. Maheshwari **(2005)** *The International Journal of The Tsunami Society* Volume 23 Number 2
[4].K.S.R. Murthy, A.S. Subrahmanyam, G.P.S. Murty, K.V.L.N.S. Sarma, V. Subrahmanyam, K.M. Rao, P.S. Rani, A. Anuradha, B. Adilakshmi, T.S. Devi **(2004)** *Current Science*, Vol. 90(11),1535-1538
[5] N.P.Kurian, T.N.Prakash, M.Baba and N.Nirupama,**(2006)** *Marine Geodesy*, 29: 135-145..
[6] Santhiya.G, Lakshumanan.C, Muthukumar.S **(2010)** *International journal of Geomatics and geosciences* Volume 1, No 3, 2010
[7] Hakan Alphan **(2005)** *Int. J. Environment and Pollution* 01/2005; 23.
[8] Richard M. Westaway, Stuart N. Lane, and D. Murray Hicks **(2001)***Photogrammetric Engineering & Remote* Sensing Vol. 67, No. 11, November 2001, pp. 1271-1281.