Open access Journal **International Journal of Emerging Trends in Science and Technology**
IC Value: 76.89 (Index Copernicus) Impact Factor: 4.219 **DOI:** https://dx.doi.org/10.18535/ijetst/v4i8.11

Regional Seismic and Tsunami Susceptibility Assessment of Chennai-Nagapattinam Coast of Tamilnadu and Pondicherry

Authors
Srinivasan.R[1], Jayagopal. R[2]
[1]Research scholar (Part Time), Dept. of Geology, Presidency College, Chennai- 600005.
[2] Formerly, Associate professor, Dept. of Geology, Presidency College, Chennai- 600005

Abstract
Coastal areas in general and Tamilnadu Coast in particular is experiencing rapid urbanization and put to variety of uses. The threat of natural disaster for the shore based activities is ever increasing and the susceptibility status of earthquake and Tsunami with respect to coastal tectonics for the Chennai-Nagapattinam coast of Tamil Nadu and Pondicherry is analysed regionally in this study. The study revealed the requirement of on shore and offshore beach ridges mapping, dating and understanding its emergence in combination with paleo seismicity. Further it is emphasised that the historical and paleo tsunami deposits identification and using this data for the future prognosis is vital for managing the future Tsunami disasters. Based on the available geological and tectonic information it can be inferred that even though the offshore areas adjoining the Tamilnadu coast appears to be low to moderately susceptible for earthquake and tsunami generation, understanding the neotectonism and detailed research in the gap areas for the studied coastal sector have been highlighted in this study.
Keywords- Subduction zone, Tsunami deposits, Seismicity, Active faults, Coastal tectonics, Susceptibil

Introduction

The Chennai-Nagapattinam coast of Tamil Nadu and Pondicherry is facing the fast growth of infrastructural, residential, industrial, Power projects and tourism development in the last three decades and with laying of east coast highway, these got accelerated. The reach from Pulicat Lake to Cuddalore is dotted with thermal, nuclear power plant, commercial and residential activities. Moreover this coastal belt is characterized by thick population of coastal villages, fishermen colonies, religious centres and archaeological monuments. In addition many new projects and developments are being proposed along the Tamil Nadu coast.

Tamil Nadu coast faces the onslaught of natural disasters such as Cyclone, storm surges, flooding, Tsunami and earthquakes every now and then. The Bay Of Bengal Sea is cyclone prone compared to Arabian Sea and severe to very severe cyclones are

formed during the October to January month and threaten the entire east coast. Storm surges during rainy season increases the coastal erosion and flooding by the ferocity of ocean waves. For so many centuries Nagapattinam and Cuddalore areas are frequently affected by the cyclones. Interestingly the very same areas have been affected by the Dec- 2004 Tsunami. Along the coast, the natural barriers or the line of defence against the attack of natural forces are the dunal sand ridges and Mangrove swamps. But these are getting degraded due to the above mentioned anthropogenic activities.

The Tamil Nadu and Pondicherry coast feebly to moderately feels whenever an earthquake strikes the Andaman or Indonesia or Sumatra (South East Asian region) depending on the magnitude of the earthquake.

Past surveys after these earthquake events indicated the felt intensity of 3 to 5 in the coastal areas and the people in the 4th floor and above of the multi-story buildings have felt it. Peninsular India has long been considered a seismically stable shield area with the potential of generating only low level seismicity at isolated places. As per seismic zonation map of India 2001, the Chennai and surrounding area occurs in Zone 3 and rest of the coastal area occurs in Zone 2. South Indian shield hither to stable has become area of slight seismicity. Seismicity data shows that northern part of Tamilnadu has higher seismicity than the southern part**.** Recent earth quakes in coastal areas of Tamilnadu has created interest in coastal seismicity in relation to morphology and tectonics associated with coastal and near shore region of continental shelf.

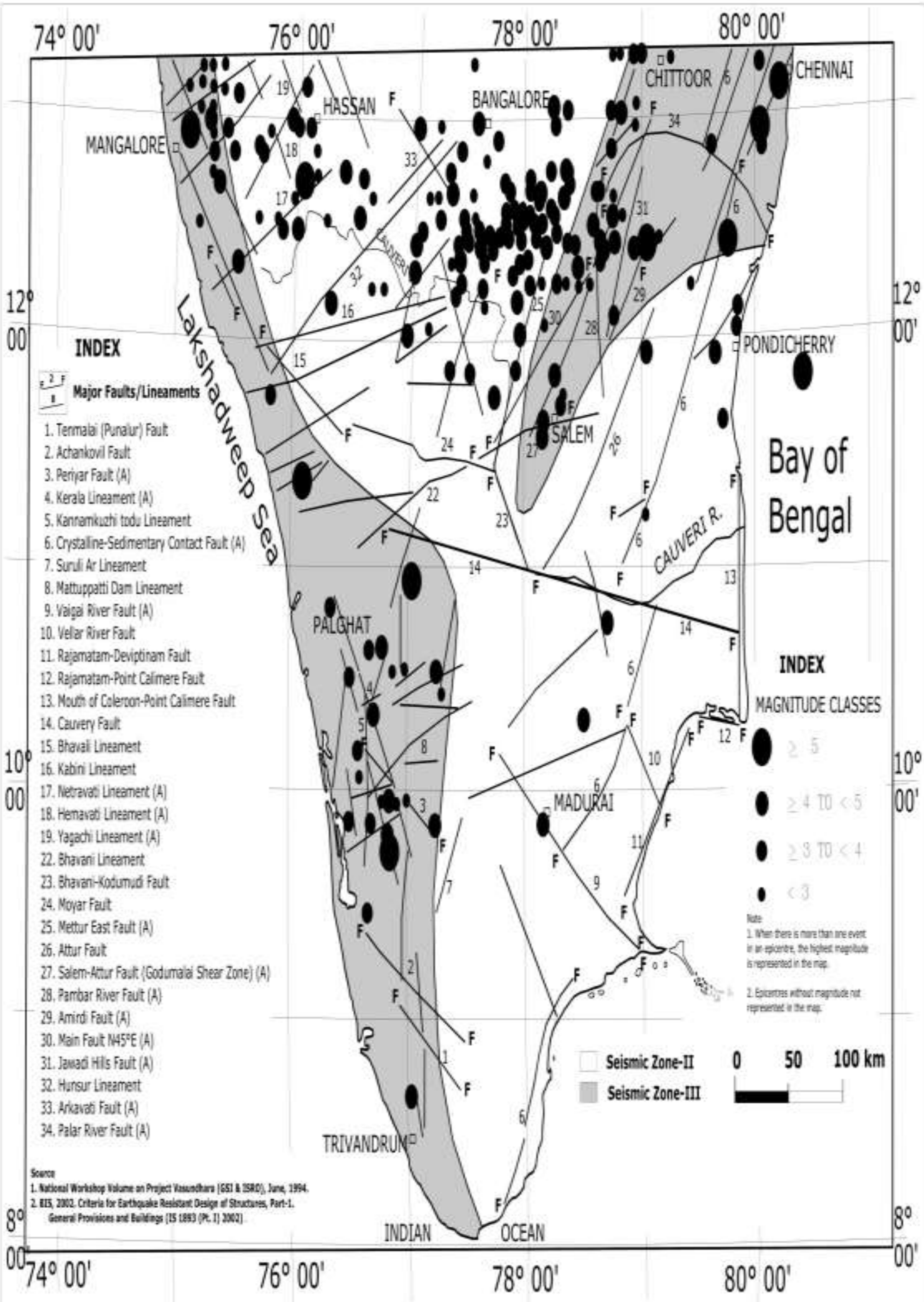
In the above scenario considering the critical urbanization of coastal sector a regional seismic and tsunami susceptibility assessment for Chennai-Nagapattinam coast of Tamil Nadu and Pondicherry is attempted in this study.

2.0 Earthquake Susceptibility of Chennai-Nagapattinam Coastal Sector

2.1 Faults of coastal and offshore areas

The Tamilnadu has number of faults and lineaments traversing in different directions. The prominent directions are NNE-SSW to NE-SW, ENE-WSW to E-W. The prominent faults and shear zones of Tamilnadu being, Palaghat-Cauvery shear zone, Moyar-Bhavani-Athur fault, Pambar fault, Achankovil shear zone, Suriliyar fault, Mettur east fault, Kottapatti fault, Crystalline Sedimentary fault, besides many smaller faults and lineaments. Most of them are Archean and Proterozoic faults. These tectonic features of Tamil Nadu have been reactivated during later period and particularly during the Quaternary period, manifested by historical and recent seismicity and expression on the geological formations at the surface.

The coastal zone of Tamil Nadu and Pondicherry is with series of block faulting with the formation of pericratonic basins where the Mesozoic and Cenozoic sediments have been deposited. Structurally the basin is of horst–graben type which includes several depressions separated by subsurface basement ridges trending in NE–SW direction such as Ariyalur–Pondicherry graben, Madanam ridge, Tranquebar graben, Karaikal ridge, Nagapattinam graben etc (Sastri et al 1981).In addition to above basement faults, the E-W trending Palar, Cauvery and Vellar lineaments, the NNE-SSW trending lineament near the Usteri tank, west of Pondicherry, and NE-SW trending crystalline-sedimentary fault are the major crustal weak zones in the coastal area between Chennai and Nagapattinam. The north south trending Tirumullaivasal –Kodikarai fault is seen as straight coast with adjoining wider continental shelf (Gopalakrishnan 1996). Moreover number of lineaments are seen in the satellite Imageries transecting the coastal belt, but not all can be confirmed on the ground. The regional map (Project Vasundhara 1994) depicting the major faults and lineaments of Tamilnadu and adjoining Kerala is shown in the following Plate 1.


74° 00'
76° 00'
78° 00'
80° 00'
12° 00'
10° 00'
8° 00'
MANGALORE
HASSAN
BANGALORE
CHITTOOR
CHENNAI
PONDICHERRY
SALEM
PALGHAT
MADURAI
TRIVANDRUM
Lakshadweep Sea
Bay of Bengal
CAUVERI R.
INDIAN
OCEAN
INDEX
Major Faults/Lineaments
1. Tenmalai (Punalur) Fault
2. Achankovil Fault
3. Periyar Fault (A)
4. Kerala Lineament (A)
5. Kannamkuzhi todu Lineament
6. Crystalline-Sedimentary Contact Fault (A)
7. Suruli Ar Lineament
8. Mattuppatti Dam Lineament
9. Vaigai River Fault (A)
10. Vellar River Fault
11. Rajamatam-Deviptinam Fault
12. Rajamatam-Point Calimere Fault
13. Mouth of Coleroon-Point Calimere Fault
14. Cauvery Fault
15. Bhavali Lineament
16. Kabini Lineament
17. Netravati Lineament (A)
18. Hemavati Lineament (A)
19. Yagachi Lineament (A)
22. Bhavani Lineament
23. Bhavani-Kodumudi Fault
24. Moyar Fault
25. Mettur East Fault (A)
26. Attur Fault
27. Salem-Attur Fault (Godumalai Shear Zone) (A)
28. Pambar River Fault (A)
29. Amirdi Fault (A)
30. Main Fault N45°E (A)
31. Jawadi Hills Fault (A)
32. Hunsur Lineament
33. Arkavati Fault (A)
34. Palar River Fault (A)
Source
1. National Workshop Volume on Project Vasundhara (GSI & ISRO), June, 1994.
2. BIS, 2002. Criteria for Earthquake Resistant Design of Structures, Part-1. General Provisions and Buildings (IS 1893 (Pt. I) 2002)
INDEX
MAGNITUDE CLASSES
≥ 5
≥ 4 TO < 5
≥ 3 TO < 4
< 3
Note
1. When there is more than one event in an epicentre, the highest magnitude is represented in the map.
2. Epicentres without magnitude not represented in the map.
Seismic Zone-II
Seismic Zone-III
0 50 100 km

2.2 Seismicity of Chennai Nagapattinam coastal area and its correlation with crustal weak zones

Project Vasundhara of GSI (1994), Gopalakrishnan (1996), Ganapathy & Rajarathinam (2010) have Correlated the recent seismicity data with lineaments and faults of Tamilnadu. The seismicity of peninsula India by Gangrade and Arora (2000) shows that in Tamilnadu most of the earthquakes have occurred between latitude 11.5 to latitude 13.00 (northern part of Tamilnadu) and they are broadly concentrated in two clusters, one around North

western part of Tamilnadu around Tirupattur-Vaniambadi-Krishnagiri areas (South of Bangalore) and the other around Pondicherry as two discrete seismo tectonic domains. Most of the seismic incidences so far occurred are of the magnitude < 5.0 and are mostly between 2.5 to 4.0. Only 12 events (on and off shore) are of greater than or equal to magnitude 5. Out of which three are closer to Chennai and one to Pondicherry (Ganapathy & Rajarathinam 2010).The following are the major events of earthquake around Chennai and Pondicherry in the recent periods.

Sl.No	Year/Month/Date	Latitude	Longitude	Magnitude	Name of Location/District
1	1807.12.10	13. 10.00	80.30.00	5.0	Chennai (off the coast)
2	1816.09.16	13. 10.00	80.30.00	5.0	Chennai (off the coast)
3	1823.03.02	13. 00.00	80.00.00	5.3	Sriperumpudur,
4	2001.09.25.	11. 00.00	86.00.80	5.6	40 km east of Pondicherry (Off the Coast)

The Cauvery basin sediments bounded by faults show different thickness of sediments in the different depressions and also the ridge portion indicate that there have been differential movements or reactivation of the boundary fault systems of these depressions and ridges during the Cretaceous and Tertiary periods. Such reactivation has given rise to the subsidence of the basin giving rise to thick sediments in the Ariyalur Pondicherry depression. The epicentres of recent earthquakes were also located in the north eastern part of this depression and they reveal that there is still reactivation on a minor scale, of the basin boundary faults. Within the Ariyalur Pondicherry depression also there are epicentres of earthquakes, which possibly relate to the basement faults within the depression.

It is also inferred that the major inland faults such as Athur lineament and Palaghat Cauvery shear zone extend in to offshore areas. This trend coincides with and appears to be a continuation of geophysical linears mapped off Pondicherry coast (Murthy etal 2002). Total field magnetic anomaly map and gravity anomaly also shows major discontinuities off Pondicherry (40 km off Pondy) and it coincides with epicenters of Earthquake of Mag 5.5 occurred on 25 Sep 2001.This geophysical linear is seen to be an offshore extension and reactivation of E-W trending Attur fault (Murthy etal 2002).

It has also been inferred from our studies that based on low flat coast without beach ridges and nearly thousand years old archeological and historical evidences of Poomuhar area the straight Nagappattinam - Tirumullaivasal coast, possibly up to Porto Nova, is sinking and the fulcrum is located south of

Nagappattinam. The sinking proceeds from south to north and the rate is probably not uniform (Krishnan & Srinivasan 1994). Even though no recent seismic activity has occurred along this fault, the neotectonic activity of crustal subsidence and sea level increase is distinctly demonstrated.

2.3 Status of Coastal tectonic/active fault study in the coastal region

Along the Tamilnadu coast,on active fault and paleo seismic studies not much work appears to have been carried out probably due to the lack of prominent expression of tectonism in Quaternary sediments in the form of displaced or disturbed morphological disposition. Moreover as precise evidence of past earth quake activity, presense of seismites, sand dykes etc at the subsurface could not be commonly noticed along the coast. However in the southern Tamilnadu coast of Gulf of Mannar, the evidences of sea level variation by the neo tectonic activities such as wave cut terraces and platforms, occurrence of raised beaches with shell bed are prominently seen.

In the Chennai Nagapattinam coast, other than the presence of various levels of strand lines or beach/dunal ridges it is difficult to get the evidences of any active coastal tectonism and paleo seismic activity. The relative age for strand lines is commonly estimated by color variations of sand from grey to yellow and to red (increasing towards the older dunes). Hence the precise reconstruction of Holocene and Pleistocene tectonics in the study area seems to be difficult.

3.0 December 2004 Indonesian Earthquake And Tsunami

In general tsunamis are generated by earthquakes, less commonly generated by sub aerial to submarine landslides, more frequently by volcanic eruptions and very rarely by meteorite impacts. By far, the most destructive tsunamis are generated from large high magnitude, shallow earthquakes perhaps in the upper 50 kilometers with an epicenter or fault line on the ocean floor. These usually occur in regions characterized by tectonic subduction along plate boundaries. During the earthquake the sudden vertical displacements over large areas disturb the ocean's surface, displace water, and generate destructive tsunami waves. The waves can travel great distances from the source region, spreading destruction along their path. Thus most tsunamis are generated by shallow, big earthquakes at subduction zones. More than 80% of the world's tsunamis occur in the Pacific along its Ring of Fire subduction zones.

A devastating earthquake of magnitude (Mw) 9.0 occurred on December 26, 2004 with a focal depth of about 30 km, off coast of Northern Sumatra. This great event was caused by thrust movement on the interface of the Indian plate and Burma plates (sub ducting Indian lithosphere and overriding Burma plate) at Sunda trench. More than 200 aftershocks of magnitude greater than 5 have occurred in the Andaman and Nicobar Islands and Sumatra. The devastating tsunami that followed was a direct consequence of the earthquake caused by large movement of the seafloor, displacing a huge volume of water and generating the tsunami wave. The vertical uplift could have been as much as several meters. It was one of the deadliest natural disasters in recorded history. Indonesia was the hardest-hit country, followed by Sri Lanka, India, and Thailand.

3.1 Impact of tsunami along the Chennai Nagapattinam coast of Tamilnadu and Pondicherry

The Impact of Tsunami which resulted in large scale damage and deaths in the Chennai–Nagapattinam coast as studied by Srinivasan and Nagarajan (2007) is described below sector wise

In the Pulicat- Palar River Sector Tsunami induced breaches in the beach ridges and inundation of inter dune and tidal flat area is prominent in the coastal zone. Breaches, 3m to 15m wide, are common between Nemeli and Mahabalipuram (Fig 1). The partially opened mouths of Kosathalaiyar and Coovam Rivers, Pulicat lagoon, Ennore and Kalpakkam creeks (Fig 2) have been forcefully opened further by the tsunami wave that has flushed out some of the stagnated urban waste. The 1.5 km long Palar river mouth has been opened (Fig 3) at number of places (for widths ranging from 200 to 300 m) and sea water has ingressed up to 1.75 km inland. The big channel bar deposits (tidal islands) have been dissected and eroded. In the Pulicat, Ennore and Adyar creek / lagoon, water level has increased nearly 1 to 2 m above the normal level and flooded the adjacent areas. In addition, the estuaries and lagoons have also been silted due to the deposition of significant amount of littoral sediment.

In the Palar River- Pondicherry sector, alteration in the beach zone, concentration of beach placers in the high tide line and levelling of inter dune areas are prominent in the coastal zone. The concentration of heavies is marked in Eggiyarkuppam (Fig 4). The partially opened mouths of Cheyyar, Yedanthittu Kaliveli and Kaliveli lagoons have been wide opened by the tsunami waves. Water level in the lagoons has risen by 1m to 1.5 m above normal during tsunami inundating the adjacent agricultural lands. Tsunami deposits in the form of silt and sand sheets are observed in Kaliveli channel as well as in parts of lagoons which chocked the aqua system for the already deformed / dwarfed mangrove plants. This has also affected the internal navigation.

In the Pondicherry-Cuddalore Sector, (Plate 2**)** the impact of the earthquake has been manifested in the form of strong seismic seicshe reported in a number of water tanks located in the coastal area. The impact of tsunami has been moderate to severe in this sector. Minor alteration in the beach zone and flattening of dune ridges and inter-dune flat area are observed in the coastal zone. The prograding beach at Virampattinam has been levelled. The partially opened mouths of Gingee, Ponnaiyar, Gadilam Rivers and Ariyankuppam Ar (Fig 5) - a prominent creek- were further wide opened. There was a marked increase in water level in these water bodies and the seawater reached much more inland than normal. Stray boats have been pushed in the estuaries as far as 2.5 Km from the sea. The creeks and estuaries are visibly silted, affecting the navigation.

In the Cuddalore – Nagapattinam sector (Plate 3) located in the tail end of Cauvery delta has been worst affected. Concentration of beach placers and breaching of barrier dunes are prominently observed in the coastal zone. Black sand, 3 to 10 cm thick, occurs as thin layer over the normal greyish brown sand. The leeward elongation created by minor impediments preserved in the sandy flat beyond the high tide level in the near flat Karaikal beach indicate a SSW propagation direction of the water front on the land. Villages situated close to the shore have invariably been affected. The impact was particularly more at Tirumullaivasal, Tarangambadi, Pattanacheri (Nagore), Kichchankuppam and Akkaraipettai due to their vulnerable geomorphic locations (low sandy flat area without any natural or artificial barrier and close to river mouths) and high population density.

Fig.1: A major breach in the frontal beach ridge. Loc: Nemili, North of Mahapalipuram

Fig.2: Creek mouth opening. Loc: Kalpakkam

Fig.3: Silting of the estuary, Loc: Palar River

Fig.4: Heavy minerals concentrated near the High tide line Loc: Eggiyarkuppam

Fig.5 : Siltation in the Ariyankuppam Ar creek posing problems for navigation. Loc: Pondicherry

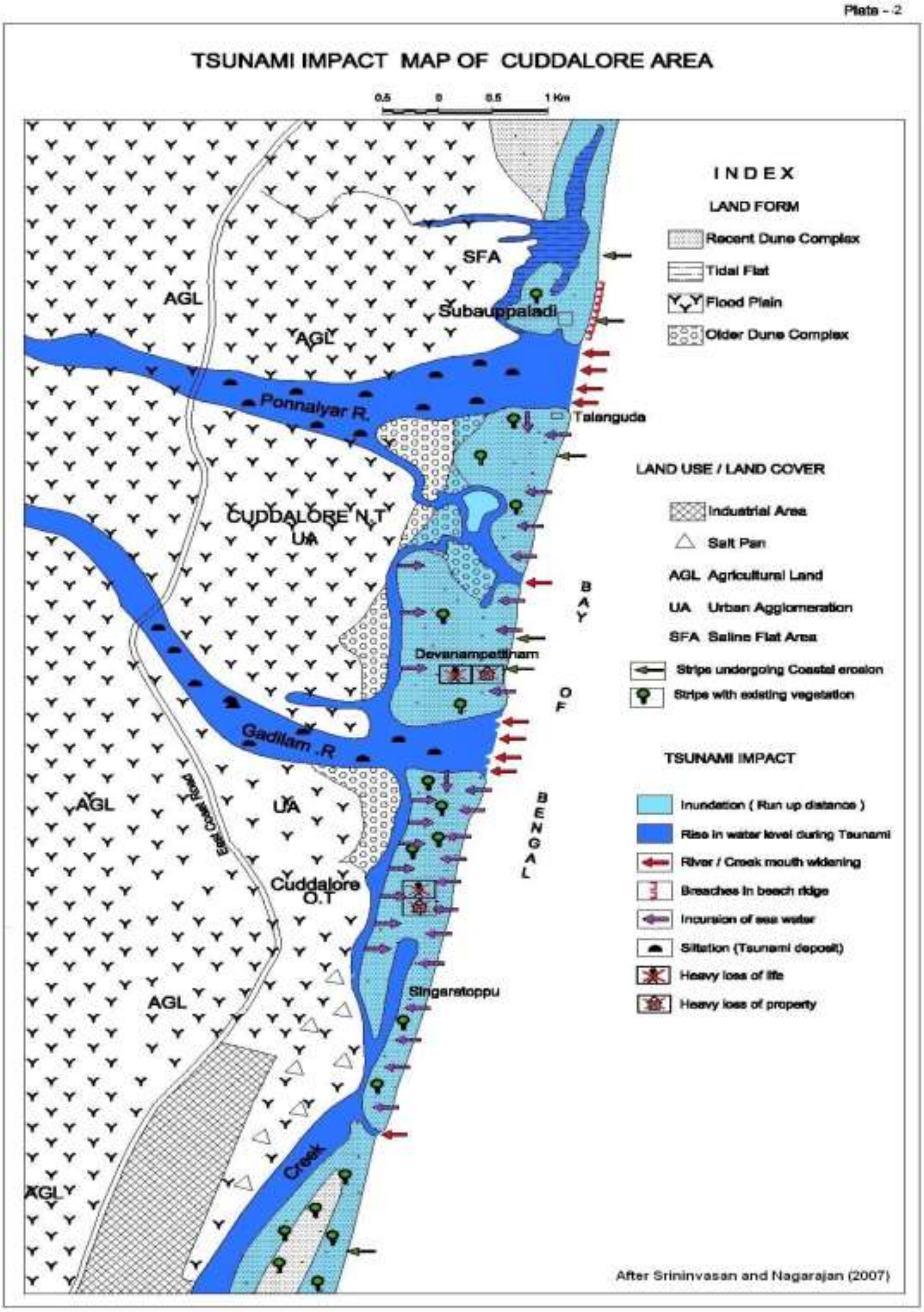
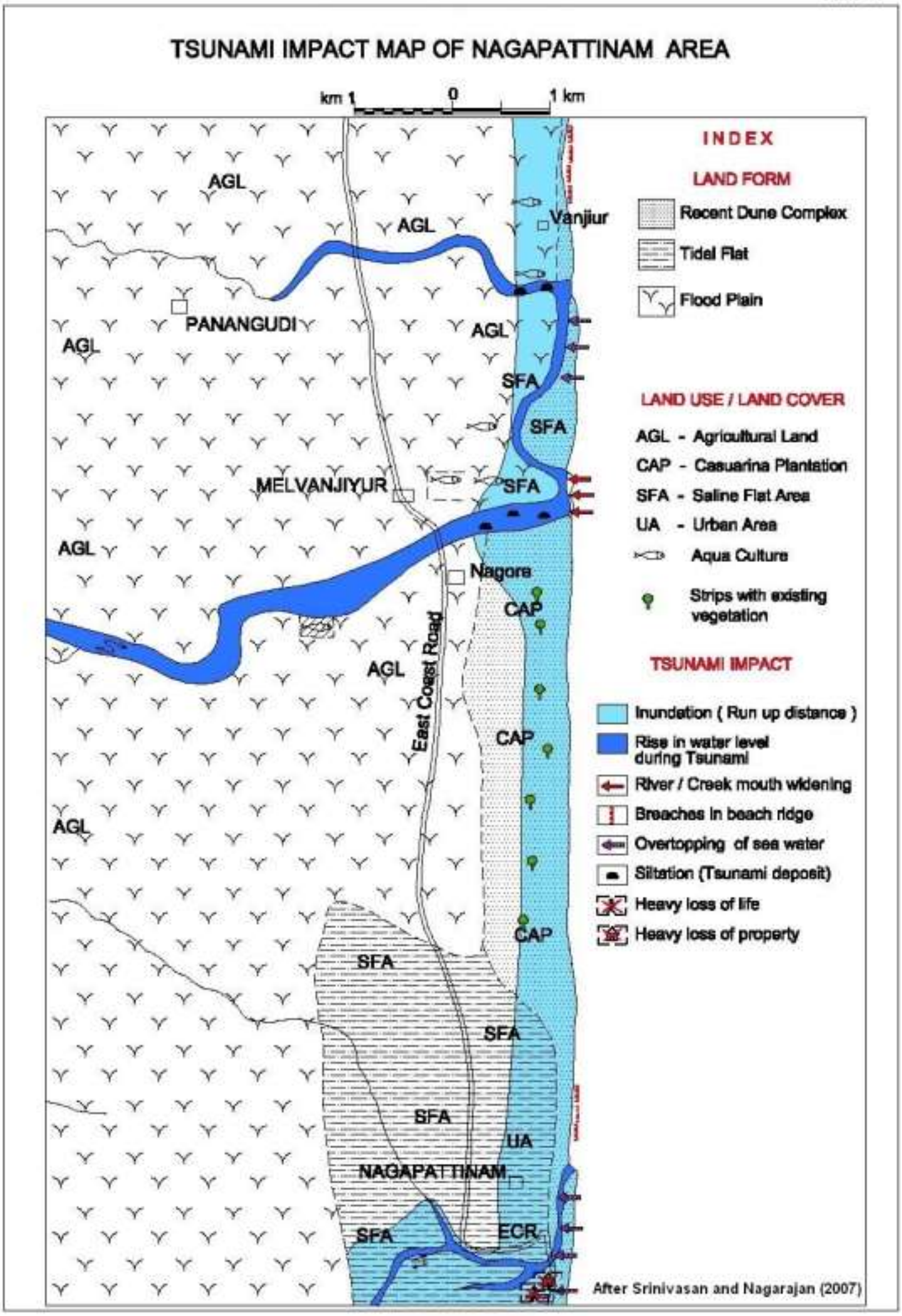


Plate - 2
TSUNAMI IMPACT MAP OF CUDDALORE AREA
0.5
0
0.5
1 Km
INDEX
LAND FORM
Recent Dune Complex
Tidal Flat
Flood Plain
Older Dune Complex
LAND USE / LAND COVER
Industrial Area
Salt Pan
AGL Agricultural Land
UA Urban Agglomeration
SFA Saline Flat Area
Strips undergoing Coastal erosion
Stripe with existing vegetation
TSUNAMI IMPACT
Inundation (Run up distance)
Rise in water level during Tsunami
River / Creek mouth widening
Breaches in beach ridge
Incursion of sea water
Siltation (Tsunami deposit)
Heavy loss of life
Heavy loss of property
SFA
AGL
Subauppaladi
Ponnaiyar R.
Talanguda
CUDDALORE N.T
UA
BAY
OF
BENGAL
Devanampattinam
Gadilam .R
UA
Cuddalore O.T
Singaratoppu
Creek
After Srininvasan and Nagarajan (2007)

Plate - 3



3.2 Interpretations and inferences from the 2004 tsunami data of the Tamilnadu coast:

In general, on reaching the shallow water the speed of the tsunami wave reduces and the energy in the wave remains same thus increasing the wave height. The final impact depends on the on shore geomorphic features and near shore coastal transformation of tsunami waves such as refraction, diffraction, reflection and energy concentration due to reduced crest with in the bay processes at a given location (Samantha Hettiarachchi, Saman Samara Wickrama 2006). The coastal transformation process of tsunami waves depends on bathymetry, geomorphology, shape of the coast line. Hence some areas are more vulnerable. Coastal bays caused funneling of tsunami waves and increase the wave heights.

To cite an example, the Srilankan island has a narrow width of continental shelf, and has eight canyons in continental slope. During the tsunami, the shallow bathymetry of narrow continental shelf increased the height and dissipated the energy close to coast. The increased wave height increased the severity of the damage (Samantha Hettiarachchi, Saman Samara Wickrama 2006). In the Cuddalore-Nagapattinam segment of the coast, the area around Cuddalore town and Nagapattinam town was most susceptible in view of the geomorphological, tectonic and offshore continental shelf configuration. The broad bay in the coast line south of Cuddalore with continental shelf being narrow, making the incoming wave to have more height. Moreover crowded dwelling with encircling creek systems make the area vulnerable. The Poompuhar-Karaikal-Nagapattinam area is a low flat tract without protective dune ridges and also densely populated. The continental shelf areas are shallower and broader making the wave to invade longer area in to the land.

It is inferred from the available data that the Bay Bengal seafloor adjoining the Tamilnadu coast is tectonically not appears to be conducive to generate a tsunami. The nearest subduction zone and plate margin exists in the Andaman and Nicobal island which is part of the trench and island arc system. The Indo Burmese range and the Andaman arc form the outer arc ridge of the arc trench system developed during tertiary age in consequence of subduction of the Indian plate below the Burma-Sumatra segment (Sujit Das Gupta 2007). However, high magnitude earthquakes occur infrequently in this sector. Recent and historical tsunamis along the coast are typically generated from inter plate earthquakes with rupture length of 100-200 km. Such earthquakes at the interval of about 100 years, usually with independent rupture zones, have been regarded as characteristics of the some of the subduction zones such as southern Kuril (Yuki sawai etal 2006). It is also interesting to note that after the major earthquake of 26 Dec. 2004, there were ten aftershocks with more than magnitude 6 on the richter scale , the highest being 7 did not generate any tsunami. Moreover there was a massive earthquake on 28 March 2005 measuring 8.5 magnitude did not generate tsunami. Usually the strike slip motion free of vertical displacement is not appears to a great threat.

In view of the rare geological preconditions required to generate a seismogenic tsunami, it is inferred that, with in the upcoming decades, in the neighbouring coastal area of Tamilnadu, onslaught by severe tsunami appears or likely to be less. Even if a tsunami occurs in Andaman region it will take two to three hours to reach east coast of India and this time gap can be used to warn and save the lives. A warning system to sense the wave height and network of seismometers to receive the seismic signal resulting in its determination of epicenter will make Government authorities to alert and fore warn the people and to evacuate the habitants. The tsunami warning system is being implemented by the INCOIS, India. However it is highly essential that the local populations has to stay in higher place in the coastal areas of Tamilnadu particularly in the Cuddalore-Nagapattinam sector above the run up elevation level of past tsunami.

4.0 Discussion and Conclusion

The tsunamis erode and deposit sediments and this forms the past record of tsunami invasion. The characteristics of the deposits can be used to generate the inundation model for a particular area as subsurface older deposit core samples indicate that there were events in the recent past. These events happen on an average of every 500 years, with recurrence intervals ranging from about 100 to about 1000 years (Smithsonian Magazine 2005).

However in many areas it may be difficult to distinguish paleo tsunami deposits from deposits of old storm surges. With respect to sedimentary characteristics, the 1929 "Grand banks" tsunami deposits of Northern America are composed of many massive to fining-upward, very coarse - to fine-grained sand, whereas the 1991 storm wash over deposits of Halloween storm consist of inter bedded and laminated coarse, medium and fine-grained sand, exhibiting delta fore set stratification and sub-horizontal, planar stratification with channels (TuttleM.P.etal 2004). Regarding landscape position, the tsunami deposits occur up to well inland (about 300 to 400m), including landward of tidal ponds, and up to 5- 6 m above mean sea level, as well as 3 m above the tops of the barrier-beach bars and related dunes, whereas the storm wash over deposits occur limited distance (50 to 75m) inland, immediately landward of barrier-beach bars and in adjacent tidal ponds, and up to 1 -2 m above mean sea level but no higher than the elevation of the barrier-beach bars (Tuttle M.P. etal 2004).

Similar exercise and research has to be carried out along the Tamilnadu coast to identify and map the historical and Paleo tsunami deposits by trenching/pitting and coring particularly in the low flat coast , bay areas and close to the tidal creeks If paleo tsunami deposits can be identified with confidence, they will contribute to the assessment of tsunami and seismic hazards along the coast. The dating of sand sheets and associated peat or plant fossils /remains to get the age ranges of paleo tsunami will be helpful in deciphering the reconstruction of the event. From the paleo tsunami inundation levels and extents, evacuation maps for that area marking the appropriate evacuation routes can to be prepared. The evacuation shelters can also be planned with deep-pile foundations, to make them seismically stable.

Moreover study of neotectonics and past sea levels derived from the geologic record comprise a composite datum for measuring long-term crustal movement. Elevated shorelines or strandlines are traces of former coastlines that have become emerged because of some combination of eustatic and crustal processes (Kenneth R.Lajoie 1986). The nature of the former shoreline may be in the form of a rock platform (wave cut or eroded by sea), sea caves, raised beaches, lagoon deposits, organic reefs, and/or related features. Hence large scale mapping and determining the ages of beach ridges located at different levels and prominently present in many segments of the coast of study area such as, wider multiple dunes at south of Cuddalore, higher dunes south of Marakkanam, the older red colored low sand mounds of Semmenancheri of Sholinganallur (south of Chennai) etc. is needed .

In all the countries, seismic hazard assessment requires three main steps: the first one consists in the seismic sources definition, i.e. the cartography of active faults. The second one is to evaluate the seismic potential of these sources. The last point is the seismic motion prediction, in term of response spectrum or acceleration time series or any other pertinent indicator, at the site of interest. This motion is the input data for the structural engineers for the civil structures planning. Specific site effects, due to very soft soil are also to be considered.

During the recent Tsunami associated earthquake, and subsequent Andaman centred tremors, due to liquefaction effect, the sand boiling and upward pushing of ground water in many bore well hand pumps located along the coast were seen. In the ponds also water lever rose with oscillation. Thus liquefaction of subsurface shallow geological medium during an earthquake all along the coastal tract of study area may be possible considering the presence of non-cohesive fine sand at shallow depth with shallow water table also. Moreover as the soft soil such as loose sand, tidal clay and silt are prevalent in the coastal region, due to the amplification of incoming seismic waves, the impact of earthquake may be more in the coastal region of Chennai-Nagapattinam sector compared to the inland.

In the recent decades it was observed that whenever an earthquake strikes around Chennai-Pondicherry-Nagapattinam coast (including the earth quakes of Andaman) the higher floors of tall constructions in the coastal area shakes particularly. This is due to the improper adoption of landuse practices without assessing the seismic hazard of the area. Srinivasan etal (2010) has arrived at a PGA (peak ground acceleration) for the Chennai city which varies from 0.0019g to 0.1261g. The maximum acceleration at bedrock level of 0.1261g has been taken for further hazard analysis. The tectonic source, which contributed a PGA of 0.1261g, is a NE-SW trending lineament southwest of Chennai with associated past seismic vent of around 5.5 magnitude on Richter scale. The Ground Geophysical site response study conducted for Chennai city indicated the more amplification of North Chennai sandy area compared to the shallow rocky areas of South Chennai. Boominathan etal (2008) calculated a bed rock level PGA ranging from 0.004g to 0.106g which indicates the moderate intensity earthquake susceptibility of Chennai coast.In view of the above and considering the rapid urbanization of coastal area with many critical land use practices it is recommended that detailed active fault studies particularly by subsurface observation by pitting and geological sampling for dating in the areas with probable evidence of neotectonism and active fault is to be carried out. The prioritised places in the study area include a) Palar fault - river mouth (big migratory river uncharacteristically do not have a delta and sharply cut by the shore line) and upstream areas, b) Inland area around Pondicherry town along the probable causative faults of recent seismicity c) Vellar river fault – river with tight meander loops and paleo meander scars due to neotectonism d) Kollidam river deltaic areas along coast indicating Cauvery river migration channels e) Low flat subsiding coast of Poompuhar-Karaikal segment.

Moreover mapping and dating of onshore and offshore dunes are needed to be carried out for assessment of tectonic emergence and paleo seismicity which can be used in the prediction or assessment of future seismic susceptibility status Chennai- Nagapattinam coast of Tamilnadu and Pondicherry. Hence it is stressed that the natural disaster assessment and preparedness along the fast developing coastal sector is the need of the hour.

Acknowledgements

The First author gratefully acknowledges the Geological Survey of India in which he was working earlier for granting permission to him to pursue the Doctoral degree by research and extending all the necessary encouragement to conduct this study. Both the authors thank the HOD, Geology Department, Presidency College, Chennai for the support and encouragement.

References:

1. Boominathan A Doda Gonder S.R Suganthi A, Uma Maheswari. R, 2008, *Seismic Hazard assessment of Chennai city considering local site effects*. Journal of Earth system sciences. Nov. 2008 pp 853-863.
2. Gopalakrishnan K, 1996. *Lineament tectonics and its relation to seismic activity in Tamil Nadu, India*. Proceedings of the International Conference on Disasters and Mitigation, Annauniversity, Vol. I, pp. A1-19 - A1-25.
3. Gangrade B K and Arora S K , 2000, *Seismicity of Indian Peninsular shield from regional Earthquake data.* Pure Applied Geophysics 157, 1683 -1705.
4. Ganapathy G.P & Rajarathinam 2010, *Use of Remote sensing and Seismotectonic Parameters to Identify Seismogenic Sources of Tamil Nadu State.* International journal of applied engineering research, Dindigul, volume 1, no1, 2010
5. Krishnan V Srinivasan R and. Sundaram R, 1994 Geological Survey of India unpublished progress report for FS: 1993-94 on *Geoenvironmetal impact studies along the Tamilnadu coast between Madras and Nagappattinam*.

6. Kenneth R. Lajoie 1986 Coastal Tectonics. National Research Council. 1986 .Book, *Active Tectonics: Impact on Society*. Washington, DC: The National Academies Press.
7. Murthy GPS Subramanyam A.S. and Murthy K.S.R. 2002 *Evidence of fault reactivation off Pondicherry coast from marine Geophysical data- scientific correspondence*. Current science Vol 83 No 12 Dec 2002
8. GSI and ISRO (1994), Project Vasundhara, National work shop volume, Geological Survey of India and ISRO Bangalore
9. Samantha Hettiarachchi, Saman Samara wickrama 2006,*The Tsunami hazard in Srilanka : a strategic approach for the protection of lives, ecosystems and infrastructur*e. J Natn .sci. foundation of Srilanka. March 2006, 34(1), 7-14
10. Sastri, V.V, Venkatachala, B.S and Narayanan,V. (1981) *The evolution of the East Coast of India*. Jnl. of Palaeo Geography and Palaeo Ecology, Vol.36, Pp.23 - 54.
11. Smithsonian Magazine expert panel discussion held on February 8 2005. *Tsunamis : Can they happen here?* Washington NASA Space Grant Consortium Newsletter for Teachers,
12. Srinivasan R & Nagarajan R 2007 *Sumatra-Andaman earthquake and tsunami 26 December 2004* ,GSI Special Publication no 89 page 183 to 203
13. Srinivasan R Balaji R Abdul Gaffar P Rama Murthy V Srinivas S 2010 *First level seismic hazard microzonation of chennai metropolis* . GSI unpublished progress report for Field Season 2007-2009
14. Sujit Dasgupta 2007 *Sumatra-Andaman earthquake and tsunami 26 December 2004* ,GSI Special Publication no 89,Page 1-4.
15. Tuttle M.P Ruffman , A, Anderson, T, and Jeter, H, 2004 *Tsunami or storm deposits? The 1929 Grand Banks tsunami versus the 1991 Halloween storm.* Abstract, Atlantic Geoscience society publication 2004 vol 40 no 4 ,Colloquium & Annual General Meeting, January 30 & 31, 2004. Moncton, New Brunswick.
16. Yuki sawai Takanobu kamataki Hiroo nasu Yukinobu okamura Kenji satake, Masanobu Shishikura, Katie Thomson, 2006 . *Tsunami deposits from Mochirippu, eastern hokkaido, northern Japan* AbstractsJapan Geoscience union meeting. P: S208-P006.