Chapter 1

Asian Tsunami – A Prologue and Dimensions of Pre and Post Tsunami

1.1 Introduction

The term “Tsunami” is a seismic sea wave that is potentially the most catastrophic of all ocean waves. It is generated by tectonic displacement – a volcano, landslide or earthquake – of the seafloor, which in turn causes a sudden displacement of the water above and the formation of a small group of water waves having wavelength equal to the water depth at the point of origin. The resulting waves can be devastating to low-lying coastal areas.

An earthquake of magnitude 9.0 occurred off the coast of Sumatra on 26th December 2004 at 00: 58: 50 (UTC)/ 06: 28: 50 AM (IST). The epicenter of the earthquake was located at 3.29°N and 95.94°E. The focal depth of the earthquake was 30 km. This earthquake generated huge tsunami waves, which devastated the Andaman and Nicobar Islands, east coast of India, south Kerala in India and several other countries like Sri Lanka, Indonesia, Thailand and Somalia in the Indian Ocean. The tsunami claimed more than 250,000 human lives in these countries. The aftershocks of this earthquake, numbering more than 250 in the magnitude range 5 to 7.3 magnitudes, were located for a length of 1300 km from Sumatra in the south to the Andaman and Nicobar islands in the north, till 30 January 2005 (USGS). Tamil Nadu was the worst affected state in India due to the impact of Asian Tsunami
with a death toll of about 8000 people. All thirteen coastal districts of the state and the Union Territories of Pondicherry and Karaikal were affected and the worst losses occurred in Nagapattinam district where more than 6,000 people were killed. An estimated 85 percent of people affected by the tsunami in Tamil Nadu are believed to be from the fishing community. Tamil Nadu has 591 fishing villages and 362 fish landing centers, which are mostly small and cater to the needs of small mechanized fishing crafts and traditional boats. The fisheries sector has suffered major damage in terms of lives, boats, and gear and to the infrastructure such as harbors and fish landing centers. Fishing activity in Kancheepuram, Cuddalore, Thiruvallur and Nagapattinam has not still recovered fully. Tamil Nadu's fishing community is a significant contributor to the state economy with marine fish landings estimated around 380,000 tones per annum. About 58,000 tones of seafood valued at about 480 million U.S. dollars are exported annually from the seafood processing units located in the state. The impact of the Tsunami waves was unknown to Indians until the morning of the 26th of December. Nagapattinam was the worst hit with the death toll of 6065 people, and several others are missing. Even after ten months, the coastal village of Akkraipettai in Nagapattinam still looks like a ‘no man’s land’ as its causeways to the mainland were washed away. The December tsunami had washed away almost all the temporary structures in Akkaraipettai and Keechankuppam the fishing hamlets on the Nagapattinam beach. The permanent constructions were destroyed partly and recovery is possible only when heavy financial help is made available. Temporary bridges are being constructed using debris on site to begin the fish trade.
1.2 Tsunami and Mass Destruction

The tsunami waves have brought out tremendous damages to the aquaculture farms too, as most of the farms are very close to the shoreline. Many hatchery and farm infrastructure facilities were severely damaged. Surging tidal waters carried pumps and other machineries away. Bunds and fencing of shrimp farms got collapsed. In the areas of Kovalam, Marakkanam, Pondicherry, Cuddalore, Chidambaram, Sirkali, Tharangambadi, Nagapattinam, Velankanni and Vedarnyam along the Tamil Nadu coast, one can notice the trails of the devastation of tsunami on the aquaculture farms. It is estimated that there is a loss to aqua farms on the Indian coasts to the tune of US dollars 1.5 million. Besides these property and infrastructure loss, collapsing of bunds due to the massive tsunami waves, and the resultant flooding of the polluted effluents caused further damages to the physical and human environment. Thus there is a further damage to the coastal eco-system in the post-tsunami period. Small aqua farmers may find it very difficult to recover from this loss.

The proposed research has been designed to study the pre and post tsunami implications in the three sample coastal villages, reconstructed permanent and temporary settlements during the post tsunami periods and the relief and rehabilitation works carried out along Nagapattinam coast zone. Nearly thirty five revenue villages and in it a total of one hundred and twelve habitations are affected due to Tsunami. There are several losses occurred both to the life and property. The death toll exceeds more than six thousand and the loss due to damage to the property has been estimated to an amount of more than four hundred million Indian
rupees. The losses can be categorized into agriculture, livestock, and damages to fishing equipments, houses and various aqua farms/factories at the coastal region. The GPS is used to locate the sites where the permanent shelters and temporary shelters are allotted for the affected habitation. The study would present a clear picture of the relief and rehabilitation works carried throughout the district and generate a geographical information base with appropriate database.

1.3 Causes of Tsunami

A tsunami can be generated by any disturbance that displaces a large mass of water, such as an earthquake, landslide or meteor impact. Tsunamis are the outcome of uplift of sea floor abruptly deforms and vertically displaces the overlying water. Tectonic earthquakes are a particular kind of earthquake that are associated with the earth’s crust deformation; when these earthquakes occur beneath the sea, the water above the deformed area is displaced from its equilibrium position. Waves are formed as the displaced water mass moves under the influence of gravity to regain its equilibrium. When large areas of the sea floor elevate or subside, a tsunami can be created. Large vertical movements of the earth’s crust can occur at plate boundaries. Plates interact along these boundaries called “faults”. Around the margins of the Pacific Ocean, for example, denser oceanic plates slip under continental plates in a process known as subduction which are particularly effective in generating tsunamis.
1.4 Formation of Tsunami

Submarine landslides, which often accompany large earthquakes, as well as collapses of volcanic edifices, can also disturb the overlying water column as sediment and rock slump down slope and are redistributed across the sea floor. Similarly, a violent submarine volcanic eruption can uplift a water column and generate a tsunami. Large landslides and cosmic-body impacts can disturb the water from above, as momentum from falling debris is transferred to the water into which the debris falls. Generally speaking, tsunamis generated from these mechanisms, unlike the Pacific-wide tsunamis caused by some earthquakes, dissipate quickly and rarely affect coastlines distant from the source area. However if the landslide or cosmic body is large enough, it will create a mega tsunami. A mega tsunami is a tsunami, usually caused by a collapsing island, asteroid impact, or huge chunks of ice falling into a large body of water, and is hundreds of meters high. Tsunami is formed when energy from the earthquake vertically jolted the seabed by several meters, displacing hundreds of cubic kilometers of water. Then large waves began moving through the ocean, away from earthquake’s epicenter.

1.5 Tsunami and Nagapattinam Coast

Nagapattinam lies in the coastal belt with a stretch of 187.9 km, which is about 15 percent of the coastline of Tamil Nadu. Nagapattinam district occupies a total area of 2.7 lakh hectares with total population of about 150,000. It is the administrative capital of this district with an urban population of 330,000 (2001). The rural population of the district is 11.58 lakhs. The Tsunami had affected nearly 200,000 populations along the coastal hamlets. The statistics available from the
district administration indicate that among the affected, 87 per cent are from fishermen community. The rest of them are from agricultural laborers, traders and tourist/pilgrims. The recent tsunami affected 38 revenue villages and 73 coastal habitations along the coast zone. Among the confirmed human loss of 8081 people in Tamil Nadu, Nagapattinam coast alone inhabit 6065 deaths, which is 76 percent of the state’s total loss. The coast zone was declared by the district administration as “Ground Zero” because of the fact that within 10 kilometer range 4592 deaths were recorded, 73 affected habitations along the coast line, flattened 51 fishing hamlets devastated, total power cut and water supply, Pilgirim town of Nagore and Vailankanni severely hit and almost 450 death per square kilometer. The tsunami has also affected the destruction of houses, boats and catamarans, fishing harbors, fishing landing and auction centers in Nagapattinam. Damages to ice plants, marine mechanics and other traders in the coast were also destroyed. Damages were also reported due to the intrusion of salt water into the aquifers and inundation of sand over agriculture and aquaculture farms.

The tsunami height varies between 2.5 and 5.2 m in these regions. Maximum surge elevations were also measured and were found to vary between 3.8 and 6.0 m (mean tidal level). Three zones of flow competence were established from the maximum transport distances of gravel, sand and flotsam in the 11 profiles from the field investigation method. Gravel transport ranged from 30 to 60 m distance from the swash zone in Pattinapakam, Periakalapet, Devanaampatnam and Tarangambadi profiles. The gravel-size classes were largely derived from tsunami damaged brick walls, foundations and roofing tiles in the region. Maximum sand
transport ranged from 90 to 430 m distance from the swash zone in most of the profiles. Beach width in most of the profiles varies between 30 and 50 m, except at Parangipetrai and Nagapattinam, where it was about 300 m. With the exception of these profiles, the average sand transport distance is about 100 m beyond the beach backshore. Tsunami sand deposits ranged from coarse upper (700–1000 mm) to very fine upper (88–125 mm) in grain size, based on comparisons with grain-size cards. The combination of local high run-up, low topography and dense development apparently accounted for the large loss of life and property. The surge water elevations, together with surge water depths appear to be important parameters in tsunami hazard analysis. Low valleys behind shore-parallel dune ridges claimed several lives due to lateral flows from tidal inlets or from breaches in the dune ridge.

1.6 Problem statement

Earthquake generated huge tsunami waves that devastated the Andaman and Nicobar Islands, east coast of India on 26th December 2004. The regions include south Kerala in India, and several other countries like Sri Lanka, Indonesia, Thailand and Somalia in the Indian Ocean. The tsunami claimed more than 250,000 human lives in these countries. The aftershocks of this earthquake, numbering more than 250 in the magnitude range 5 to 7.3 magnitudes, were located for a length of 1300 km from Sumatra in the south to the Andaman and Nicobar islands in the north, till 30 January 2005. Heavy loss to life and property were reported in the first 500m from the shore, where coastal hamlets were washed away/destroyed. Small differences in local run-up and coastal topography resulted in large differences in
tsunami inundation and associated changes with the total ecosystem and morphology of the coastal region of the south east coast of India. The surge water elevations, together with water depths appear to be important parameters in tsunami hazard analysis. Low valleys behind shore-parallel dune ridges claimed several lives due to lateral flows from tidal inlets or from breaches in the dune ridge. Keeping in view the observations during our survey, a detailed study has been taken up to assess the affected areas along the Nagapattinam coast relating to pre and post tsunami conditions and rehabilitation processes aftermath of tsunami.

The present study necessitates the impact of tsunami on the coastal hamlets, the loss incurred to human lives and assets and rehabilitation processes activated during the post tsunami time periods; the study also highlights the demarcation of coastal regulation zone enunciated by the Ministry of Environment and Forests (GOI) and to design a GIS and GPS data base of the rehabilitated settlements and new houses constructed by the various agencies.

The December Tsunami has caused multi faceted problems along the Tamil Nadu coast both physical and cultural damages particularly the coastal communities who are living adjacent to the sea for their day-to-day survival. They have lost their families and incurred heavy loss to the property as well as the fishing boats and nets. The inland aquaculture farms were also encountered severe loss due to the seawater intrusion through the river channels. Nagapattinam district is one of the coastal districts in Tamilnadu which was severely affected by Tsunami that washed away the entire Tamil Nadu east coast on 26th December 2004. Although many other places are affected in Tamilnadu, Nagapattinam district is severely damaged
when compared to other coastal districts. There are severe damages to the loss of life and property throughout the district. The sea water inundation level of 200m to 3000m has been noticed at different villages of the district. The worst affected habitation is Keechankuppam and Akkaraipettai wherein the maximum inundation level is approximately 3000m. This is mainly due to the presence of mouth of Uppanar River at this region and also densely populated coastal hamlet and Boatyard is situated in this habitation.

There is various relief and rehabilitation activities were carried out throughout the district by various departments. The Government at the centre and the local had provided immediate relief in the form of cash to the affected people and to the next kin those killed by the killer waves. Human resource department had provided relief amount to the loss of life, injury, destruction of the houses, loss of employment etc. Fisheries department extended their support to construct boats, catamarans, and purchase nets, Valla’s and other fishing equipments. Animal husbandry department has provided relief amount to loss of livestock. Health department make available first aid and treatment to the affected victims of the habitations. This geographical information base provides data and mapping of the above-mentioned impacts and relief work carried out by various departments.

1.7 Literature Review

Rahul Prakash Srivastava (2006) states that the Tsunami event of December 26, 2004 in the Indian Ocean that the state of Tamil Nadu in India suffered maximum damage in terms of life and property. The research takes into its gamut the model simulation of tsunami waves using a numerical model, Tsunami N2. The model
results show the propagation of the sea waves for the event of December 26, 2004 taking into account the fault geometry, bathymetry and initialization conditions for running the model. The tsunami waves reach the Indian coast in 180 minutes that is in agreement with the real tsunami event of December 26, 2004. J.P. Narayan, (2005) indicates the most severe damage was observed in the Nagapattinam district on the east coast and the west coast of Kanyakumari district. Decrease of damage from Nagapattinam to Kanchipuram district was observed. Intense damage again appeared to the north of Adyar River (from Srinivasapuri to Anna Samadhi Park). It was inferred that the width of the continental shelf and the interference of reflected waves responsible for intense damage in Nagapattinam and Kanyakumari districts, respectively. Many people observed the first arrival. The largest tsunami amplitude occurred as the first arrival on the eastern coast and in the second arrival on the western coast. Hakan Alphan (2004) 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 Land sat 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. R. M. Westaway, S. N. Lane, D. M. Hicks(2005) has studied 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. N. Chandrasekar, et al (2006) implies that 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. Based on the seawater inundation with relative to their coastal geomorphic features, it has been classified the tsunami impact along the coast and the probability of the behavior of the beaches in case of similar havoc in future. The maximum seawater inundation recorded in the study area is 750 m as in the case of Colachel and the minimum is 100 m as in the case of Kadiapatanam, Mandakadu and Vaniakudy. Kenneth Pye and Simon J. Blott (2006) have studied 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 defenses may become unsustainable in the medium to longer term, and that the survival of internationally important wildlife habitats is under threat. N. P. Kurian, et al, (2004) research was about 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 in this study. 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. K.
S. R. Murthy et al, (2005) have studied 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 26th December 2004 (Mw 9.3). Surge heights in this part were of the order of 2 to 5 m, with inundation of the order of few hundred meters 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.

James Lee Witt, (2005) proposes a real-time, Web-based management system that combines a federated system of real-time analysis and visualization tools and publishing environment to maximize the efficiency and coordination of the Sumatra Tsunami relief management effort. The Sumatra Earthquake on December 26th, 2004, the 4th largest ever recorded, set in motion the 6th most deadly natural disaster in recorded history. Approximately 200,000 – 300,000 people were killed and over 100,000 are still missing he force of t he tsunami Caused over a million people to lose their homes, creating billions of dollars in damage, and leaving salt water, waste, dirty water, and chemicals in its wake, resulting in untold environmental damage across 13 difference countries. Faced with the over whelming problems created by this disaster, Governments, the UN and aid agencies have banded together as best they can to solve a myriad of issues. Tasked with organizing the United States response to this disaster, James Lee Whit Associates has turned to Many One Net works to address the challenges faced by this over whelming event.
In the project work carried out by Tamils Rehabilitation Organisation” (26 June, 2005) it is said that Six months after a devastating tsunami overwhelmed the coast of SriLanka on 26 December 2004, the Tamils Rehabilitation Organisation (TRO) is publishing this report to provide awareness of its tsunami related activities including current projects, challenges and partners. In late December 2004, men and women worldwide interrupted their daily lives to read, watch and hear the devastating headlines coming out of Asia. Powered by an earthquake in the Indonesian Sea off the island of Sumatra, the devastating tsunami destroyed coastlines throughout the Indian Ocean. In Sri Lanka, over 40,000 people lost their lives, a further 500,000 were displaced and countless others injured and severely traumatised by the tragedy.

Albert P.Rayan (2005) quotes that “It is not easy for the affected people to come out of their traumatic experience; It will take years”. He in his desertion explains some important facts about the Relief and rehabilitation works carried out in India such as what is the impact of tsunami relief and rehabilitation program? He says that although many welfare schemes proposed by the Government and NGO.s are aimed at giving only a temporary relief to the helpless people, such relief measures make the people dependent on donors and make them beggarly.” If the Government and NGO.s are really interested in the welfare of the people then they should focus their activities on sustainable development. According to researcher, the statistics provided by the Government of TamilNadu and various NGO’s is not correct. The damage has been exaggerated in some districts and understated in others. As a result, those who are most affected and in need of relief packages
haven’t got what they deserve and those who are not at all affected have enjoyed relief benefits. The manipulation of statistics is quite common among Governmental organizations in India but what is surprising and shocking is the distortion of statistics by a few so-called volunteer organizations that receive money from funding agencies. “It is very difficult to find really committed people among those who are involved in the tsunami relief and rehabilitation work. More than tsunami survivors and affected people, those who work for the welfare of the victims benefit,” says John Rayan of the Center for Human Empowerment through Education Related Services.

Ravinder Rena (2007) states in his desertion work titled “Asia Tsunami exposes rich-Poor divide (Indonesia) that “It is clear that the death toll from the tsunami estimated at more than a quarter of a million; one of the highest ever resulting from a natural disaster was a direct product of mass poverty”. In Asia and Africa, many regions have had no tsunami warning system, and millions of people were made vulnerable because of their living conditions. This poverty was not some unfortunate occurrence or an accident, but the outcome of economic processes that are vital to the very functioning of global capitalism. In the aftermath of the tsunami, it was widely noted that, despite the scale of the human devastation and suffering, the stock markets of the world, and those in the region itself, barely missed a beat. This signified that as far as capitalist property and wealth were concerned, the massive death toll was of no consequence.

The NGO Coordination Cell, Nagapattinam (2005) proposes that since the Latur earthquake, each subsequent disaster has been contributing to refinements to
shelter reconstruction policies, based on the lessons learned, mistakes made, and the achievements of the previous policies. Having taken cognizance of earlier shelter rehabilitation policies, the following recommendations focus on those aspects that can contribute to a more owner-driven, technologically appropriate, efficient, equitable, and culturally/environmentally aligned reconstruction and rehabilitation programme for the communities affected by the Tsunami.

Revathi and Niruj Deepu (2005) says that, with the Government closing down relief and moving on to rehabilitation despite overflowing god owns, an upbeat media flashing pictures of fancy schemes by NGOs, as most volunteers to the disaster zone have packed their bags and left, one reality of the politics of rehabilitation has come out glaringly. Even as the Meenavar community is coping with its losses and trauma and getting on with the rehabilitation process the left outs, facing starvation, in the relief network are taking to streets demanding food relief. These marginalized agricultural labors and unorganized labors, have failed to attract any attention from the administration. Sadly this issue is yet to find media coverage, possibly because hunger is not on par with deaths. This may sound rather cynical but people in several villages are beginning to believe that their surviving the tsunami is going against them now. The Governments have turned away from them while only a handful of NGOs consider this issue serious enough to intervene effectively.

M.S.Swaminathan (2005) explicate that, for the affected communities that “It will be necessary to form teams of men and women psychiatrists and trauma Counselors who can cover the severely affected areas during the next few weeks to bring comfort and confidence to those who have lost their dear and near ones.
Fishermen will have to be assisted in overcoming their fear of the sea. Farmers also need technical help and moral support. The professional counseling sessions could be organized by appropriate civil society organizations in association with Panchayats. Those living in relief camps need particular attention. Destitute women should be rehabilitated in their own community and should not be herded in destitute homes, either old or new. For Livelihood rehabilitation task the researcher proposed that “A Special Food for Livelihood Revival and Eco-protection programme should be initiated immediately in all the affected areas. Such an open-ended Food for Work Programme, which can be sanctioned for a year in the first instance, should aim to create assets for the Tsunami ravaged families, and should not solely be community centered, as in the case of normal Food for Work programmes”.

John Kurien (2005) explains in his work that it is now clear that tsunamis are rare happenings. However, they create a lifetime of havoc and devastation. Tsunamis always affect only coastal communities – but here too differentially. The poor suffer more than the rich. Those who live close to the sea suffer more than those who live further away. Fishing communities in TamilNadu, while they lived, were rarely the center of attention in civil society. Now that so many of them have been taken away by the sea and thousands are faced with a shattered future, they are the focus of an outpouring of concern. This swell of human kindness – if it is not to take the shape of a tsunami of misplaced concerns and competing priorities – needs to be properly canalized. This requires an understanding of the pre-tsunami realities and the post-tsunami needs. This note is a preliminary attempt of a group of concerned persons with a significant fund of knowledge and work experience among
fishing communities in India and abroad. It hopes to provide some modest guidelines for the formulation of a master plan by the state for action in which the vast experience of civil society organizations will be integrated and the participation of the affected communities assured. In India the impact was primarily on the islands of Andaman and Nicobar, and in Tamilnadu, Pondicherry, Kerala and Andhra Pradesh more than a month after the tragedy, the focus is gradually shifting to rehabilitation issues and to restoration of livelihoods, fisheries and non-fisheries. This dossier puts together various articles and information that is likely to be of relevance to those engaged with rehabilitation of fisheries-based livelihoods in TamilNadu, the state in India that has been hit most severely by the tsunami. The contents of the dossier include a Preliminary Proposal by concerned citizens towards post-tsunami livelihood security for fishing communities in TamilNadu. This was first presented at a meeting organized by the Citizen’s Platform for the Tsunami Affected at the Madras Institute of Development Studies, Chennai on 7 January 2005. The Proposal, put together by people with extensive experience of working with fishing communities in India and outside, is by no means prescriptive. It was formulated with the intention of initiating and stimulating a process of debate on short-term, medium-term and long-term measures to be taken for post-tsunami rehabilitation of fishing communities. The dossier also contains other published and non-published articles on post-tsunami rehabilitation issues. These articles also provide information about the fisheries sector in TamilNadu. Also included are some statistics on marine fish production in Tamilnadu, by year, by district, by craft and by gear group. Information
on socio-economic aspects of the fishing community is provided, based on an analysis of the data available from the Marine.

Fisher folk Census undertaken by the Fisheries Department of Tamilnadu on a periodic basis also included are excerpts from the write-up on the Pattanavan community the fishing community predominant in Tamilnadu from the well-known book by Thurston and Rangachari on *Castes and Tribes of Southern India*, first published in 1909. The excerpts highlight the fishing-related knowledge and skills of this traditional community and its social organization, aspects that continue to hold true today. It is hoped that the information in this dossier is found useful. Any comments and suggestions on the contents are welcome.

L.A. Samy (2005) is the director of AREDS (Association of Rural Education and Development Service) in the TamilNadu state of India and in his research work about the relief and rehabilitation work that was supposed to have been commenced in the wake of the December 2004 catastrophic tsunami that claimed thousands of life-both human and animal and left many more thousands of people homeless and devastated their livelihood sources in the state of TamilNadu, India is yet one more example of the wrong way to build. While the construction of new homes and rebuilding the infrastructure was driven by the imperatives of the donor agencies and the NGOs who wanted to be seen to respond quickly, these imperatives met with a number of challenges coming not only from the state but also from the non-state actors themselves. While the lack of prior experience in managing a disaster of such a magnitude should necessarily be taken into account while evaluating the progress made in the relief measures, one wonders what prevented the state and the NGOs
from consulting their counterparts in other parts of the world who had gained both positive and negative experiences and involving the actually affected people in meeting their actual needs and requirements. While the international donor agencies which rushed generous funds to the Indian NGOs within the shortest time imaginable, neither they nor the NGOs who received these funds had any culturally appropriate vision of how the catastrophe-affected areas should be rebuilt, though fortunately the former avoided sending pre-fabricated plans and kits. This problem was exacerbated by the bureaucratic lethargy and the whimsical approach on the part of the State Government with the result large funds running into several millions of Indian rupees remain unspent or the house construction works have stopped half way through.

The statement made by one of the top bureaucrats of the Indian State Government of TamilNadu, R.Santhanam (2005) who recently expressed particular enthusiasm about the safety and security of the fisher folk by removing them to places which are at least 1000 meters away from the seashore that “the construction of permanent houses for tsunami victims has begun in some areas and the first (80 houses built in Pudukuppam in Cuddalore District) will be handed over in a few months” speak volumes about the callousness, lethargy and indifference on the part of the Government towards the unfortunate people whose are still groaning under the weight of the havocs of December 2004. The construction of the houses is part of the ‘comprehensive rehabilitation and reconstruction project’ under way with the loans from the World Bank and the Asian Development Bank to be executed in three years. For him tsunami had also a bright side: “The collective outpour of emotional
support of people to the victims, exposure to the vulnerability of environment, generation of greater confidence to deal with disasters, sensitization of environmental laws and rules,” he claimed, are some of the ‘positive lessons’ one learnt from the disaster. What he avoided admitting was, obviously, that the Government can hardly take credit for any of these. He somehow had to come nearer to the truth when he talked of the “coming together of the Government and several NGO’s.” A concept note was prepared in the wake of the Tsunami Disaster of Dec. 26th, 2004 covering several countries of north Indian Ocean and various States of India.

Aquaculture, for marine and brackish water species as well as for freshwater species, is expanding rapidly throughout the world. Some of the driving force for this expansion is simply the need for additional food resources. However, in other cases the recognition of fish oils and other products as healthy substitutes for other traditional products cause the demand. New potential aquatic species are being studied and cultured each year creating a need for specialized formula feeds and feed ingredients. New food products and processes, especially those from aquaculture, have created by-products that are well suited for aquatic feeds. Many of these products are high moisture and require specialized drying equipment or a carrier on which the product must be dried. The complex infrastructure supporting all these activities, particularly the formula feed industry, is constantly expanding and adjusting to meet demands. Feed microscopy is one of those support areas that is critical to maintaining quality aquaculture feed ingredients and formula feeds.
Feed microscopy is source rather than nutrient oriented. Because many aquatic species require rations high in protein, a wide variety of animal and marine meals of very similar appearance are used. Unfortunately these similarities, because they cannot be detected with any routine protein, fat, fiber or other common tests in a laboratory, offer opportunities to adulterate both ingredients and formula feeds. Aquaculture producers and their feed suppliers need to monitor the quality of their ingredients and feeds constantly to assure they are buying the quality of products they are being sold. Similarly, knowledge about an ingredient source allows a feed manufacturer to take advantage of price differentials without risking the quality of their feed. Feed microscopy is the ideal technique to assure the quality of ingredients and formula feeds in a rapid expedient manner.

A second factor encouraging contaminated and adulterated feeds is the inability visually to check the cultivated population. Water is generally turbid from high population densities of whatever species is being cultivated. Netting or trapping of the fish, shrimp, crab, etc. is necessary to weigh and follow feed performance. When low nutritional quality ingredients find their way into aquatic feeds, the effects are often not discovered for some time. Even with an extensive quality control program, the few chemical assays available for identifying lower quality materials are not always accurate. Feed microscopy offers a relatively rapid solution for such problem feeds as long as the analyst is familiar with the wide range of aquatic ingredients, their identification and common adulterants and contaminants.

It is quite obvious that the rapid expansion of aquaculture has resulted in many profitable opportunities but with its share of difficulties. If we are to sustain a
strong aquaculture industry with continued growth, we will need quality feed products, better basic knowledge of the aquatic environment plus improved nutrition and management of the various species cultured. This paper addressed the first of these, the importance of quality feed ingredients and finished feeds, primarily from a feed microscopy viewpoint as it interfaces with routine chemical analyses and the specific analytical problems encountered in aquaculture feeds. Hundreds of farming and fishing communities throughout the region are protesting against the intrusion into their lands and the despoliation of their land and water resources by aquaculture farms. These farms have been set up by commercial companies, mainly in the past five to 10 years, along coastal areas, as part of national Government policies and often aided technically or financially by international agencies. The shrimps, which include the large ‘Tiger Prawns’, are mainly exported to rich countries (especially Japan, USA and in Europe), where shrimps fetch a high price and have become a fashionable and expensive cuisine item. The rapid expansion of commercial, intensive aquaculture has often been called the ‘Blue Revolution’, following the term “Green Revolution” used to describe the introduction of chemical-based agriculture. Since the 1970’s, global production of cultured shrimp has jumped by incredible rates, mostly in Asia which in 1990 produced 556,500 metric tons or 80% of the world output. In the same year, it was also estimated that 820,000 hectares was being used for coastal shrimp aquaculture in Asia and international transfer of information and technology.
1.8 Historical events of Asian Tsunami

Tsunamis are not known familiarly to this region as this does not occur frequently. There are some records of the occurrence of this event. They pose a major threat to lives and property in many parts of the world. Although Tsunami had occurred several times the Tsunami that occurred in Dec 26th, 2004 is highly ferocious and let to loss of life of more than one hundred and fifty thousand life over the world. The past historical incidents are, on 12th April, 1762 an Earth quake in Bay of Bengal have occurred and let a rise in the wave of about 1.8m. On 19th August, 1868 an Earth quake of Magnitude 7.5 occurred in Bangladesh coast. This let to rise in the sea level of about 4m at Port Blair. On 31st December 1881, Earthquake of Magnitude 7.9 occurred in the Bay of Bengal Coast let to the run-up level of about 0.76m. In the same year another Earthquake event at Carnicobar and Port Blair let to raise in the sea level of about 0.3m and 1.22m respectively. On 27th August 1883, Tsunami waves at Madras and Nagapattinam Caused raise in the sea level of about 1.5m and 0.6m respectively. On 26th June 1941, an Earth quake of magnitude 8.1 occurred in the East Coast of India with amplitude 0.75m to 1.25m was reported. There have been several destructions at the coastal area due to this event. On 27th November, 1945 Mekran Earthquake of Magnitude 8.1 occurred and caused a raise in the sea level of about 12 to 15m height in Ormara in Pasi at Mekran Coast in Gulf of Cambay of Gujarat. The estimated height of wave at Mumbai was about 2m. Boats were taken away from their moorings and causality occurred.
1.9 Research Objectives

a. To study the impact of tsunami along the coastal hamlets of Nagapattinam coastal villages to assess the damages caused to men and materials and aggravating the existing environmental problems,

b. To design a Tsunami impact and relief mapping using Geographical Information System for death toll, Loss of fishing equipments, rejuvenation of aquaculture farms and loss of live stocks and so on at village level,

c. To generate a synoptic and in depth geographical information base for the relief and rehabilitation work carried out after the Tsunami impact in the coastal villages of Nagapattinam,

d. To demarcate the coastal vulnerable zones by assessing the sea water intrusion levels and river channels and to draw a line of coastal regulation zone as per the Ministry of Environment and Forests (India) guidelines and look for the vulnerability of rehabilitated settlements in this zone.

1.10 Research Design

To analyze the impact of tsunami along the Nagapattinam coast, three worst affected fishing villages of Nambiyarkuppam, Keechankuppam and Akkaraipettai were selected. The IRS P6 digital data were procured from the NRSA for the pre (18-12-2004) and post (6-1-2005) tsunami periods and subjected to various digital image analyses to assess the damages caused to the physical and cultural features for the Nagapattinam District as a whole at micro-level. For digital image processing analysis supervised classification of spectral angle mapper in Envi 4.1 was used. The selected villages are just within 100 m away from the coast. The general analysis performed to the entire Nagapattinam coast shows a large scale damage of physical landscape Specific analysis is made, selecting three areas in the study
area, Zone A (Nambiyarkuppam), Zone B (Keechankuppam) and Zone C (Kallar and parts of Akkaraipettai).

The Geographical information base for the Tsunami relief and rehabilitation work base map such as District map and taluk maps are obtained from the Department of Survey of India and it is converted into digital data. Scanned Maps are then geo referenced using software tool ArcGIS 9.0. Spatial features needed for the study are digitized in the Geo referenced map using Arc Map and it is converted into shape files. Information regarding Tsunami relief and rehabilitation work that carried out at Nagapattinam coast is collected from Tsunami relief and rehabilitation department at district administrative office. The data also from other departments such as relief amount provided by Human Resource development department, Fisheries department, Agriculture department and various recovery measures carried out by health department are obtained from the concerned officials. After collecting all the data of the location of the permanent shelter, temporary shelters and primary health care centres are located using GPS (Global Positioning System) instrument – GS 20. GPS field survey has made awareness about the present condition of the affected people and it also made us evaluate about the successfullness of the relief and rehabilitation work carried out throughout the coast. The water intrusion level obtained thus is digitized and the GPS points for the location of the permanent shelters have been overlaid. From this the Permanent shelters that have been constructed in the water intruded area have been identified and mapped.
The location of temporary shelters and permanent shelters obtained by GPS are overlaid in the digitized maps and the corresponding data are added to the attribute table. For mapping the relief work carried out by health sub centers and primary health centers configuration area of the individual primary health centers are shown and the corresponding data are added into the database of the primary health centers. The data for impact and corresponding relief and rehabilitation work carried out is brought into the ArcGIS9.0 software. Located Pie Charts for the damages, relief and rehabilitation works provided by various departments are shown separately. Finally the distance of the permanent shelters from the sea shore have been found by using buffer analysis and the vulnerable habitations in which the permanent shelters that have been constructed at the distance less than five hundred meters have been identified.

To study the pond characteristics, forty two ponds of seven ownerships in the selected village of Pappakoil have been taken for the study along the Nagapattinam coast and these ponds are two kilometers away from the coast. They were worst affected during December tsunami due to its locational character, which are located along the river uppanar and Kaduvaiyar river course. During tsunami the destruction waves carried sea water through the river course and the post tsunami study indicate that the intrusion of salt water through surface and subsurface levels. To study the impact of post tsunami for the selected forty two ponds, the environmental conditions that affected during the tsunami and the aggravated environmental conditions were mapped using GPS and field survey methods. All the sample ponds were mapped using GPS and different shape files were created using ArcGIS 9.0.
All the forty two ponds, the inlet of salt water and outlet of contaminant water have been tracked using GPS and mapped at micro-level to study the pond character at in-depth level. Stagnant water level maps for all the 42 ponds were devised using GPS and mapped. As an example one sample pond has been taken for the analysis. The inlet and outlet for the sample point has been considered to show the flow pattern. The surrounding land characters in the sample ponds were also mapped to study the category of lands. From the sample study it is useful to infer two major aspects of a, the post tsunami conditions of sample ponds and the deteriorated environmental conditions, b, the rejuvenation and increased growth of aqua culture practice during the post tsunami period due to the intrusion of salt water, both surface and subsurface, which increases the growth rates.

1.11 Mode of Analysis

To produce the Geographical information base for the Tsunami relief and rehabilitation work base map such as District map in the scale of 1:50000 and taluk maps in the scale of 1:25000 are obtained from the Department of Survey of India and it is converted into digital data by scanning with the help of a scanner. Scanned Maps are then geo referenced using software tool ArcGIS 9.0. Spatial features needed for the study are digitized in the Geo referenced map using Arc Map and it is converted into shape files. Digitized Spatial features such as village boundary, taluk boundary, District boundary, road network etc., are stored as shape files and maintained in Arc Catalog. Information regarding Tsunami relief and rehabilitation work that carried out at Nagapattinam district is collected from Tsunami relief and rehabilitation department at district administrative office. The data also from other
departments such as relief amount provided by Human Resource development department, Fisheries department, Agriculture department and various recovery measures carried out by health department are obtained from the concerned officials. After collecting all the primary data of the location of the permanent shelter, temporary shelters and Primary health care centers are located using GPS (Global Positioning System) instrument – GS 20. GPS field survey has made awareness about the present condition of the affected people and it also made us evaluate about the successfulness of the relief and rehabilitation work carried out throughout the district. Secondary data for digital image, Indian Remote Sensing IRS-P6 LISS 3 data dated 6th January 2005 for Nagapattinam district collected from National Remote Sensing Agency (NRSA, Hyderabad). This Indian remote sensing data IRS P6 LISS III of 23.5m Resolution were used to access the water intrusion level at the time of Tsunami by adopting classification Technique in ENVI image analysis software. The water intrusion level obtained thus is digitized and the GPS points for the location of the permanent shelters have been overlaid. From this the Permanent shelters that have been constructed in the water-intruded area have been identified.

The location of temporary shelters and permanent shelters obtained by GPS are overlaid in the digitized maps and the corresponding data are added to the attribute table. For mapping the relief work carried out by Health Sub Centers and Primary Health Centers configuration area of the individual primary health centers are shown and the corresponding data are added into the database of the primary Health Centers. The data for impact and corresponding relief and rehabilitation work carried out is brought in to the ArcGIS9.0 software. Located Pie Charts for the
damages, relief and rehabilitation works provided by various departments are shown separately. Finally the distance of the permanent shelters from the sea shore have been found by using buffer analysis and the vulnerable habitations in which the permanent shelters that have been constructed at the distance less than five hundred meters have been identified.

In the present research the damages caused due to Asian tsunami, three adjacent coastal villages of Nambiyarkuppam, Akkaraipettai, and Keechankuppam subjected to assess, using IRS P6 digital data. This micro-level analysis of impact assessment will help the field workers and the administrations to work out the recovery strategies. The present study also assesses the damages caused to the physical and cultural features in Nagapattinam coast zone and to study the impact at micro level, by selecting the worst affected three coastal hamlets of Nambiyarkuppam, Akkaraipettai and Keechankuppam through the image analysis of remote sensing digital data (IRS P6). The study records the damages caused in terms of seawater intrusion, low lying area, and sand inundation levels and in the Nagapattinam coast zone.