

## **Structural and Nonstructural mitigation measures in coastal area threats**

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### **Abstract**

Oceans are a support system for many creatures in the environment; it also supports humans by providing various benefits. The coastal area faces various threats like earthquakes, storms, cyclones, floods and erosion. This is a huge cause for concern to the people living in coastal areas. Nearly 38% of the population in the world are living near coastal areas, and are directly exposed to the various threats due to any changes in the ocean. People residing in coastal areas need to receive scientific data and have to disseminate information properly to avert these threats. This paper brings one such decision making model called the tsunami model. It provides critical information during emergencies to help communities to protect themselves even before the event occurs.

### **1. Introduction**

Emergencies can happen anywhere at any time little or more seriously. The best protection in any emergency is to be prepared for the unexpected and know what to do from this situation. This will help in controlling the situation better and allow recovering more quickly. This also involves the current and accurate information such as hospitals and health centers, Governmental buildings. Any emergency is bring out the people from the initial shock and find the immediate response With the lot of damages from disaster increasing globally reports from international various agencies clearly stated that the developed and under developing countries are most affected by this disaster. For avoiding the disaster affects today all countries they developed the disaster management activities. Every disaster management functions are classified in three major parts. First pre disaster activities this performs the disaster operation in advance i.e. various possible emergence operations in aspect of disaster management. The second operation response to the event, this identifies the affected information due to disaster. Identify the losses example during the flood, emergence sources are drinking water, proper communication, evaluate the people from the flooded place to

safety location. The last function is post disaster activity, it perform after disaster. The main objective of this work recovers the people or environment from the disaster. During the disaster lost has been damaged so this post disaster activity identifies the damage evaluation. The major function for this

### **1.1 Preparedness:**

This is process of identify the previous threat and effect. This is helpful to the people or community recover from the threat.

### **1.2 Recovery:**

It is recovered from the event with help of various communities and proper technology. It not only recover the people from the threat also give the gaudiness to recover from their financial loss.

### **1.3 Response:**

Response is defined how they react for the problem. In major places this function perform the education, it gives the proper knowledge to the people how they react during the problem.

### **1.4 Mitigation:**

Construct the proper network come out the shock properly.

## **2. Tsunami measures countries have taken**

- Most of the countries place an ocean to monitor water level changes it helps them to identify any threat happen on because of coastal environment.
- Germany, Japan and US are upgrading the regions shore based tide-gauge station, which can measure the se-level changes caused by Tsunami.
- Thailand has worked hard to improve local warning, erecting 62 sites on towers along beaches in six provinces, each capable of alerting people as far as 2km inland.
- Text message and internet alert system have also been put in place in countries to warn people as soon as possible.
- Many countries have already modified their legal framework to allow for dedicated preparedness of communities and swift warning and response by local authorities and institutions.
- Indonesia has already adapted its school curricula while other countries are starting to translate educational material into local languages.

### **2.1 Measures which India has taken**

- The early warning system for Tsunamis was finally commissioned in 20078 in Indian Ocean region at Indian National Centre for Ocean Information Services(INCOIS), Hyderabad which is perating on a round the clock i.e. 24X7 basis. The systems provide advance warnings of Tsunamis likely to affect the coastal areas of the country.

- Under developing of various projects for Tsunami counter Measures.
- Developed various Tsunami/storm surge code for coastal structures and protection measures based on the Tsunami force evaluation.
- Role of Bio-shield as a soft measure for protection against the Tsunami waves.
- Evaluation of the hard and soft measure for the coastal protection and rehabilitation works.
- Shoreline dynamics and design of coastal protection measures in the Tsunami affected areas.
- Identify and prepare the risk maps it helps to the various people and Government and NGO organization to prepare the vulnerable coasts.
- Create based on the affect and environmental change based on the Tsunami guidelines for coastal systems such as coastal structures and saline embankments and construction procedure in the place of coastal affected areas.
- Construct the houses which not affected by rising of sea water. For that people who are living near to the coastal areas relocation of houses at higher places.
- Plant the Mangrove plantain.
- The effect of Tsunami in the coastal area information is recorded and this information's are included in school curriculum.

### **3. Reduce the effect of Tsunami effects in Coastal areas**

This process is carried the effect the Tsunami in the coastal area. These operations are carried by Structural measure and non structural measure.

#### **3.1 Structural Measure**

##### **3.1.1 Construct Tsunami Walls**

Construct Tsunami walls in Tsunami threat beaches built in the purpose of reducing the tsunami risk. These walls are constructed in many meters wide and some places it construct in few kilometers in length.

##### **3.1.2 River Gates**

This is the most important task for reducing the effect of Tsunami. Because most of the rivers and other water bodies in our nation connected to sea acts as a channel. By use this channel the great chances are their water can easily enter to the people living location. For avoid the bad situation construction of River gates reduce the impact of Tsunami.

##### **3.1.3 Tsunami forests**

This acts as a wall to tsunamis and it now implemented in Sri Lanka this is one of the best natural way to avoid the tsunami effect, and one of the best way to create the natural barrier. This is constructed based on the vulnerable of the area. Based on the environment it is decided the width and length.

### 3.2 Non Structural Measures

#### 3.2.1 Create Early Warnings

Most the critical situation this system works effectively and it play very important role in emergency. In coastal areas people are very trained and well educated in this worst situation how they behave based on the alerts.

#### 3.2.2 Education and give the proper training in School environment

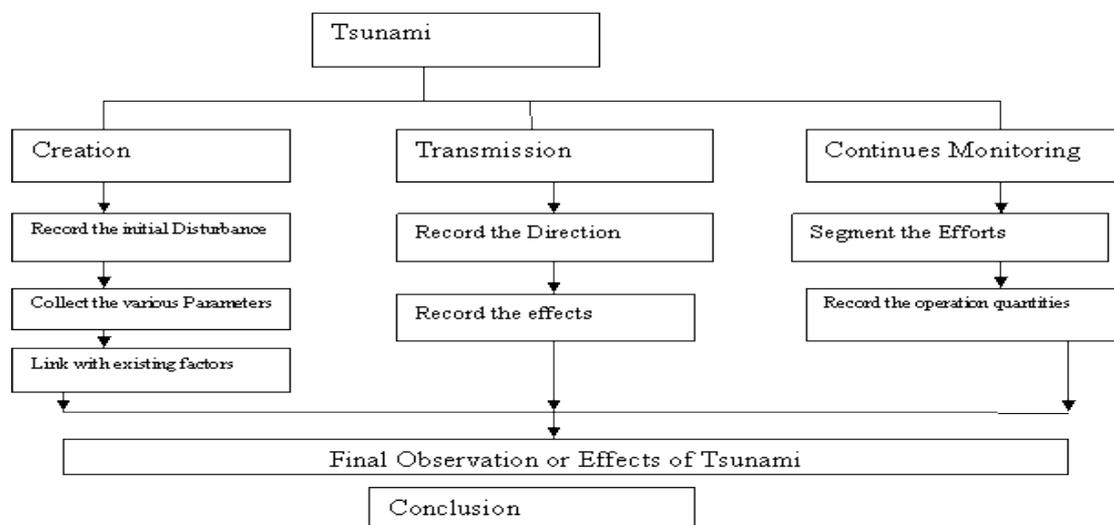
Education is the best part of the Tsunami effect. In most of the countries now they start given more constriction on this issue. In school and higher level curriculum now tsunami hazards and effects are added. It also gives the proper training to the children due to the emergence situation how they protect them self and also give the guideless how they help the affected society. School children can teach how to behave in the situation not only themselves and also help to guide their parents and other people who are affect by the situation. This is one of the best techniques to overcome the effect.

#### 3.2.3 Information and communication services

Information is communicated through the various electronic and social media like face book, twitter and short message systems.

### 4. Tsunami Model

This model helps to overcome the problems during the effect of Tsunami. This study helps the researchers and the people who are involving the mitigation process, this model develop based on the previous history and effect of the tsunami. Data's from the past effect help to take the proper steps such as construct mitigation plan, evacuation plan, identify the vulnerable location on the environment. Information is feeded from the past sources.



**Figure 1:** proposed Tsunami Model

#### 4.1 Creation

These modules explain the initial disturbance in the ocean surface due to the factors such as earthquake or any other natural events reflects on the sea floor. This initial disturbance happen due to the heavy cause of natural effect, it distributed in the form of long gravity waves radiating based on the event surface. This normally brings the effect based on the event, and the causes also based on the environment change. For this initial development various model are proposed through the world. Some basis parameters are required to estimate the effect of this like area affected by this the length and width, angle, depth of the effect, magnitude in case of the effect happen based on earthquake. All the above parameters are important for calculate the effect. This module also record the various factors such as initial disturbance level and other factors related to the disturbance and link this factor to the past record identify the event strength. Based on this observation it is easy to the community and other supporting agencies prepare the action plan.

#### 4.2 Transmission

In coastal area any events occurs it was transmitted in all directions from the place where actually the event occur. The effect based on the event and the level of the water, support event occur in the middle of the sea efforts are not much affect the people who are all live near to the coastal area. The same effect happens in the seashore it affects more. Here causes are recorded based on the place where the events are occurred. Normally the wave height to 40 to 50 cm approximately, but the effect of disaster this levels increased unpredicted level. The transmission in the entire sea not in equally, it may strong in one direction and weak in other side it depends on the factor such as dimension of the generating location, environment. This transmission normally happens from the bottom of the sea.

#### 4.3 Continues Monitoring

Due to the transmission of water in the sea level bring the various causes to the coastal area. Increasing the water level affects the people who are living near to the coastal area, it also affect the population of fishes and other sea livings. Most of the tsunami model are developed and tested with various values recorded on that time. This factor estimated based on form creation, transmission and continues monitoring.



**Figure 2:** Coastal alert system past 24 hours source taken from <http://www.tsunami.incois.gov.in/ITEWS/Seismiclatestdata.do?function=onPageLoad>



**Figure 3:** National wide Tsunami reporting Station source taken from <http://www.tsunami.incois.gov.in/ITEWS/UpdateReportingStations.do?stType=TIDE>

## 5. Warning System

The basis coastal monitoring consists of network sensors system it used to detect any abnormal change happen in the sea. It produces the correct magnitude if any event occurs. This is most important source when the Tsunami centers. It works around 900Km radius and produce the safely alarm any abnormal event. Followed by tsunami model such as creation, transmission and continues monitoring this help to the community and other bodies to find the threat and helpful to record the event affect and cause effectively. The third part is data base system collect the various event information. Any events are estimated based on the previous record and it helps for various mitigation operation, future plan find the various vulnerable sites, affects people, areas affect due to the event all this information needed for classify the event not even for mitigation process also helpful for find the threaded area near to the coastal location. Communication infrastructure this is one of the most important phase for any evacuation plans that are generated. It works on 24X7 timeline and produce various safety alarm to the community protect themselves from the threat. It receives the information from the authorities and the same was distributed to the people. Every warning system consists of software and hardware systems supporting the detection of coastal hazards. It helps the community to prevent their life, economic loss and more. The function is in the early warning system consist o f:

### 5.1 Monitoring and warning service:

It monitor the situation systematically a make decision based on the received information. In some situation it gives the warnings automatically.

### 5.2 Information Sharing:

It consists of the transfer of the message or the early warning through the various electronic devices such as Television, Mobiles, Face book, and Twitter use web technology.

**5.2 Research and development:**

This help to reduce the incidence of occurrence of the problem with help the past data set.

**5.3 Response capability:**

It gives the works plan during the emergency situation. This is one of the important functions for any relief operation. It responded based on the effect, situation, environment change, cause and more.

**6. Conclusion**

The Tsunami model proposed here is useful to the communities to take mitigation plans such as identifying safe areas during the emergency period, identifying the shortest and the safest path and also constructing safety shelters. The model also helps the community in creating and sharing knowledge among the people and other local and Government bodies. This gives the complete detail and information during the emergency. Answers for various queries such as when will the events happen, how to react and how we can protect ourselves, which is the first step etc can be spread across the community. This Tsunami model here helps in answering such questions and helps to keep the community safe.

**7. References**

- [1]. T. Srinivasa Kumar, Shailesh Nayak, Ch. Patanjali Kumar, R. B. S. Yadav, B. Ajay Kumar, M. V. Sunanda, E. Uma Devi, N. Kiran Kumar, S. A. Kishore and S. S. C. Sheno (2012), Successful monitoring of April 11, 2012 off coast of Sumatra tsunami by Indian Tsunami Early Warning Center (ITEWC), *Current Science*, Vol. 102, No. 11, 10 June 2012.
- [2]. Shailesh R. Nayak, Srinivasa Kumar Tummala. In: Gupta, Harsh K. (ed.) *Encyclopedia of Solid Earth Geophysics*, Springer Dordrecht, Vol. 2, 2011, 1498-1505.
- [3]. R.S. Mahendra, P.C. Mohanty, H. Bisoyi, T. Sinivasa Kumar and S. Nayak, "Assessment and management of coastal multi-hazard vulnerability along the Cuddalore - Villupuram, east coast of India using geospatial techniques", *Ocean & Coastal Management* 54 (2011), 302-311.
- [4] Mahendra R.S., Prakash C. Mohanty, Srinivasa Kumar T., Sheno S.S.C and Shailesh R. Nayak "Coastal Multi-Hazard Vulnerability Mapping: A Case Study Along the Coast of Nellore District, East Coast of India", *Italian Journal of Remote Sensing*, 2010, 42(3):67-76.
- [5] T. Sinivasa Kumar, R.S. Mahendra, Shailesh Nayak, K. Radhakrishnan, and K.C. Sahu, "Coastal Vulnerability Assessment for Orissa State, East Coast of India", *Journal of Coastal Research*, DOI:10.2112/09-1186.1, May 2010, 523-534.

- [6] Dexter Davis *et.al.*, “Determining and monitoring Sea Level in the Caribbean using Satellite Altimetry”, FIG Working Week 2012 Knowing to manage the territory, protect the environment, evaluate the cultural heritage Rome, Italy, 6-10 May 2012, pager 02-13.
- [7]. Sho Yamao *et.al.*, “Estimation of the current risk to human damage life posed by future tsunamis in Japan”, Research gate, Pages 01-05,2015.
- [8] Choyon Kumar Saha, ”Dynamics of Disaster-Induced Risk in southwestern Coastal Bangladesh :an analysis on tropical cyclone Aila 2009”, Journal of Natural Hazard, Vol 75,Issue 1,2015,Pages 727-754.