Disaster Risk Assessment of Tsunami in Indian Coast Line and Mitigation of the Same

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Abstract—*Satellite data can be used to assess the disaster extent and plan relief operations during disaster and plan mitigation operations to prevent future catastrophes. Tsunami is a special category wave which is very dangerous and devastating to the coastal region. It is difficult to predict the tsunami occurrence and its return period along with the earth quakes that produces it. Hence it is necessary to be prepared for the worst case scenario in highly hazardous zones for a peninsula like India where the hazard for Tsunami is always present. The study focuses on how the Indian coast line should be mitigated to prevent catastrophes from Tsunamis. The methodology is planned for an earthquake occurrence in "Indian plate" region and hazard assessment based on the factors like cities, power plant, ports & rescue capabilities unlike traditional methods. The study incorporates the data of major ports, cities, power plants etc. Assessment of risk along with rescue capabilities is addressed. Highly hazard prone areas can be identified and mitigation measures could be calculated based on the requirement.*

Keywords: *Disaster, Tsunami, Mitigation, Indian coast lines, Remote sensing.*

1. TRODUCTION

India is a unique country with multi-cultural heritage. It's also highly vulnerable to disasters costing about 2% of GDP on an average, when compared to the total area of the land[1]. Table 1 illustrates the risk of disasters in India and Table 2 lists the disasters that occurred in India in past decade.

Table 1: Risk of Disaster in India [2]

Type of Disaster	Area Prone	Percentage of area
Earth quakes	-	58. 6
Floods	40 million hectors	12
Cyclones & Tsunami	5,700 km	75% coast line
Drought	-	68% of Cultivable land

Table 2: Disasters in India during past decade [3]

S. No.	Name of Event	Year	State & Area
1.	Sikkim Earthquake	2011	North Eastern India with epicenter near Nepal Border and Sikkim
2.	Cloudburst	2010	Leh, Ladakh in J&K
3.	Drought	2009	252 Districts in 10 States
4.	Floods	2009	Andhra Pradesh, Karnataka, Orissa, Kerala, Delhi, Maharashtra
5.	Kosi Floods	2008	North Bihar
6.	Cyclone Nisha	2008	Tamil Nadu
7.	Maharashtra Floods	2005	Maharashtra State
8.	Kashmir	2005	Mostly Pakistan, Partially Kashmir
9.	Tsunami	2004	Coastline of Tamil Nadu, Kerala, Andhra Pradesh, Pondicherry and Andaman and Nicobar Islands of India

Remote sensing data can offer great help for disaster assessment & its mitigation. The satellite data can provide accurate information of pre and post disaster scenarios that can help in rescue and relief operations as well as capacity building for planning. Even during the planning stage, the remote sensing data can be utilized to issue warnings for slow onset disaster and calculate the impact level for disasters like drought using agricultural index and issue cyclone warning and predict its landfall time in an area.

After 2004 Tsunami many studies are performed for Tsunami risk assessment using traditional methods likeScenario-based Tsunami Hazard Analysis (STHA) and Probabilistic Tsunami Hazard Analysis (PTHA) [4]. The risk assessment isperformed by various agencies and organization for some parts of India. The major gap in the field is the update of knowledge and application of newer methodologies. The return period of Tsunami is uncertain and the earth quake that produces Tsunamis are difficult to identify. Hence many plans are based on the two methods which check the probability of an incident may fail to identify the hazards that are actually present in it. One of the best cases to be mentioned is Fukushima-Daichi incident where the Tsunami counter measures are done in 1960[5]. Unlike the traditional methods, the study focuses on a new method of assessing the risk of a given area. It doesn't consider the probability of a disaster but assumes the worst case scenario if the causes for a disaster are present. Later the risk would be calculated based on population, ports, power plants etc. along with the rescue capability for an area.

2. DATA USED & STUDY AREA

Different datasets are required for the assessment of the risk and for this purpose, the data of roadways, railways, ports etc. are used since they can be used in rescue operations (Table 3). **Bhuvan**, a software application (developed by ISRO) which allows users to explore a 2D/3D representation of the surface of the Earth has been used in the study. The browser is specifically tailored to view India, offering a high resolution in the region and providing content in four local languages. It can beaccessedat http://bhuvan. nrsc. gov. in/bhuvan_links. php

Table 3: Data Used in the analysis

MAPS USED	SOURCE
Railway Map	http://www. mapsofindia. com/maps/india/india-railway-map. htm
Road map	http://www. mapsofindia. com/roads/wall-map. html
Airports & Sea ports	http://www. worldofmaps. net/en/asia/map-india/map-india-airports-seaports. htm
City Maps Of Coastal regions	Bhuvan Portal

3. RESULTS

A plan has been made to identify a highly hazardous area and identify the risk in it. The methodology of the project is as follows in Fig. 1.

Table 4 Risk Matrix;

Risk level = Hazard rating * Rescue efficiency
Rescue Efficiency = 5-[(sum of the rescueefficiency rating)/6]

Hazards present	Hazards rating	Rescue facility available	Rescue efficiency rating
Sea Port	5	Airport	5
Nuclear Power Station	5	National Highways	4
Major City	4	Minor roads	3
City	3	Railways and rail availability	4 3 2
Villages	2	Disaster cell efficiency	1
Agricultural Land	1	locations	2

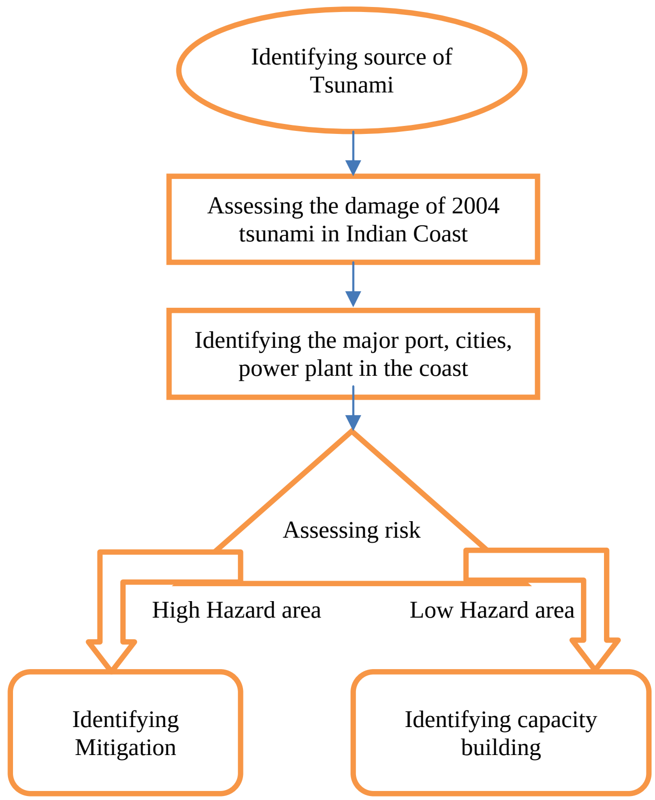


Fig. 1 Methodology

Based on the above calculations, the risk of each area could be identified and the risk assessment is performed for the coastal regions. The risk rating for Nuclear power plant and sea port areas is always "**high**".

Mapping of each district in the coastal regions and identification of the ports and power plants locationshas been done. These are further mapped in Fig. 2 and its detailed version is shown in Fig. 3. The map of each state is divided into grids. The grid is then color coded as red or brown. Red indicates urban area (city) while brown indicates port or power plant. Same color coding is given for both port and power plant since they are viewed as high risk areas. Similar processing is done for each coastal state and final mapping is done for India.

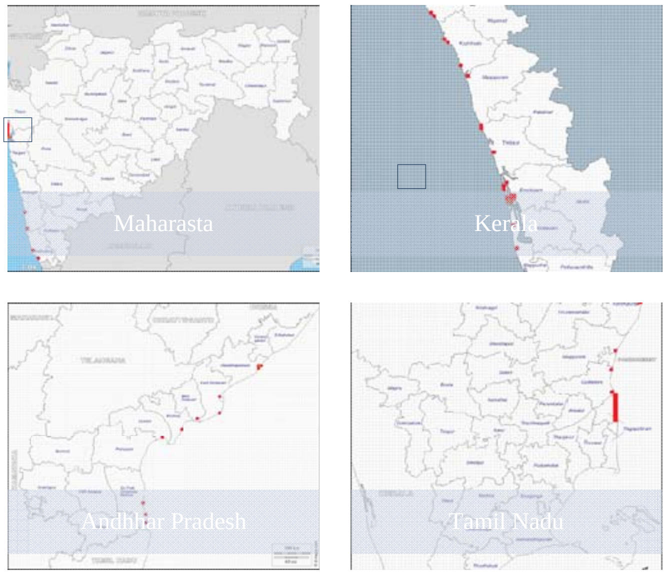
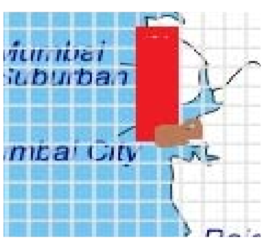
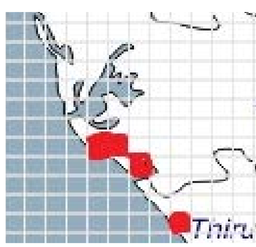


Fig. 2: Maps(cities and power plants/ ports)

Mapping of Maharastra(Mumbai)
- Red- City
- Brown - Power plant or Port

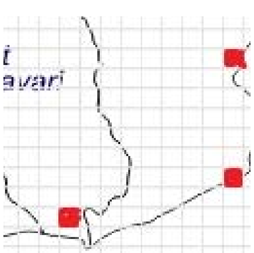
Mapping of Kerala
- Red- City
- Brown - Power plant or Port





Mapping of Andhra Pradesh
- Red- City
- Brown - Power plant or Port

Mapping of Tamil Nadu (Chennai)
- Red- City
- Brown - Power plant or Port



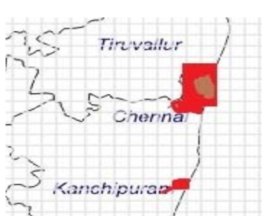


Fig 3: Detailed version of fig. 2

The future work of the project would be focused over the following objectives [6-8]:

I. The High Risk zones to be identified and mapped based on risk matrix
II. The mitigation of tsunami in the Indian Coast line

Some illustrations will be presented in the ASET 2015 conference.

4. ACKNOWLEDGEMENTS

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