EFFECTS OF TSUNAMI ON THE CHANGES OF LAND AND WATER IN THE INDIAN SUBCONTINENT

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INTRODUCTION

The recent tsunami disaster which occurred on December 26, 2004 at Banda Aceh, Sumatra as epicentre measured 9.8 on the Richter scale. It claimed over 2,80,000 human lives in South Asia. It was triggered by the world's biggest earthquake in the last 40 years. Several countries in this region viz. India, Sri Lanka, Indonesia, Thailand, Malaysia, Myanmar, Somalia and Bangladesh were severely affected by it. Tsunami struck the coastal areas of Tamil Nadu at 9 am and reached Kerala only at 12.55pm i.e. after a clear 4-hour's gap. Tsunami struck Kollam, Alapuzha and Ernakulum districts in Kerala leaving 180 people dead. Nearly 160 of them belonged to one village. 2727 houses were completely destroyed and thousands were left homeless and without livelihood. Majority of the affected was fisher folk. Thousands of fishing boats and nets were completely destroyed.

The aftermath of this tsunami was most devastating whether it was Nagapattinam in Chennai (India), Ban Nam Khem in Thailand,

Colombo in Sri Lanka or Banda Aceh in Sumatra (Fig 1, 2), the scenario was similar. Piles of rubble, wrecked houses, flooded fields, large broken fishing boats and hundreds of dead bodies strewn along the coast, untouched by people too busy trying to survive and too isolated from a massive global aid mission that has helped so many others. Initially the death of human beings was recorded as 1,60,000 (ToI, Jan 15, 2005). In India alone the figure was reported as 10,749. Later on, it was reported the increase in number as more than 2,80,000 (TOI Jan 25,2005). The corresponding figure for India was estimated to be more than 16,400.

Figure 1. Floods due to tsunami in the fields located in northwest Sumatra

Figure 2. Tsunami hitting the beach at Khao Lak, Thailand. This photograph was found on the camera of a Vancouver couple when their bodies were identified.

GEOGRAPHICAL IMPACT

The giant waves of the recent tsunami pushed India 12 cm closer to Indonesia according to the Scientists of National Geophysical Research Institute (NGRI), Hyderabad, Andhra Pradesh, India (TOI March 18, 2005). The findings are the result of analysis of data gathered over a month through Global Positioning Satellite (GPS) receivers of different localities by a team of NGRI Scientists. These post-quake coordinates of the two landmasses indicated by the GPS receivers, supplemented by the permanent GPS stations in Indonesia and India showed that Southern India had moved 10 - 15mm eastward and Sumatra a bit less westward. These movements bring the two countries 12cm nearer to each other. The massive tectonic activity off Sumatra, that triggered the deadly tsunami may have twisted the Andaman Islands and sunk an area in Port Blair – according to Dr. V.S. Ramamurthy, Secretary, Department of Science and Technology, New Delhi (India) (Pioneer, Jan 22, 2005). According to Harsh Gupta, Secretary, Department of Ocean

Development, the recordings made by the ‘tide-gauge’ (used for recording the height of the waves) placed at a certain location in Port Blair have indicated that the place has sunk by a meter due to the earthquake preceding the tsunami. However, similar testing done in Chennai did not indicate any such change. Part of Nicobar Islands - the southern most part of India (Indira point with its lighthouse and the surrounding areas are totally submerged under the Indian Ocean and the land mass is lost forever). Not only that, many smaller islands too are completely lost too; Chowra, a small island of the Nicobar chain was almost completely submerged.

ARCHEOLOGICAL FINDINGS

In Chennai, Mahabalipuram is famous for its Shore temples. After the excitement of discovering man-made rock structures under sea off Mahabalipuram coast, the excavation team of Archeological Survey of India (ASI) has now unearthed traces of two more temples on shore adjoining the Shore Temple. These findings could perhaps give credence to legends about “Seven Pagodas (Temples)” having stood on this historic spot - a flourishing port town during the reign of the Pallavas. The ASI is presently excavating the remains of two structural Temples on the Shore, both to the south of the present Shore Temple.

IMPACT ON SOIL AND WATER

It is known that in coastal areas the soil, surface water as well as ground water are generally saline. It is estimated that in 3.1 mha area along India's coastline, salinity is a serious problem affecting crop production adversely (*Yadav&Agarwal,* 1983). After this massive deluge both soil and water sources are highly enriched with salts of different chemical nature. The coastal soils have turned out to be more saline due to the process of secondary salinisation. The saline water contains excess of neutral soluble salts mostly chlorides and sulfates of Na, Ca, and Mg. Poor plant growth in saline soils will be associated with high osmotic stress, causing lower physiological availability of water, toxic ionic effect and nutritional imbalance due to complex nutrient element interactions. Salinity exerts a harmful or adverse effect on soil-biota also. Beyond a threshold level, salinity reduces the power of atmospheric Nitrogen fixation by *Nitrosomonas* or *Nitrosococcus* and *Nitrobacter.* Soil respiration has been drastically reduced in salt affected soils (Patra & Singh l992). Soil

salinity decreases P-availability to the plants due to precipitation of applied P, higher soil P-fixation, ionic antagonism, excess of Cl^{-} and SO_4^{2-} and reduced root growth (Hassain *et al*., 1970). Likewise uptake of micronutrients by plants in salt affected soils are also well documented. Most coastal areas except parts of western coast experience high rainfall during the kharif season, and rice is the major crop grown in these areas. With the receding monsoon and with the periodic inundation of the fields the soils become increasingly saline from October onwards with maximum soil salinity in the month of May. Soil and water testing would play a pivotal role in the management of the soil-water ecosystem.

Figure 3. Deposition of titanium along the devastated coast of Tamil Nadu

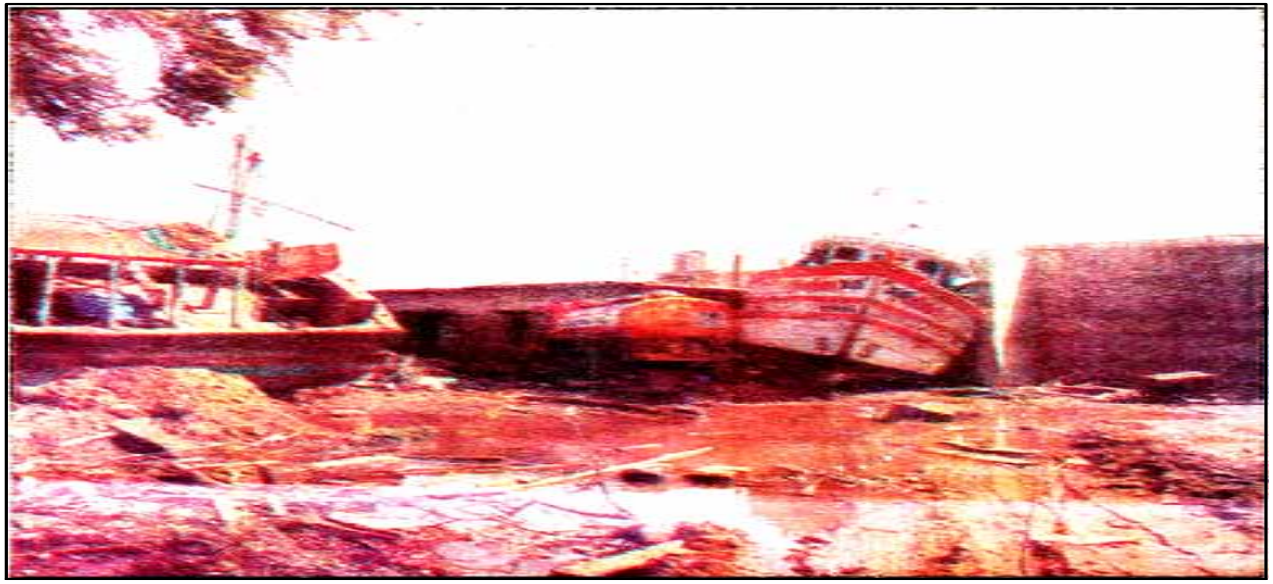

Figure 4. Tsunami caused damage at Nagapattinam Port

DEPOSITION OF TITANIUM ON COASTLINE IN TAMILNADU

Dr. V. J. Loveson, of the Central Mining Research Institute (CMRI), Dhanbad with his team, coincidentally arrived in Nagapattinum on December 26, 2004 for a routine survey but this time they had a new piece of equipment – Ground Penetrating Radar, which could scan and analyze the mineral content in the beach sand (*in situ* studies). They scanned 10-12 km stretches in Karaikal, Nagapattinum, Poombuhar and Velankanni (Figure 3). The depth of the geophysical profiles of the coast varied between 4 and 8 m and they found incremental deposits of Titanium ore varying between 1-3 m in thickness in most parts. According to Dr. Loveson, an estimate of ~40 million tons of Titanium would have been deposited along 500 km of the coastline (ToI, January 14, 2005).

ENVIRONMENTAL POLLUTION AND HEALTH HAZARD

WHO also warns of Post-tsunami trauma. It was feared that psychological trauma amongst tsunami victims might be more widespread. The mental anguish of those who narrowly escaped the tsunami or lost their close relatives, lost their homes, their belongings, their children – is unbearable. Such people need urgent psychological support (ToI, January 21, 2005)

After this most devastating incidence, the entire coastal belt wore a completely different look (Figure 4); dead bodies here and there, dead animals and pets lying around, broken houses and other buildings, broken boats, uprooted lamp posts, trees. The rivers nearby, wells in the coastal areas got contaminated with saline water. The sewage, latrines, toilets in the slum dwelling units in the coastal zones got mixed up with the tsunami water causing serious problem of water pollution. Even the effluents from the small and medium industries added to the pollution load of the aquatic system in those areas. Toxic and hazardous heavy metals would have worsened the

level of environmental pollution connected with the Biosphere through Biogeochemical cycle. After any such disaster, there is always a threat of diseases like Diarrhoea, Dysentery, Cholera, Typhoid and other water-borne diseases. WHO and UNICEF urged the Governments of the affected countries to vaccinate their children against Measles. Malaria is another disease which could kill 1,00,000 warned by the health experts from WHO (TOI, Jan14, 2005).

DISASTER MANAGEMENT PROGRAMMES

Indian Govt. has initiated to set up the Early Tsunami Warning System keeping in touch with all the leading countries of the world, particularly with the countries of Indian Ocean (ToI, January22, 2005)

Post-tsunami, the rules regulating development along coasts may get stiffer. First notified in 1991, these rules regulated the development along the coast, for the protection of mangroves, coral reefs, coastal forests, sand dunes and others. In 2002-2003, about 3500 ha along the coastal belt were brought under mangrove cover. A committee, chaired by M. S. Swaminathan, is trying to improve the CRZ (Coastal Regulatory Zone) rules. They will identify the eco-sensitive zones and important geomorphic features for effective management of coasts. Tamil Nadu is now talking of greening the coast as a protective cover. It is also being planned that the villages of the fisher-folks should be located away from the edge of the sea, and mangroves and shelter-forestry and even a seawall should be used to protect the villages. The Govt. of India announced the

Formation of National Disaster Management Authority to effectively coordinate the working of different Departments on a war-footing mission (ToI, Jan 11, 2005).

ACKNOWLEDGEMENT

We are thankful to Jawaharlal Nehru University, New Delhi and Gargi College, Delhi University, New Delhi for necessary facilities and permission. Technical Assistance rendered by Dr. Arindam Bhattacharyya is gratefully acknowledged.

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