

**Public Awareness
Education and International
cooperative Endeavors**

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The Tsunamis that hit the coast of India on 26 December, 2004, caught the country completely unaware. Our response to this event requires that we enhance our awareness for such events. However, the response must not be Tsunami-centric, because another Tsunami may not show up for half a century or a century! Considering rarity of such catastrophic events, a better option is to take a holistic view and enlarge our awareness of our coastal environment and the coastal hazards that occur along the coastline.

There are a number of compelling reasons to take this approach. Consider for example our fishing community. India has about a million active fishermen. It has been estimated that about 80% of the families that suffered due to the Tsunami came from the fishing communities that live in the low-lying areas near the coastline. Could we have lessened their pain by making them aware of the hazards that exist along the coast and preparing them for facing the eventualities that arise from the hazards? There are other reasons to pay more attention to coastal hazards. India is now investing heavily in its offshore areas: Oil and Natural Gas Commission (ONGC) is expected to invest in the offshore areas for oil and gas exploration about US\$ 1.2 billion/year in the near future. The total from all oil companies is expected to be about US\$ 2 billion/year. In addition, we have a number of other activities going on along our coastline: marine transportation; dumping of industrial waste and sewage; submarine pipelines; communication cables; ports and harbours; naval operations; etc.

The coastal region around India has special features. Driven by monsoons, the waters around India form a part of the only basin that is not connected to the mid-latitudes and polar region. The two factors, monsoon driving and confinement of the basin to tropical areas have implications to physics (circulation of the waters exhibits

seasonal reversal with fast response time), chemistry (low-oxygen environment), and biology (impact of low oxygen environment on fisheries, susceptibility to algal blooms, etc.). None of these features, however, find mention in text books used in teaching post-graduate, undergraduate, or high school courses in our educational system. To make matters worse, popular science books on these topics are not popular.

The need of the hour seems to be a major overhaul of our education infrastructure at post-graduate level. We need to make this education more quantitative and multidisciplinary with emphasis on the Earth System Science. The education must include new tools, such as mathematical modelling, Geographical Information System (GIS) and remote sensing. The need to revamp our earth science education has been highlighted recently in his editorial by Prof. P. Balaram in *Current Science* of 10 January 2005. Once the post-graduate education is reorganized, its impact will need to trickle down to lower echelons of the education system.

It is important to recognize that our coastal environment, while being a preferred location for living (25% of India lives within a 50 km corridor from the coastline), the awareness of the hazards that go with this region is rather poor. Yet, well known and quite deadly hazards are found along the coastline. The biggest hazard comes from the storm surges. This is most prevalent along the east coast, but the west coast of India too has experienced its devastation. In comparison to storm surges, Tsunamis along the coast are a rarity. But, as the recent events demonstrated, their impact can be deadly. There are other hazards known to exist along the coastline: Harmful Algal Blooms (HABs), that perturb the coastal ecosystem from time to time; coastal and estuarine pollution; etc.

Systems to prepare coastal population to face these hazards well in advance of their manifestation should be one components of Coastal Observing and Prediction System that the country must put together. Our science programmes must gear to put such a system in place. This science needs to enter curricula at various levels of education. To aid this exercise, there is a need to make data from coastal areas accessible to the lay public and to researchers.

It is now known that signatures of the December 26, 2004 Tsunami in the Indian Ocean have been observed in the Pacific. Have signatures of the great Tsunamis in the Pacific been observed in the Indian tide-gauge network? Could it be that smaller Tsunamis - triggered in the tectonically active region off Indonesian and Andaman-Nicobar islands have gone unnoticed in the past along the coast of India? Thanks to the Geodetic and Research Brach (G&RB) of the Survey of India (SOI), we have well over a century-long record of water level variability along the coast of India. Sea level time-series analysis is a wonderful way to make people in any discipline aware of the coastal environment.

As we go about putting together programmes to make our people aware of the coastal hazards, it is necessary to participate in international programmes with similar goals. We need them because coastal hazards don't recognize national boundaries. Proposals to study geophysics of the region where the M9 earthquake occurred have been put forth by Japan, France, and other countries. We should provide all the help we can to ensure that these studies progress smoothly. Equally important is the fact that oceanographers globally are putting together the Global Ocean Observing System (GOOS). Its Indian Ocean component is IO-GOOS. Our observing systems need to get integrated with IO-GOOS.

In summary, the Great Tsunami was a wake-up call to get our act together on a number of issues. The four most important amongst these are the following. First, we must assemble a Coastal Ocean Observing and Prediction System (COOPS) with coastal hazard preparedness as an important component. Second, we need to revamp the education system at all levels (post-graduate to high school) to sustain effectiveness of our research initiatives including COOPS. Third, we will need to enhance public access to historical data on coastal environment, including sea level data, to support science of our coastal ocean regime. Fourth, we should support international programmes to integrate our science with the global effort.