Tsunami Warning System: Beyond Technological Fixes

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China, nor in the former Soviet Union. The thinking of the traditional left of all shades appears confused from the pronouncements that they make on economic policy. They now know what did not work, but they also know that the other model would largely be an extension of global capitalism dictated by the interests of the richer countries. The way out, I believe, lies in a clever mixture of rapid expansion in the domestic purchasing power of the poor people with expansion of productive capacity through decentralisation, reaching the lowest level of elected local governments, e g, the panchayats. The expansion in purchasing power would come from public works financed initially, if necessary, through deficits of central and state budgets. But without going in for the 'gigantism' of large, high-tech projects, they would by and large finance manageable decentralised projects of rural communications, warehouses, school buildings, health centres, minor irrigation schemes, etc. The panchayats must have the full financial authority to design and implement these projects. Transparency and the right to information at all levels is not primarily a moral issue in this context; it is not even an issue of deepening our political democracy. The best way would be to see it as the mechanism through which our political democracy is brought closer to our as yet grossly distorted economic democracy. "(S)he who benefits should largely pay" would be the guideline of this kind of decentralised public works and they would be time-bound programmes, without creating the blackhole an indefinite income transfer to the panchayats from the state governments. It would differ from short-term Keynesian style demand management, insofar as the investment would not be financed over the medium-term from utilisation of the excess capacity, but from capacity created and utilised through these decentralised works. But in order to break new ground, the government at the centre and states should not be afraid of deficit financing.

Bureaucratic Dodge

The tragedy of the current Employment Guarantee Bill, 2004 is that it is a deliberate bureaucratic dodge which is almost bound to discredit itself. There is almost no scope for local initiative at the panchayat level. The 'poor households' will not self-select themselves at the local level, but some difficult-to-operationalise bureaucratic norms would decide it for them. The employment guarantee schemes to be initiated at the state level can anytime be modified by the notification of the central government. Even the wages to be paid are not the statutory minimum. Worst still, the Bill almost divorces the employment guarantee schemes from unhindered access to information to the concerned public by stating that relevant documents (e g, like muster rolls) would be available only "after paying such fee as may be specified in the scheme". A neat scheme indeed for price-rationing out of the poor working on the projects.

The pathetic state of affairs of our developmental politics becomes all the more clear when we consider it in the light of the Right to Information Bill 2004. The Bill actually is retrogressive in withdrawing access given in the earlier Act to information available with the state governments, district or local-level administration. And, to my knowledge, no state has objected. They neither want to share the financial burden for a wider employment guarantee scheme, nor do they want to be open to public accountability or share power genuinely with the panchayats. It is the path of least resistance for the powers that be, no matter what they preach to the electorate. But this arrangement of convenience would be short-lived, if justice is not done to the poor by this government. By the next election, they would again mete out justice to a government that refused to be just to them. EPW

Tsunami Warning System

Beyond Technological Fixes

To be effective, a tsunami warning system must consider resolving basic scientific problems inherent in non-linear phenomena such as earthquakes and volcanic eruptions. It must move beyond the notion of technological fixes to include people, their levels of awareness and perception, within the overall structure of warning system.

BISWANATH DASH

The massive earthquake on December 26 in the Indian Ocean triggered off tsunami waves, resulting in a colossal loss of lives and affecting millions of people in 11 countries. The total death toll is in excess of 1,50,000 with thousands more missing and the devastation caused is unprecedented in contemporary history. Given the fact that a majority of the affected population are ecnomically poor, the rehabilitation process is going to be extremely difficult. One of the major policy responses on the part of the government in India has been an announcement to install tsunami warning system for the country. Such a warning system is most essential to ensure preparedness for future occurrences of similar hazards but the installation process itself will be a major challenge considering the requirement of real time data sharing that will be involved among various participating countries. However to be truly effective, such a warning system must address two other important aspects: (i) resolving the basic problems inherent in sciences such as seismology and volcanology and (ii) connecting people with warning technology for the desired results. While the first concerns the science involved and assumes that a warning system is as good as our understanding of the observed phenomena, the second relates to moving beyond the notion of technological fixes and includes people, their awareness, perception, existing social structures, etc, within the overall structure of warning system to make it effective.

The tsunami has raised many questions, some of which touch upon our very understanding of nature. One most widely discussed issue after the disaster struck was; why did we not have an early-warning or any anticipation of such tsunami waves hitting our coasts. According to seismic science, the earth on which we live consists of a number of large and small tectonic plates[1] that float on a fluid surface. The movement along the edges of these plates (faultlines) provide ground for the release of energy and cause the phenomena known as earthquakes. The region where the earthquake occurred on December 26 falls under a major faultline where high intensity earthquakes can always be expected. If this is so, why did the scientific community in India not consider tsunami to be a distinct possibility? For example, the Indian Meteorological Department (IMD), the nodal government agency for detecting earthquakes and other meteorological events such as cyclonic storms, never included tsunamis as part of its mandate. Such lack of anticipation is most evident from the fact that after the department (IMD) detected the earthquake and its epicentre in the Indian Ocean, it did not realise that there could be secondary effects leading from it until news of tsunami waves hitting the south Indian coast were reported on television.[2] This becomes really difficult to comprehend because there were not only clear evidences of earlier tsunamis in the Indian Ocean region[3] but also historical records of high seismicity. In such a case, how could the scientific establishment in India not anticipate the secondary effects that could result from earthquakes under sea? The argument that the particular fault-line falls under the Indian Ocean and given the geopolitical realities of the world, such faultlines are less studied in comparison to those in Pacific is valid to large extent, but if acknowledged leads to bigger issues such as nature and universality of seismology science. For example, if seismology as a science is based on certain basic principles, these principles cannot be different for different regions on the earth. Thus the only plausible explanation for not being prepared appears to be the non-occurrence of a tsunami of comparable intensity in recent history, because of which, there was lack of regional collaboration required to put an early warning system in operation. However, even if one assumes the above to be true, it still does not explain why the scientific establishment failed to anticipate tsunamis as a high probable risk from geological disturbances in the region.

The problem really lies in our approach to understand complex non-linear phenomena such as earthquakes and tsunamis and our assumption that current scientific thinking and avilable methods are adequate to understand them. Thus theoretical breakthroughs have always been considered a matter of disciplinary development to be achieved in due course of time. The fact though remains that as of now we understand very little as to when and how the earth experiences such severe tremors at some selected places. Similarly, the tsunami phenomenon itself is very poorly understood[4] and it is not yet known clearly, precisely what amount of energy release can cause these giant tsunami waves to be formed, what facilitates such wave formation, how do they move on the surface of sea the energy distribution of these waves, how these are different from the normal sea tides observed at the shore? In fact, we are also not any better placed in our understanding of similar other non-linear phenomena such as cyclonic storms, climate change and its impact. The point is, without adequate understanding of such phenomena, it becomes very difficult to have an early warning system which can be reliable and effective in saving lives.

It is pertinient here to note that earthquake zoning of the country needs to be further scrutinised now, keeping in view the impact of this earthquake. For example, in spite of the distance from the epicentre, tremors were felt over a large area in the eastern coast of India. The necessity for further scientific research is best understood when we look at current methods of measuring an earthquake's magnitude which appear to be too vague to be useful. For example, the IMD measured the earthquake of December 26 as 8.6 in the Richter scale, whereas Earthquake Research Institute in Japan estimated the same to be 9 and the United States Geological Survey initially measured it to be 8 and subsequently revised it to 9 in the same scale.[5] Given that these small differences are significant in terms of energy release, it raises an important question; that is, when a warning system for tsunami is based primarily on estimating the size of the earthquake, can we expect such a system to function effectively where methods of measurement are so flexible? Further such a magnitude also dependant on the depth at which the earthquake occurs and thus provide very little information. The point being made here is in addition to installation of warning infrastructure such as sensors, communication networks we must also give high priority to further research in related areas with fresh ideas to complement such warning system.

The seond set of issues which pertain to combining warning technology with people arises because issuing a tsunami warning in itself is not going to automatically lead to evacuation of millions of people living along the coast. The experinces in our country where a warning system for cyclonic storms exists indicate that evacuating the vulnerable population is far from easy. For example, during the Orissa supercyclone in 1999, the IMD provided warnings which were technically correct but such warning did not lead to evacuation[6] and as a result nearly 10,000 people died. The problem for disaster managers in case of a tsunami warning is really compounded because the phenomenon unlike cyclones[7] provides very little lead time, at the most an hour or so, for evacuation to safe places. In addition to this, while warnings for cyclonic storms are based on land fall forecasts which help in delimiting the vulnerable coastal areas needing to be evacuated to a maximum of a few hundred kilometres, the same is not the case for tsunamis. As it is known and also seen in the instance of this disaster, tsunami waves can travel great distances which means vulnerable coastal areas extend over a large area and the number of threatened population needing to be evacuated will be much more in comparision. To make a tsunami warning system effective, there should also be adequate consideration to the evacuation process which also includes false warnings, dissemination, public perception about issuing authority, road communication, etc. We have already had an instance of false tsunami warnings in India and given the poor understanding of this phenomenon, there are going to be many such cases in future as well.

There are several other issues which are equally important in connecting warning technology with the people and needs to be further deliberated. For example, where do we expect the threatened population to evacuate? How far from the sea can be considered a safe distance from the approaching waves considering that this distance will be related to the topography of coastal areas. Can we have an adequate number of multi-purpose shelters at appropiate locations all along the coast and can we maintain such shelters over long periods of time? How do we ensure that people overcome their fear of losing their household belongings during a period of temporary absence? In essence, to develop an effective tsunami warning system we must try and understand the phenomena better with new ideas and at the same time integrate the best available warning technology with other factors such as awareness among all sections of society, proper warning dissemination and evacuation plans. EPW

Notes

1 The plate tectonic theory is a relatively a new scientific concept emerging from continental drift theory, see J Kious and R I Tilling (1996), *This Dynamic Earth: The Story of Plate Tectonics*, US government printing office, Washinton, DC.

2 The director general of IMD was reported as saying the department had quick information about occurrence of the earthquake and its epicentre but learnt about tsunami waves from television, *The Times of India*, Delhi, December 30, 2004.

3 There are clear evidences that tsunamis have occurred earlier in the Indian Ocean region during 1883 and 1941, B H Choi, E Pelinovsky, K O Kim, J S Lee (2003), 'Simulation of the Transoceanic Tsunami Propagation due to the 1883 Krakatau Volcanic Eruption', *Natural Hazards and Earth System Sciences*, (3): 321-32.

4 G Pararas-Carayannis, 'Tsunami: Forecasting Preparedness and Warning', Fifteenth Conference on Broadcast Meteorology of the American Meteorological Society, April 9-12, 1985, Honolulu, Hawaii .

5 'How Scientists and Victims Watched Helplessly', *The New York Times*, December 31, 2004.

6 See B Dash (2003), 'Orissa Super Cyclone: A Case of Inadequate Warning', *Asian Disaster Management News*, Vol 9 (1) and also B Dash (2002), 'Lessons from Orissa Super Cyclone', *Economic and Political Weekly*, Vol XXXVII (42): 4270-71.

7 Cyclones provide considerable lead time sometime extending up to days for evacuation.

PRE- AND POST-TSUNAMI

Is the Sethusamudram Shipping Canal Project Technically Feasible?

The tsunami of December 26 has given us an idea of what might happen to the proposed Sethusamudram Shipping Canal. Rushing through with the project without analysing issues related to sedimentation and meteorological regimes might cause a great economic disaster.

R RAMESH

The Sethusamudram Shipping Canal Project (SSCP) is an offshore shipping canal project in the Palk Bay. It plans to cut short the distance navigated by ships sailing from the west coast and bound for ports on the east coast by avoiding circumnavigation of Sri Lanka. Ships would navigate through the Gulf of Mannar and Palk Bay and enter the Bay of Bengal directly.

The tsunami that battered the east coast on December 26, 2004, has generated a renewed debate on the technical feasibility of the canal. We shall look into the pre- and post-tsunami technical issues that the canal project is facing.

Let us first consider the events that occurred at the project site during the tsunami. We base our observations on the three animation models by 'tsunami and water body modelling experts' around the world[1,2,3] and the newspaper reports of the events that had affected the places in the project area.

Tsunami and Palk Bay

The December 26 tsunami was generated by an earthquake of 9 Richter magnitude off the west coast of north Sumatra. Its hypocentre was at a depth of 30 km below mean sea level. The earthquake was unusually large in geographical extent. An estimated 1,200 km of faultline slipped 20 m along the subduction zone where the India Plate dives under the Burma Plate. The seabed of the Burma Plate is estimated to have risen several metres vertically up over the India plate, creating shock waves in the Indian Ocean that travelled at up to 800 km/per hour, forming tsunamis which, while less than a metre high in deep water, resulted in huge waves when they reached land.

The tsunami waves travelled west and eastwards. The eastern wavefront was blocked by the Thai, Malaysian and Indonesian landmasses. Hence a portion