

## Coping with disasters in future: Some Indian initiatives\*

The 2004 tsunami was a demonstration of the enormity of damage that could be caused on the Indian coast, by an earthquake located more than 2000 km away. Even countries far away, such as Maldives and Somalia were not spared. The lesson that came through was that we cannot afford to ignore the existence of some of these seismic sources, although located far beyond our political boundaries. It has sent a message, that we need to gear up to handle such events in future, to expand our data-gathering capabilities and use more advanced technologies for faster communication of information. The response of the political, administrative and scientific community to this unprecedented event was overwhelming. Meetings and workshops are now being organized at various levels, to evolve programmes to develop effective strategies to mitigate damage due to such events in future. Here we report on three important meetings, with the above goal.

(a) The brainstorming session organized jointly by the Departments of Science and Technology, Ocean Development and Space, together with CSIR and INSA, New Delhi was attended by nearly 200 delegates – seismologists, geologists, ocean scientists, physicists, engineers, and tsunami experts. Experts from USA, Canada, Germany, Japan, Russia as well as representatives of the UN and diplomats from some neighbouring countries attended this meeting. Deliberations took place in two technical sessions over two days, followed by a panel discussion that reviewed the main ideas that emerged. At the end of the discussions, H. K. Gupta (Secretary, Department of Ocean Development) presented an action plan, which involved deployment of 8 DART systems; he also proposed linking up of some of the seismic observatories to obtain near-real-time data on source parameters. DST proposed further strengthening of its network and upgradation of the communication network for near-real-time data transfer and strengthening of computing

facilities. The panel discussions focused on the future course of action. Strengthening of seismological monitoring; expansion on tide gauge network and deployment of DART-type pressure-monitoring devices, preparation of inundation maps, ocean and near-shore maps; identification of past tsunami deposits and improved modelling capabilities were identified as priority issues. Setting up of a 24 h tsunami-warning centre, with real-time data processing and computational facilities and capabilities to issue warnings on other types of disasters, such as cyclones, surges, etc. was recommended. The need to strengthen trained manpower in specialized areas of earth sciences and to improve education and public awareness are other issues to which the meeting drew attention. A consensus that emerged was that, while an operational warning system is being installed, there is a definite need to evolve a national research agenda to improve the coastal hazard preparedness.

(b) The two-day national workshop on formulation of science plan for coastal hazard preparedness held at NIO, Goa aimed at evolving appropriate research programmes that would help develop a long-term action-plan. The basic themes discussed at the workshop concerned methodologies to search for past storm surges, including tsunamis, using the archived tide gauge data and geologic evidence. Assessing the seismicity of the region, with an appreciation of the tsunamigenic sources, studies on near-shore bathymetry, geomorphology, coastal inundation, coastal engineering and coastal erosion were among the main issues addressed, in addition to the important aspect of education and public awareness. Eighty-seven researchers from various research organizations and universities attended this workshop, where 70 proposals, whose outlines were available to all participants were discussed. This type of discussion, focusing on specific goals involving a broad spectrum of workers, provided a unique opportunity for interactions and formulating research programmes through collaboration among specialists. Above all, it brought together the best talents in the country where one could take stock of our needs, capabilities and availability of resources. The proposals, put together in the science plan may now be considered by national agencies such as the CSIR, DST, DOD and others.

(c) The Indo-Japan workshop at NGRI, Hyderabad, funded jointly by DST and Japan Society for Promotion of Science, was another effort to bring together experts from various countries and formulate future programmes. The important themes discussed were: (1) practices in real-time monitoring of earthquakes and data handling, (2) components of tsunami-warning system, issues related to simulation and modelling, including methodologies for inundation mapping, (3) R&D, including earthquake precursory studies as related to tsunami, (4) public awareness, (5) post-seismic and aseismic slip monitoring, (6) palaeoseismology from coastal geology/geomorphology, and (7) tsunami effects on coastal environment. Indian initiatives for developing an early warning system for oceanogenic disasters, Japanese experiences on tsunami detection, success of the cabled ocean floor observatory in predicting tsunamis, strategies for disaster reduction and the ongoing efforts to understand earthquake processes in subduction zones, results of geodetic/GPS observations and field studies of deformation, near and far field inundation mapping were the major topics discussed. The major recommendations were not different from those of the earlier meetings, but this one provided a forum to identify collaborative research programmes between Indian and Japanese researchers. It also gave a flavour of the experiences of the Japanese efforts in monitoring earthquakes and tsunamis and managing local tsunami-warning systems.

Discussions in all these meetings generally focused on the need to address issues specific to the Indian Ocean region, drawing from the experience of Pacific and Japanese warning systems. The Indian Ocean situation calls for a regional warning system that would not get much lead time, at least for some of its coastal regions under threat, such as the Andaman and Nicobar. Obviously, the effectiveness of a warning system depends on the speed with which information can be communicated to the regions likely to be affected. Our capabilities in space technology, quick and effective dissemination of information and transmission through audio-visual media should make this feasible, as was discussed in these meetings.

In summary, the three important events in January, February and March 2005,

\*A report on three meetings regarding strategies to mitigate damage due to earthquakes and tsunamis – the brainstorming session at INSA, Delhi (21 and 22 January 2005); the meeting at NIO, Goa (18–19 February 2005) and the Indo-Japan Workshop at NGRI, Hyderabad (18–19 March 2005).

zeroed in on the immediate steps that the country must follow, to minimize the enormity of similar disasters in future. The brainstorming at New Delhi helped to consolidate an action plan for a tsunami-warning centre, which is expected to take shape in the immediate future; discussions at Goa have successfully put forward feasible research programmes that will generate data and provide inputs for realizing this action plan as well as other coastal disasters and the Indo-Japan workshop has identified specific problems that researchers can indulge in, to understand

the nature of earthquake recurrence, its effect on coastal regions and the use of modern technologies such as GPS-based tsunami-warning systems.

Indeed, the year 2004 ended with a catastrophe that caught us unawares; it has taught us that disasters may strike where it least expected and they can never be prevented. Perhaps, with the passage of time, at least some of them would become predictable, with reasonable reliability, thereby improving our level of preparedness. The outcome of these meetings will surely lead us in that direction, toward better

appreciation of disasters looming in the horizon and to better preparedness – through improved database, better communication network and a pivotal system that will step into action in times of emergency.

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## Genetically modified organisms – Biosafety aspects\*

Genetically modified plants/organisms have been adopted globally during the past five to seven years. Up to now, many characteristics have been modified by transgenic technology in crop plants. These include resistance to insects, pests and diseases, enhanced nutritional qualities, resistance to abiotic stress and development of new varieties. However, the scientific community is still divided over the issue of transgenic technology. Debates and discussions are held at various fora over the uses and risks involved in transgenic technology. There is less scientific consensus on the free release of transgenic varieties. Many people are still disillusioned over the environmental hazards associated with transgenic crops. To educate students, researchers, college and university teachers, and to address certain concerns regarding genetically modified organisms (GMOs), Delhi University Botanical Society (DUBS) organized a National Seminar on Genetically Modified Organisms – Biosafety Aspects.

The two-day deliberations consisted of five scientific technical sessions and a panel discussion. The main topics covered were: Status and priorities for biotech crops; Technology options for development of genetically modified crops; Biosafety aspects of genetically modified organisms; Development of transgenic crops in India;

Risk assessment and regulatory procedures and Conventions and IPR issues.

The seminar was inaugurated by Deepak Pental (Director, University of Delhi, South Campus). He stressed on the importance and application of transgenic technology for betterment of mankind and emphasized on proactive research in this area. Pental emphasized that GMOs are needed to improve food security and national economy of the country, and India has to open the gates to this technology. K. R. Koundal (Director, National Research Centre (NRC), Plant Biotechnology) in his presidential address, highlighted the status and priorities of agricultural biotechnology in India. He stressed on the need for collaborative research in transgenics and focused on confidence-building measures, which should be adopted to make GMOs people-friendly. Koundal stressed that better scientific evaluation methods have to be designed to study the risks associated with GMOs and combat the myths associated with them.

Since *Bt*-crops are one of the commonly grown transgenic crops and have been permitted by GEAC (Genetic Engineering Approval Committee), the discussion was centred on *Bt*-crop technology. P. Ananda Kumar (NRC Biotechnology, Indian Agricultural Research Institute (IARI)) spoke about '*Bt*-transgenic crops'. His presentation gave a detailed overview of *Bt*-technology, right from its inception to its present status. 'The biosafety of *Bt*-insecticidal proteins to biodiversity and environment has been intensively investigated and documented. Abundant scientific evidences indicate that cultivation of *Bt*-crops is safe to the environment. The assessment of risk and biosafety will have to be carried out on a case-by-case basis taking various factors

into consideration, which include geographical location where the crop is intended to be grown', according to Kumar. Concluding his talk, Kumar cautioned the audience that transgenic crop cultivation has to be integrated with practices that nurture crop diversity, crop rotation, soil fertility and wild life diversity. Raj K. Bhatnagar (International Centre for Genetic Engineering and Biotechnology (ICGEB), New Delhi) gave a lecture on 'Insecticidal proteins of *Bacillus thuringiensis* and their application'. Critical evaluation of performance of transgenic crops over the years has demonstrated economic, environmental and social benefits of *Bt*-crops and the major reason for acceptance of *Bt*-proteins is their lack of interaction and activity in mammals, including man. He elucidated how the onset of resistance in insects against *Bt*-insecticidal proteins is delayed and what strategies are being practised to avoid resistance and improved expression of insecticidal proteins in transgenes to prevent escape from cultivated crop systems to wild relatives.

The safety and regulatory concerns associated with transgenic crops constitute a major hurdle for developing countries, because many lack the regulatory frameworks and technical capacity necessary to evaluate these crops and the conflicting claims surrounding them. Gurinder Jit Randhawa (NRC on DNA fingerprinting, National Bureau of Plant Genetic Resources (NBPGR)), New Delhi, in her presentation gave information on steps taken by NBPGR to issue permits for transgenic planting material for research purposes. According to her, 'Since 1997, transgenic lines are being imported on regular basis through NBPGR and till date 32 imports of different crops

\*A report on the seminar organized at Indian National Science Academy, New Delhi during 10–11 March 2005, in the memory of late P. Maheshwari, doyen of plant embryology in India and founder of Delhi University Botanical Society, as a part of his birth centenary celebrations. The seminar was sponsored by the Ministry of Environment and Forests, Government of India.