

We stayed at Kankhoi (Bhachou Taluka), and strayed 8–10 km into the Rann. Typical observations are as follows:

1. Destruction in Bhuj and Gandhidham is qualitatively different than in Bhachou, Anjar and Ratnal. Bhachou in particular looked as if some of the buildings may have sunk into the earth, while many dwellings moved away and collapsed. Demolished structures looked as if they had been ground. It was notable that irrespective of the size, shape or the construction material, all structures were destroyed in this region.
2. Half of Anjar, Bhachou and the villages near Chobari have a similar pattern of destruction.
3. About 4–5 km from Kankhoi in the Rann, we found psi-shaped fissures on the surface, a few inches wide

and few meters long, though not very deep.

4. There is practically no damage to trees and crops all along, and hardly any impact on the sea-shore we visited. Villagers told us that in the past there was an earthquake when trees got uprooted but buildings were not damaged. If true, this is surprising, and merits attention.

Seeing the pattern of destruction, it seems that Bhachou and similarly ruined towns/villages not only experienced jolts from the earth movement; there may have occurred fissures in the earth as wide as a few meters and tens of meters deep. A possible cause could be a belt of shallow or hollow tunnels beneath the earth surface in this region. Obviously relocation of the villages would be necessary rather than going for quake designs. In Ahmedabad and Bhuj, strong ground oscillations appear

to have been dominant, as we gathered from the vivid narrations by the people. Here, efforts to build earthquake structures would be important.

Experts say that fore-shocks and after-shocks are normal. It would be better to analyse such data of minor tremors instead of making general statements. Immediate installation of seismic activity sensors/detectors deep inside the earth at Bhachou and continuous monitoring of the intensity and duration of the tremors there would provide useful information to understand the mechanism of the earthquakes. I appeal to scientists to act as fast as possible.

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Public policy for natural hazard management

In the last decade four disastrous earthquakes (1991 Uttarkashi, 1993 Latur, 1999 Chamoli, 2001 Bhuj) and two extremely destructive coastal storms (1998 Kachchh and 1999 Orissa) struck the Indian subcontinent. But we did not learn any lesson on hazard preparedness. With all the determination and capabilities we, the governments and the people of India, have failed to cope with the variety of natural hazards that strike India relentlessly year after year. There is therefore a need for addressing the problem squarely and systematically.

Public policy for natural hazard management should include landuse classification, building codes, capital investments by governments, public information, education and warning.

Policy plans include formulating and enforcing laws and regulations for preventing or restricting development and use of the lands prone to hazards as indicated in the hazard-zoning maps. Since preventive and restrictive measures have proved ineffective in India, the most effective way of curbing the

tendency to occupy hazardous tracts would be to impose a series of disincentives such as (i) denial of government assistance for development of roads, hospitals, schools, etc. in the identified hazard-prone areas, (ii) non-availability of loans from banks, (iii) denial of essential supplies such as water and electricity, and public services such as communication lines, sewer system, bus service, etc. and (iv) denial of insurance against hazards, natural or man-made.

Alternatively, the government can acquire the areas for alternative landuse such as recreation parks, wildlife sanctuaries, afforestation or allowing the original owners to pursue agriculture but forbidding construction of buildings, etc. In this way productive use is made of the land that is in short supply while the degree of risk is reduced.

A distinction must be made between a critical structure and an ordinary structure. A critical structure, such as a nuclear power plant or high dam, is one whose destruction or severe damage by a natural disaster would cause such ex-

tensive damage that it should not be built even if the chance of hazard is relatively small. An ordinary structure (e.g. building or a bridge) might fail or cause property damage or loss of life but the destruction would not be catastrophic.

There is also a need for legislation for mobilizing financial resources for monitoring, research and management of hazards.

Formation of a national commission (which might be called the Natural Hazards Management Commission (NHMC)) is necessary to provide the community with all information relating to vulnerability of the areas to hazards, extent and magnitude of risks and likely impacts, and the mitigation measures to be taken up in time. This can be conveyed through periodic bulletins on hazards or other media containing all the information, including the hazard zoning maps. The Commission would plan and coordinate the efforts of different government agencies and voluntary organizations mobilized to cope with hazard, relief and rehabilitation. It

may be emphasized that each government agency through its normal activities is expected to provide leadership and take action to reduce the risk and minimize impacts. The chief of the NHMC will act as the coordinator (*in the manner of the Chief Election Commissioner during elections*) and help mobilize governmental personnel and civil defence organization, and provide financial assistance for all measures, including relief, medicare, food, sanitation, shelter, unemployment allowances, loans for economic recovery, etc.

The NHMC would develop and promote an integrated programme of hazard-zone mapping and landuse classification. The programme can be pursued through academic and research institutions, if need be on contractual basis. The various maps and comprehensive reports may be published and distributed among all agencies, organizations and the interested public.

The local governments should be required to identify areas prone to any hazard and publish information regard-

ing the frequency of hazard and the magnitude of risks. Simultaneously, they should identify buildings and structures that are too dangerous for continued/future use. The local governments would have their own hazard-management plan to be approved and coordinated by the NHMC.

The critical parts of the identified hazard zones, through an agency are to be constituted or contracted through the NHMC, compulsorily acquired by the governments and converted to parks, forests, fuelwood farms, fodder farms, horticultural gardens, etc. There is a strong need for legislation enforcing disincentives for use and occupation of the identified hazard-prone areas.

Local governments should lay down building codes in populated areas identified as hazard-prone. Building standards should be enforced even by lending and mortgaging agencies, such as banks, which should not support or finance construction without first ascertaining that adequate safeguards against hazards have been incorporated into the

construction plan. Implied in this regulation is the full declaration by the applicants of reports on the state-of-the-environment of the area, including its vulnerability to hazards.

The National Commission of Hazard Management would monitor and adjudicate the observance of the hazard-management rules by the local governments.

Effective network of satellite-based telecommunication must be developed in the disaster-prone areas. Instead of investing in laying wires and meeting recurrent cost of periodic repairs and maintenance, it will be prudent to invest heavily for this efficient and reliable mode of communication, the satellite telephones, with at least one telephone in every settlement.

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NEWS

Goa University – Setting a model for the rest of India

As captain of the ship for over three years now, dynamic and forward-looking Vice-Chancellor of Goa University, B. S. Sonde gave an insight into the on-going activities of this 'young' University, as he termed it. In a half-hour interview, recently, he spelt out his dreams and future directions.

'A historical perspective is essential to understand the achievements' said Sonde. Taleigao plateau, overlooking the scenic Zuari river joining the Arabian Sea is the home of one of India's young universities. Set up as late as 1985-86, Goa University grew around what was the Centre for Post-Graduate Instruction and Research, affiliated to the University of Bombay, established in 1965. Before this, surprisingly only Medicine and Pharmacy Licenciates, both founded in 1840 were the sum-total of higher education in Goa leaving

'only the adventurous' to search for education outside the region. These Licenciates were the earliest to be established in the subcontinent.

In 1961, the integration of Goa with India saw the beginnings of a proper educational framework. The Goa Medical College and Pharmacy evolved in 1963 and was soon followed by other institutions. Out of two alternatives open to the Goans, Central or State funding for their University, they chose the latter and Goa University was born. It comprises now of 22 University teaching departments, 4 UGC centres, an academic staff college and a fleet of 43 affiliated colleges, for both professional and general courses and 6 institutions conducting research which are recognized by the University.

Goa University has taken a 'unique step forward' according to Sonde. Our

meeting naturally concentrated on science-related programmes. Arising from the interest of the university, in the fields of life, natural and environmental sciences, the departments of Earth and Computer Sciences have begun a fruitful collaboration supported by Indian Space Research Organization (ISRO), Bangalore, in the form of a Remote Sensing Laboratory (RSL). This unique laboratory concentrates on application of remote sensing and Geographic Information Systems (GIS) in Goa. Also, a common course is conducted in remote sensing with emphasis on issues relevant to the region, open to all post-graduate students in the science stream. This 'makes them proficient with a modern additional tool and a right perspective, to do research', stated Sonde.

Under a Goa University – National Informatics Centre, New Delhi co-