Meeting the challenges of earthquake disaster

Recently President A. P. J. Kalam had urged scientists to develop a viable earthquake prediction capability to help reduce the scourge of destruction and fatalities in such disasters.

Seismologists and geologists have pronounced a grave threat of devastating future earthquakes in the Himalaya[1,2]. Renowned earthquake engineer A. S. Arya[3] has determined that such an event could claim 100,000 to 150,000 lives. Similarly, Max Wyss[4] estimates that a magnitude 8.1 earthquake in the Uttaranchal region can claim 96,000 to 199,000 human lives and between 210–433 thousand injured people in Dehradun. However, retrofitting the vulnerable housing stock can substantially reduce the losses both of life as well as property. We note that the engineers have produced the necessary building codes, implementation of which could help reduce the building damage and as a consequence human fatalities also.

Some initial efforts by government agencies, national (e.g. SEEDS and others) and international (e.g. Geohazards International, USA) NGOs are now going on. But by any reckoning this effort is far too short of what is required. We have a very large number of old and non-engineered dwellings in cities, towns and villages. Hence we need to take a fresh look at how to proceed in this matter. The needed effort requires a national participation and mass movement from grass-roots level upwards. I venture to propose some avenues of a complementary nature for the consideration of public and governments alike.

Civil engineering departments may adopt vulnerable regions for study of their retrofitting needs. They may assign thesis topics to their students to identify the needs and prepare retrofitting designs and estimates of cost. The required funds could be sought from sources such as the Government, World Bank, etc. The construction programme could be implemented by the students who did the initial studies. This approach would ensure the involvement of the trained people at grass-roots level of the society, as well as provide self-employment to engineering graduates.

Activate the political system and make the legislators responsible to take up retrofitting programmes in their constituencies using special funds provided to them as legislators for their constituencies for this purpose.

Form voluntary groups of engineers in cities and towns to provide technical advice to the needy, free of professional fee, etc. as is done for legal advice by groups of attorneys and by doctors for eye camps, etc. The organizations like the Institution of Engineers, the Institution of Architects and Town Planners, Universities and IITs must take initiative, and open dispensing windows for advisement on retrofitting plans.

Involve the media resources, particularly the icons of film industry, to bring out films/serials/documentaries based on earthquake disaster and reconstruction to take earthquake-safe practices to the homes of a large population very quickly. We might model such programmes on the lines of programmes aired on Discovery Channel investigating how the pyramids might have been constructed, etc.

Introduce a compulsory insurance plan against earthquake disaster that rewards buildings with better earthquake-resistant features by keeping their premiums lower.

Lastly, we should harness human as well as economic potential of the industrial houses and corporations. Here, Bill Gates' programme in respect of AIDS in India is notable.

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Water pollution and groundwater recharging

According to the prescribed desirable limits for pesticides, DDT, heptachlor and BHC should be totally absent in drinking water. Unfortunately, total-DDT, heptachlor and BHC, have been found to be maximum at around 1064, 97 and 115 nanograms per litre respectively[1] in Yamuna water supplied to Delhi.

The normal concentration of arsenic in human hair is around 50 to 250 ppb but hair samples of some individuals from Raipur, Chhattisgarh and from Choube Chapra, Bihar were found to be 6310 and 4790 ppb respectively[2]. This was due to regular consumption of water containing high concentration of arsenic.

In India, around 62.5 million people are suffering from disorder of teeth or bones through fluorosis[3], which is due to consumption of fluoride-rich water.

Is the above scenario of water pollution in India not alarming? Virtually almost all the surface water in India is unfit for direct consumption. In spite of the fact that the municipal water supply in most of the cities is through treated surface water, due to over contamination, more stringent treatments would be required to make the surface water potable. The most prominent source of surface water pollution is domestic sewage, industrial wastewater and the agricultural run-off. The alert, cautious and sound urban society is spending a lot against the polluted water but at the same time the rural folk are silently following the path of slow suicide.

Society has been struggling against the problem of water pollution and trying to counteract it. Meanwhile, another problem, namely, of water scarcity arose, over the last few years. The groundwater level declined at an accelerated rate during summer. Mainly two causes, for such an unexpected experience were reported by scientists. One as excessive evaporation of surface or sub-soil water due to very high temperature in summer[4] and second, pumping of excessive groundwater during summer for agricultural as well as for domestic purposes.

No doubt, their assumptions were very close to being correct, but unfortunately they could not come to the root cause, specially in the case of the problem in urban areas. The authors believe that if the municipal water supply would have been sufficient to meet the public need, the general public would not have been forced into using difficult and expensive independent water pumping systems involving jet pumps or submersible water pumps. Domestic independent water pumping systems promote wastage of water. Thus, if the concerned authorities would have improved the municipal water supply systems in time, such a problem would not have arisen.

Likewise, in the case of rural areas, traditional system of flood irrigation is followed, in which large amount of ground water is wasted through evaporation, leaching and surface flow. Water leaching from agricultural farms is harmful. Such water carries a high concentration of chemicals, especially fertilizers and pesticides, which pollute the groundwater pool. Various alternative modern systems of irrigation such as furrow, surface drip, subsurface drip, sprinkler, etc. are available but their correlation and suitability with respect to the crop, crop cycle, climate and other agro-economic factors need to be wisely explored.

Recently, the Government of India has recommended installation of groundwater recharging units at the domestic level. We feel that it is important for the authorities to gain scientific knowledge of artificial recharging in order to adequately protect the groundwater aquifers. There are certain grounds, which should be analysed and reviewed before taking the decision of artificial recharging, such as – quality of source water available for recharging; underground storage space available; transmission characteristics; best possible applicable method (injection/infiltration), cost of construction, regulation and the recurring charges, public perception, maintenance problem, etc.[5].

One must also not fail to analyse possible disadvantages, which may appear in some of the following ways. The recharging units may fall to disrepair and ultimately become sources of groundwater contamination[5]. Recharge can degrade the aquifers unless quality control of the injected water is adequate. Run-off water containing high organic matter may result in microbial growth in aquifers. Further, chemical reactions may get initiated by mixing of chemically dissimilar water[6]. High dissolved oxygen in rainwater may dissolve metalloids bound in rocks and release them in the aquifers.

According to a report on the effect of artificial recharge on water quality in the aquifers, elevation in the level of chloride, arsenic, total coliform bacteria and atrazine, a herbicide, have been reported[7], though, the source water used was treated to reduce turbidity and to remove organic compounds using powder activated carbon.

There are several artificial recharge techniques in use in Latin America and the Caribbean, including infiltration basin, water traps, cut waters, surface runoff drainage wells, septic tanks, effluent disposal wells, sinkholes, etc. But the only process imposed on the urban society in India is the deep injection borewells. By such a decision the state is free and the problems now lie at the doorsteps of owners of borewells. In the Indian perspective, where it is hardly possible to use filters for drinking water, is it possible for each and every family to allow rainwater to occupy the aquifers after proper treatment, as water injected through this process should be potable water treated to drinking water standards[5]?

We respect the wisdom of people in advocating artificial recharge but we are of the view that for surface recharge, rainwater need not be treated. If we go through the last two to four decade maps of any city, we may find a large number of water bodies that have now been encroached upon. If they are restored, they may solve the problem.

The decision of recharging the ground water is not a simple trial and error experiment. It is an experiment with nature and nature takes revenge in the form of 'ecological backlashes'. We need to be awake today or we shall not be able to awake tomorrow.

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The Indo-US nuclear 'deal'

I read with great interest Srinivasan's article[1] on the Indo-US nuclear 'deal'. It provided valuable background information. However, certain claims made for a new process in an article in a recent issue of the *Scientific American*[2] if true, can upset all considerations that must have gone into arriving at the 'deal', a prime one being that India has no good sources of uranium.

The process is said not only to allow one to get more energy from a given quantity of fissile material but also to take care of long-term radioactive waste! Briefly stated in simplified manner, new metal fuel rods can be made from mixtures of uranium and actinides recovered from materials produced by present-day reactors, regarded as 'waste', through electrorefining and pyrometallurgy. Solutions of salts of metal mixtures recovered from