

programme, that we have to maintain, we cannot compromise on that'. He has also drawn attention to the reality that the three stages are intimately linked through fuel cycles and the 'fuel cycle is intimately linked with the strategic programme and our programmes. ... The fuel cycle is for the same infrastructure which also feeds the strategic programme and I don't have such a big infrastructure that I divide this saying, *ek beta ye aap ke liye, ek beta ye aap ke liye*'.

Assuaging the varied perceptions outlined above, the Prime Minister has stated clearly, 'I reiterate today that no part of this process would affect or compromise our strategic programme ... our doctrine envisions a credible minimum nuclear deterrent to inflict unacceptable damage on an adversary indulging in a nuclear first strike. The facilities for this, and the required level of comfort in terms of our strategic resilience have thus been our criterion in drawing up a separation plan. Ours is a sacred trust to protect succeeding generations from a nuclear threat and we shall uphold this trust ... We will offer to place under safeguards only those facilities that can be identified as civilian without damaging our deterrence potential or restricting our R&D effort, or in any way compro-

missing our autonomy of developing our three stage nuclear programme ... our proposed Separation Plan entails identifying in phases, a number of our thermal nuclear reactors as civilian facilities to be placed under IAEA safeguards, amounting to roughly 65% of the total installed thermal nuclear power capacity, by the end of the separation plan. A list of some other DAE facilities may be added to the list of facilities within the civilian domain. The Separation Plan will create a clearly defined civilian domain, where IAEA safeguards apply. On our part, we are committed not to divert any nuclear material intended for the civilian domain from designated civilian use or for export to third countries without safeguards ... We have made it clear that we cannot accept safeguards on our indigenous Fast Breeder Programme...'

On 2 March 2006, Prime Minister Manmohan Singh and US President George Bush reached an understanding in New Delhi on implementation of the 18 July 2005 Agreement on civil nuclear cooperation; further details were not available. While the interests of the US may be based on business opportunities, India's interests to overcome trade barriers and to meet technological inputs not only for nuclear facilities but other programmes

may be fulfilled. Some have opined that this also is an opportunity for Indian technical personnel to be outsourced, although this writer is not too gung-ho about this prospect. The late-news (*The Hindu Business Line*, 3 March 2006) is that 'India has agreed that 14 of its civilian nuclear reactors would be open to safeguards', while the FBR programme would be outside this purview. 'The separation of India's 22 nuclear reactors would be undertaken in a phased manner and completed by 2014 ... India has also made it clear that classification of nuclear reactors to be built in future would be its sole decision and there would be no debate on it'.

Much needs to be discussed and negotiated at the US Congress, IAEA, NSG, etc. for implementation of the 'Deal' in the months and years to come. Nevertheless, the steps taken by the Government and the Prime Minister are laudable and are in the right direction to mitigate energy deficit in the long run.

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Geoethical audit of tsunami of 26 December 2004: Challenge before leaders, media and scientists

Arun D. Ahluwalia

After World War II, if there was another landmark moment in human history, it was indeed on the morning of 26 December 2004. The three hundred thousand dead included citizens of 52 countries. Millions lost their homes and/or dear ones. A tsunami was initiated soon after the Sumatra quake at 00.59 GMT and within 8 minutes a warning was possible. The geoethical question being avoided is: could the number of deaths have been much less with a little alert and conscientious utilization of scientific understanding, data and available communication skills within reaction time? As a safeguard in future, geoethical rectitude must

be inculcated and audited regularly and systematically across the globe in a spirit of accountability to the taxpayer. The strong will behind various wars and space explorations was missing in this war on the biggest disaster of human history. This war was lost without a fight. Tsunami, the enemy, gave 15 min to several hours warning. Humanity could not ask for more from nature. There was no line of command and no system existed of a civil or military defence against such a disaster. Defence personnel were ignorant of the tsunami and political leaders/administrators learnt about the tsunami from media. The warning dissemination

system needs to be decentralized. It should be every scientist's mandate to interact with communities. That fruits of science and technology did not reach victims of a second worst quake and worst ever associated tsunami, calls for redefining and prioritizing societal duties of scientists. Scientific establishments like USGS, BGS, NGRI, Meteorology Department and GSI cannot make excuses that awakening the masses in such rare emergencies is not their job. This should have been the natural reflex action of any establishment blessed with knowledge and resources. To do the right thing at the right place in future, it is worthwhile

auditing psychological reactions of these elite communities during precious reaction moments gone abegging. Correct geoethical behaviour demanded immediate activation of hotlines to countries of the region and bombardment of text messages in the region on mobile phones, radio and TV. Expensive seismic research outputs should have gone straight to the grassroot user across half of the world's tsunami-prone population living in coastal areas. Right to life-saving information round the clock across the globe in a form intelligible to all is a geoethical obligation of scientists to society. Media and leaders have to be educated by the scientists in an ever evolving, effective and vibrant system of mass communication.

All the Indian Ocean nations as well as the UNESCO would do well to immediately set up Tsunami Museums on the pattern of the Pacific Tsunami Museum. Due to systematic awareness created by Pacific Tsunami Museums, deaths have been much fewer in the Pacific region compared to our region where a dismal record of misery has been set. Had our coastal population been made aware about tsunamis soon after severe earthquakes recurring for several weeks in Indonesia, they would have definitely watched the sea behaviour and run upland about 30 to 50 feet high and saved their lives. Without a system of creating awakening constantly, this tragedy like all natural disasters will be forgotten. If aware, soon after an earthquake or even without a perceptible earthquake (because tsunamis can be caused by a distant quake, huge landslide or volcanic eruption in ocean or a meteorite impact), on seeing ocean waters suddenly recede too far and stay there for a while, people could save themselves. We hear of smart and gutsy survivors and alert individual saviours from the Indian Ocean but not of one scientific establishment across the world that reacted to the fore-shocks or the main shock near Sumatra.

Stories of Pacific tsunamis carry great lessons and are extremely interesting. The last significant tsunami before 2004 was in June 1998, in New Guinea. The last time a major disaster like Sumatra's happened was on 23 May 1960. Tsunamis triggered by the great Chile earthquake struck Hawaii. The Pacific Tsunami Museum in Hilo, Hawaii, is special because of its human face and a human basis. Hilo was heavily damaged by tsunamis in April 1946 and again in May 1960. Tsunamis as such are always on Hiloans'

minds. In 1994 the museum was founded to help keep the population prepared and alert. It takes a little extra effort to mobilize people against something they have not experienced. On 26 November 1999, such efforts paid off. A seven-magnitude quake struck Vanatau in south Pacific and a tsunami completely wiped out the village of Baie Martelli but only five lives were lost. A research team report quoted from About Geology.com (11 January 2005) says: 'The small number of casualties was due to prior education and a party. Because of a wedding on the day of the earthquake, almost everyone was still up celebrating when the earthquake occurred. A lookout was sent to note the condition of the sea. When it was reported that the water was receding, villagers concluded that a tsunami was coming, and they ran to a nearby hillside to escape the wave'.

Part of the funds raised now should also be used for tsunami museums in our regions using local dialects and visuals to be more effective. TV and radio channels in local dialects can have a crucial role to play in such disaster risk reduction. In larger public as well as enlightened self-interest, media will have to proportionate its coverage to focus on the human safety and geosciences applications. Interesting innovative programmes breaking barriers between science developments and man on the coast could save millions. Had scientists reacted or had there been more science journalists chasing scientists, alerts would have been effectively and comprehensively communicated. Even the most vulnerable persons could possibly save their lives, e.g. fishermen deep in the sea could have been told to remain there for it is safer over there than on the beach during a tsunami strike.

International Union of Geological Sciences (IUGS) has resolved: (a) To promote the development and application of scientific expertise and experience in understanding the geological forces at work in the development of all types of natural hazards and the processes involved in their mitigation of natural hazards; (b) To share this information as freely as possible with other members of the scientific community, government officials, policy makers and planners, the insurance industry, and the public as a whole. The International Strategy for Disaster Reduction (ISDR) has noted ten preliminary lessons learnt by its experts from this disaster, worst in history, namely (for details see <http://www.unisdr.org/>

[eng/media-room/point-view/2005/ISDR-19-lesson.learned.doc](http://www.unisdr.org/eng/media-room/point-view/2005/ISDR-19-lesson.learned.doc)):

1. We are all vulnerable to natural disasters.
2. Careful coastal land-use planning is essential to minimise risk.
3. Public awareness and education are essential to protecting people and property.
4. Early warning saves lives.
5. Countries can work together ahead of time, as well as when disaster strikes.
6. Reducing risk depends on close interaction between the scientific and technical community, public authorities and community-based organizations.
7. Developing and respecting appropriate building codes can minimise exposure to risks.
8. Humanitarian aid needs to invest more in disaster prevention in addition to immediate relief needs.
9. Concrete action and good coordination are vital to ensure people's safety from disasters.
10. Telecommunications and the media have a crucial role to play in disaster risk reduction. More scientists should spend part of their time as science journalists as media personnel normally remain obsessed with routine issues of 'news value'.

Nearly 430 nuclear reactors across the world are all in coastal areas and these cannot always be shut down in time because not all floods can be predicted. Relocation from coastal areas looks impractical but it is unavoidable. It is high time we start focusing on this logistical challenge. Looking the other way is not going to diminish the risk. Free and frank discussion on this issue is not happening even in the best democracies of the world boasting of absolutely free media. Scientists appear to be scared of being dubbed as alarmists. Silence on such a vital issue could mean asking for global human disasters in the short as well as long run. Right to information giving protection against natural hazards should become a fundamental right of all global citizens. Scientific awakening and research must be intertwined and made obligatory. Our armed forces must introspect on how their personnel were ignorant about tsunamis. Military geologists are employed the world over but not in Indian Ocean region. With a little vision our saviours

would have been saved in Andaman. Government of India and all the Indian Ocean States must realize that it is penny wise and pound foolish not to introduce geological education across schools and colleges and all universities in the country. We lost a precious opportunity to document tsunami in its grandeur because our own administrators and armed forces in Andaman failed to alert New Delhi. In the long run, proper focus on geosciences would not only mitigate disasters but also accelerate mineral exploration and mineral-based cottage industries. Economics of geosciences-savvy leaderships and societies have to seep into our system immediately. At times what looks economical is actually most extravagant. Tsunamis and floods (reverse tsunamis) have damaged us much more than the worst wars. Our will to fight conventional wars is ever strong but we lack leadership and motivation to engage in these real wars against disasters and geoscientific ignorance, thinking we do not have

money for such programmes. The money we saved in not installing our own tsunami system in spite of Indian Ocean having been hit by tsunamis ten times in the last 250 years was not ever worth saving.

Attacking all geohazards in a war mode is better than providing relief. UN also needs to learn this lesson right now for it has stopped geosciences funding to its IGCP Programmes. Geological processes as well as fruits come slowly but steadily and in great bounty. It lies on the shoulders of geologists to explain to national leaders frankly and effectively. Ignoring geologists and letting nongeologists head key organizations like GSI has been comprehensively counterproductive. It is like allowing Army doctors and engineers to become Chiefs of Staff. We need to reorganize our coastal areas urbanization as well as geoscientific institutions and initiate regional geological collaboration in South Asia or within SAARC which would bring out our real human resource potential towards tackling hazards and exploring

and exploiting mineral wealth successfully. Neighbours exploring their mineral resources and tackling hazards jointly makes scientific, diplomatic as well economic wisdom. Once this realization dawns, Indian Ocean nations as well as Himalayan ecology-sharing countries have full potential to manage their disasters. Geologists need to articulate their voice and opinion in a manner that they lead the policy makers. It is now or never for this positive about turn to manage the region with geoscientific prudence and vision. This much scientific homage to the 3 lakhs who died is a must to atone for our geoethical fiasco and inaction on the fateful morning of 26 December 2004.

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