

The 26 December 2004 tsunami recalled: Science and technology for enhancing resilience of the Andaman and Nicobar Islands communities

P. C. Kesavan and M. S. Swaminathan*

Extreme natural disasters, particularly those induced by hydro-meteorological factors are not only becoming more frequent, but their destructive potential is also increasing. Population explosion and global warming are enhancing their adverse effect and hence, strengthening the coping capacity to natural disasters is of particular concern to coastal communities. The Andaman and Nicobar archipelago is of particular interest in view of its rich and unique diversity of fauna, flora, ethnic tribes and their strategic location from the point of national security. In this article, it is emphasized that the past (pre-tsunami) unsustainable development activities should be stopped, and a new 'bioisland paradigm' of sustainable development should be ushered in. The vast marine resource base has a high potential for sustainable livelihood and economic prosperity. In the past, forestry and agriculture have been overexploited with detrimental consequences to ecology and sustainable livelihood. Disaster preparedness, mitigation and management strategies need to be integrated with sustainable development of the Andaman and Nicobar Islands in order to enhance the natural-disaster coping capacity and resilience of local communities.

Keywords: Andaman and Nicobar Islands, disaster preparedness, sustainable development, tsunami.

NEGLECTING science and technology (S&T) as well as the ecological prudence of the native tribals while making policy decisions and implementing the development activities, especially in the coastal area accentuates death and devastation caused by extreme natural disasters. Degradation of mangrove forests along the east coast and violation/relaxation of the Coastal Regulation Zone (CRZ) norms in development activities have led to a substantial increase in the avoidable loss of lives and livelihoods. A recent scientifically validated report¹ points out that mangrove forests may reduce the velocity of cyclonic storms and tsunami waves and consequently, their destructive potential as well. Another recent report (CRZ Notification 1991–2006, by Equations Bangalore; e-mail: infor@equitabletourism.org) states that violation of the CRZ norms was largely responsible for an avoidable accentuation of death and devastation in the Andaman and Nicobar Islands ravaged by the 26 December 2004 tsunami. It is often claimed that relaxation in the CRZ norms is done only to benefit the poor and the deprived by way of providing shelter and livelihood close to

the shore. However, the poor and the deprived are the ones who often face the brunt of an extreme natural disaster. Mortality tends to be high and loss of livelihood adds to the suffering. A National Committee constituted to review the CRZ Notification, 1991 has recommended strict adherence to 12 basic guiding principles in their report submitted in February 2005 to the Ministry of Environment and Forests, Government of India. The Committee's point number 12 reproduced below is meant as a reminder for policy planners, administrators, elected representatives at the grassroots-level institutions and all the vulnerable sections of the communities. It states, 'Due to pressures of development, recreational and housing activities, the CRZ Notification has been frequently amended. Aquaculture enterprises have often led to the denudation of precious mangrove forests. Large scale sand-mining, extraction of coral reefs and dumping of sewage and toxic wastes into sea are still in progress. While this committee started its work in this background, it ended its deliberations in the context of extensive damage caused by the titanic tsunami to lives, livelihood and property on 26 December 2004'. It further goes on, 'Tsunami served as a wake-up call. Any further neglect of sustainable Coastal Zone Management practices will spell doom to the future of coastal

The authors are in the M.S. Swaminathan Research Foundation, Third Cross Road, Taramani Institutional Area, Chennai 600 113, India.

*For correspondence. (e-mail: pkesavan@mssrf.res.in)

communities. Good ecology alone can ensure sustainable human security to coastal habitations. Compounding the serious problems arising from demographic and commercial pressures as well as the greed of the rich and genuine needs of the poor, which confront us today, we have also to be prepared to face the prospect of sea level rise within the next few decades as a result of global warming and the consequent melting of glaciers and the Arctic and Antarctic ice deposits'.

Many recent scientific studies² by the world's leading geophysicists, seismic and tsunami experts reveal that geophysical and hydro-meteorological disasters, to which India is highly vulnerable, may become even more frequent with enhanced destructive potential. Population explosion and global warming are among the major factors. Further, the major earthquake of 26 December 2004 (moment magnitude 9.3) has not quite released the stress, but has further enhanced it³⁻⁶. Hence, it is appropriate that the Swaminathan Committee to review the CRZ Notification, 1991 referred to the 26 December 2004 tsunami event as a 'wake-up call'. Despite these forewarnings, the on-the-site corrective action plan is only marginally evident and that too just in a few coastal villages only. S&T is often relegated, or even set aside with sad consequences. The right to decide and responsibility to bear the consequences should go together. It is now well established⁷ that higher the level of development (scientific, technological, social, gender and economic), lesser is the impact of an extreme disaster in terms of loss of life. India is reaching a moderately high level of technology development in the urban areas, but unfortunately the rural areas where a little over 70% India's large population of more than one billion people live still remain under/unreached. Further, the prevailing social, gender and economic inequities greatly weaken the coping capacity of the underprivileged sections of society. Huppert and Sparks⁸ observe that humankind is increasingly becoming susceptible to natural disasters largely as a consequence of population growth and global warming, and that an extreme calamity with a million casualties is just a matter of time.

Keeping these dimensions in view, Swaminathan⁹ wrote an article comprehensively dealing with an action plan elaborating the mid- and long-term rehabilitation strategies for the vulnerable coastal areas. These aim at enhancing the coping capacity of the highly vulnerable communities. The 'beyond tsunami' strategy was designed to integrate the ecological, technological (especially, bio, space, and information and communication technologies), agricultural (green and organic for low-input, low-volume, high-value crops), social, economic and gender dimensions for enhancing the resilience of the largely unskilled, marginal farming, fishing and landless rural families in the coastal areas. This article elicited response from the then Lt. Governor of the Andaman and Nicobar Administration as well as the Prime Minister, and the Union Home Minister. As a result, a multidisciplinary team consisting of natural

and social scientists from the M.S. Swaminathan Research Foundation (MSSRF), Chennai led by one of us (P.C.K.) spent more than three weeks in the Andaman and Nicobar Islands. The team studied and carefully assessed not only the devastation caused by the tsunami, but also the effects of unsustainable development activities over several decades in the past and the multiplying effects of degradation of the natural ecosystems coupled with anthropogenic pressure on enhancing the overall vulnerability to such extreme natural disasters in the future. The MSSRF report was appropriately titled as 'Action plan for development of post-tsunami "New Andamans"'. The word 'New' implied a shift from several of the past, pre-tsunami unsustainable activities to more ecologically sustainable and economically viable development activities. In this context, it may be noted that way back in 1975, late Indira Gandhi, the then Prime Minister of India, had also expressed deep concern and serious reservation over the creation of red oil palm and rubber plantations after clearing vast areas of natural forests in Little Andaman and Katchal islands respectively. Dhingra¹⁰ quotes late Indira Gandhi, the then Prime Minister of India, who in 1975 said 'that the rehabilitation and commercial plantation project in the Andaman and Nicobar Islands are having environmental problems. These programmes need clearance of substantial areas of virgin forests ... there would be no point in going to the trouble and expense of clearing the forests if we were not assured of favourable long term outcome'. This prophetic statement has come true, since both these plantations have unfortunately proved economically and ecologically unsustainable. The 2004 report of the Tata Consultancy Services (TCS) on these plantation crops is quite analytical, and recommends the closing down of these plantations with immediate effect.

The MSSRF report (2005) has pointed out that the ecologically fragile Andaman and Nicobar Islands cannot support the chemistry-based high-volume, high-input and low-value agriculture. Application of mineral fertilizers, chemical pesticides and gypsum whenever necessary, exerts profound detrimental effects on the soil, aquifers and biodiversity of the Andaman and Nicobar archipelago designed by nature primarily to support evergreen, wet deciduous and mangrove forests with scores of rare and unique endemic fauna and flora, and an exceedingly rich marine biodiversity. Several unique avian, amphibian and reptilian species as also primitive tribes such as Jarawas, Sentinelese and Shompens are on the verge of extinction. The Great Andamanese in their original genetic and cultural identities do not exist any longer. The present and succeeding generations should realize that much damage has already been done to the biodiversity of these islands, and mankind have a great responsibility to protect these islands.

A paradox in the development strategy of these islands is that agriculture and forestry and not the fishery has been chosen as the major resource base for development. Despite the inappropriate directive and support for application of

mineral fertilizers, the yields of crops and coconut are still far lower than the average national yield. It is also evident from the yield data that from economic and ecological points of view, paddy is not suitable for the Andaman and Nicobar Islands. On the other hand, these islands have a coastline of about 1960 km and around 35,000 cubic km of continental shelf that provides potential fishing grounds. Therefore, the MSSRF report suggested strengthening of the fisheries sector for sustainable livelihood and economic benefit.

A small proportion of agriculture being recommended for the Andaman and Nicobar Islands must be 'green agriculture'^{11,12} and emphasis should be on low-input, low-volume, high-value crops (e.g. spices) which are also largely organic. The Nicobarese in the various Nicobar groups of islands, largely depend on coconut, pandanus and pigs for their food security; they do not apply any chemical fertilizer or pesticides to their coconut plantations (actually these are coconut 'forests' and not coconut plantations since they are naturally grown than planted and cared for). Hence, these are 'organic' by default. Intercropping of coconut and arecanut with pulses (to improve soil nitrogen fixation), pepper, clove, nutmeg, etc. has enormous economic opportunities without ecological degradation of soil health and quality of freshwater sources. The Nicobar Islands could easily be transformed into 'organic islands', the first of its kind combining ecoagriculture and ecolivelihoods in the world.

Further, the small-scale production of bio-fertilizers (azolla, *Trichoderma vridae*, etc.) and biopesticides (*Trichogramma* sp., *Oryctes baculo virus*) and vermicompost by the self-help groups (SHGs) would provide not only the necessary software for ecoagriculture, but also income-generating livelihood.

Forest timber should not be felled to feed medium/large-scale wood-based industries or export market. Degradation of the virgin evergreen and associated biodiversity leads to loss resource base for sustainable development. It is known that mangroves nourish fish and several other marine food resources¹³. The fast-growing non-timber species found in abundance can be used by the SHGs/tribal councils for making matchstick, veneer, etc. Honey collection and orchids production are the other possible forest-based ecoenterprises.

The 26 December 2004 earthquake (M_w 9.3)⁵ has raised the northern Andaman by about 0.8 m and sunken the great Nicobar by about 1.8 m. These and other major geomorphological changes reported by various authors are summarized elsewhere by Kesavan and Swaminathan¹⁴. A report from the Agriculture Department states that about 8000 ha has been damaged/left unsuitable for agriculture, especially paddy cultivation. Considerable fields in the middle and south Andaman, where paddy was cultivated before the tsunami, get regularly flushed by sea water during high tide. Some of the fields are now constantly under tidal water. These are no more suitable for paddy

cultivation. The MSSRF has advised against application of gypsum to reclaim some of these paddy fields. It was a timely suggestion as it saved crores of rupees from wasteful expenditure and unknown ecological problems. The MSSRF had also outlined as to how the paddy fields now under saline water can be developed for mud crab fattening, prawn and marine fish culturing in an eco-friendly and economically profitable manner. These are the opportunities arising from the calamity caused by the tsunami. It is also a blessing in disguise in the sense that income generation from mud crab and prawn from 1 ha would be several fold higher than that from a paddy crop. With nature having provided new opportunities, a change of mindset can lead to more gainful ecoenterprises through fisheries.

The MSSRF report (2005) also recommends that the agriculture should be 'biology' rather than 'chemistry'-based. This is to say that mineral fertilizers and chemical pesticides must be largely avoided and instead, biofertilizers and biopesticides should be used. Vermicompost, organic manure, cow dung and urine of farm animals from a well-designed 'mixed dynamic farming' would enrich the soil, while biopesticides (e.g. *Trichogramma*, *Oryctes baculo virus*, etc.) should substitute chemical pesticides. Since the Nicobar Islands are largely organic by default, efforts should be made to obtain 'organic certification' for coconut, arecanut and spices. The agriculture in the Andamans should have more legumes, pulses and vegetables than paddy. The 'green agriculture'^{11,12} that provides for integrated pest management (IPM) and integrated nutrition management (INM) should be the mode of promoting what has been advocated as the 'evergreen revolution'¹⁵⁻¹⁷. Evergreen agriculture is the pathway for achieving productivity in perpetuity without accompanying ecological harm. The 'evergreen revolution' also opens up avenues for on-farm and off-farm livelihood opportunities. Appropriate 'ecotechnologies'^{17,18} for sustainable use of local resources by the local communities form the basis of ecoenterprises in the biovillage paradigm. The unskilled, largely illiterate rural women and men become skilled through 'techniracy', which is a pedagogic method of learning by doing¹⁹. Yet livelihoods in the ecologically fragile Andaman and Nicobar Islands through agriculture and associated ecoenterprises could be no more than 20% (Figure 1).

Opportunities for sustainable livelihood are immense based on the marine resources. Yet this is the least developed, and given attention to in these islands. The MSSRF report (2005) has discussed these aspects in great detail. It is a paradox that tiny land masses with already too many people are taxed far beyond their 'carrying capacity', while the vast expanse of sea all around beckons a harmonious relationship for providing basic human needs in these islands. The 'ecological overshoot'²⁰ should be avoided in these islands not only because of their ecological fragility, but also because of their susceptibility to extreme natural disasters (earthquakes, volcanoes in Barren island, cyclones

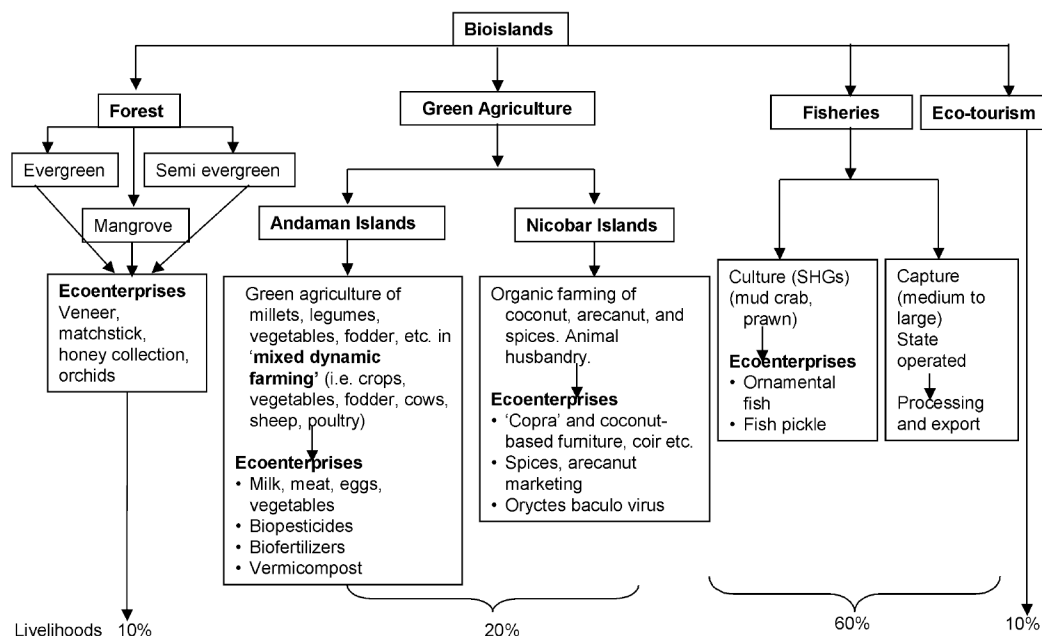


Figure 1. Eco-friendly livelihood base in the Andaman and Nicobar Islands.

and tsunamis). It is widely known that high-powered fishing vessels intrude into India's territorial sea and make huge catches of several categories of fish. Estimates by the National Bank for Agriculture and Rural Development of India are that the Andaman and Nicobar Islands harvest annually only 30,000 tons of marine fish out of a sustainable potential of 2.43 lakh tons per annum. MSSRF's initiative of 'fish for all' could find a meaningful partnership with the Andaman and Nicobar Administration, if only the Government of India and the Andaman and Nicobar Administration strengthen the infrastructure and resource allocation to the Fisheries Department. The livelihood potential of the different sectors in the Andaman and Nicobar Islands is given in Figure 1. It is evident that about 60% of the sustainable development potential is based on marine resources.

The model (Figure 1) provides for sustainable development, while ensuring the conservation of the rich and unique biodiversity (also human biodiversity) of these islands, rightly emphasized by several leading ecologists of India working in the Andaman and Nicobar Islands for a long time^{21,22}.

The fisheries sector also provides not only livelihoods for marginal fishing families through fish-pickling, making poultry feed, etc. but also viable commercial avenues. Planning however needs to be carefully done in order to ensure the sustainability limits. Remote sensing will be of help in determining the locations of 'optimal catch' for least energy and other resources spent.

In short, the need of the hour is not expanding the pre-tsunami unsustainable development activities, but in making use of new opportunities for sustainable development out

of the calamity and challenges resulting from the 26 December 2004 event. This is also the way to enhance the coping capacity and resilience of the highly vulnerable poor and the deprived in the biodiversity-rich, ecologically fragile Andaman and Nicobar Islands. Needless to add in conclusion, that a planned population size (around 3 lakhs) and the simple lifestyle of the tribals would ensure a longer lease for the survival of the natural beauty and cultural diversity of the Andaman and Nicobar Islands.

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Received 9 January 2007; accepted 20 January 2007