India's second green revolution needs to transform the drylands

The President of India, A. P. J. Abdul Kalam has recently called for a second green revolution, while inaugurating the triennial conference on Global Forum on Agricultural Research at New Delhi on 9 November 2006. This is not the first time that he has spoken about this issue. Three years ago, he had outlined the applications of technological innovations to meet future foodgrain needs demanded by the increasing population growth[1]. By 2020, India has got to increase productivity above 340 million tonnes of foodgrains in view of population growth, so the President appealed to agricultural scientists and technologists to work hard to double the productivity of available land in view of less area being available for cultivation, with limited water supply and diminishing number of available farmers.

Interestingly, the timing of the President's statement coincides with the recent Living Planet Report published by the World Wide Fund for Nature[2]. The report portrays a grim fact on the changing state of global biodiversity and the pressure on the biosphere arising from excessive human consumption of natural resources. The report warns that people are turning resources into waste, faster than nature can turn waste back into resources and by 2050, humanity will demand resources double the rate at which the earth can generate them[2]. Thus the President's reference to double the foodgrains productivity by 2020 is timely and deserves serious attention.

Five major factors that determine the extent of global overshoot or demand on bio-capacity include population, consumption of goods/services per person, resource use intensity, bio-productive areas, and bio-productivity per hectare. India has to make appropriate plans with persistence to eliminate overshoot of the above five factors. One crucial aspect to eliminate overshoot of bio-productive areas is to transform India's vast barren, rural drylands.

Undoubtedly, India is a land of villages with 700 million people living in over 600,000 villages, many in the enormous drylands. No developmental strategy can succeed that neglects the rural drylands that occur in 177 districts or 56% of India's total geographic area, covering States such as Rajasthan, Gujarat, Madhya Pradesh, Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu[3]. The drylands in these states have to be targetted to increase productivity of foodgrains, if India has to succeed in a second green revolution, without creating serious negative consequences to natural environment.

During a recent visit to Dahod district, a major dryland area in Gujarat along the Rajasthan border, I witnessed the contributions of a local non-government agency named 'Sadguru' (Sanskrit meaning, 'true teacher') in transforming drylands by building cost-effective check dams and lift-irrigation systems to increase productivity of agricultural crops[4]. During the last few decades, the small non-profit agency has assisted several villages in the drylands of western India to build simple check dams to harvest rainwater. Water saved through the check dams apparently transformed the infertile drylands into productive agricultural lands in a short period of time, which ultimately alleviated poverty among some rural tribal communities. Tribal cooperatives manage the check dams and farmers pay a modest sum for the use of water to irrigate their fields[4]. This system can be followed in the South Indian States such as Tamil Nadu, where the government provides free electricity to farmers in the name of increasing agricultural productivity and reducing poverty. But the free electricity provision often leads to excessive wastage and draining groundwater reserves.

Check dams are not new in India. In fact, the first Grand Anicut, also known as the 'Kallanai' in Tamil, was built by an ancient Chola king Karikalan in the Kaveri river delta, Tamil Nadu during the second century. It was based on a simple check-dam design. It is the oldest water-diversion structure in the world still in use, with a superb dam-building design. This design was later adopted by the British irrigation engineer, Arthur Cotton, who built various dams and irrigation structures across India during the British occupation. India has pioneered in developing simple, innovative technologies to harvest water and to boost agriculture centuries ago. Hence transforming the drylands to achieve a second green revolution will not be a daunting task if India's ingenious past is understood precisely by scientists, policy-makers and politicians.

1. Abdul Kalam, A. P. J., 2003, http://www.indianembassy.org/presidnt/jan25_03.html.
2. Living Planet Report 2006, WWF International, Switzerland, 2006.
3. Shah, M., Banerji, D., Vijayshankar, P. S. and Ambasta, P., *India's Drylands. Tribal Societies and Development through Environmental Regeneration*, Oxford University Press, Mumbai, 1998.
4. Jagawat, H., *Transforming the Drylands, The Sadguru Story of Western India*, India Research Press, New Delhi, 2005.

GOVINDASAMY AGORAMOORTHY

Department of Pharmacy,
Tajen University,
Yanpu, Pingtung 907, Taiwan
e-mail: agoram@mail.nsysu.edu.tw

Disappearing beaches of Kerala

Beaches are the most important geomorphological features of a coastal state. They are one of the most eye-catching and captivating destinations of tourists throughout the world. Nearly two-thirds of the world population live within a narrow belt directly landward from the ocean edge and many of them depend on the bounties of the sea for their livelihood. The uses are innumerable: swimming, surfing, sunbathing, beachcombing, walking, jogging, fishing, etc. Good beaches attract thousands of visitors and are economically important not only to the communities living nearby but to the whole country as well. Beaches are of great economic importance both for recreational use and as a buffer zone to protect land and the proper-

ties on it from wave attack. However, it seems that many coastal states fail to understand the value and importance of this natural divide between the huge volume of the sea water and the land. It is both sad as well as alarming to see this gift of nature slowly disappearing or even shrinking in size.

The growing population pressure is of late asserting itself on the environment, and the beaches are no exception to feel the full impact of this. Concern over beaches has been at an all-time high throughout the world due to their deteriorating condition and many countries have adopted plans and policies for coastal management.

Kerala is well endowed with its natural bounty and could ascend to the world tourism map because of its beaches, despite its poor infrastructure. The tourism industry of the state is dependent for most part on sun, sand and sea. The state has ~600 km long coastline and 90% of it has well-developed sandy beaches. Unfortunately beaches have not been perceived as areas needing management, protection and funding rather than as a permanent feature of the landscape.

However with increased population pressure man started taking on nature and even encroaching on its domain. The sea and its dynamism are discussed only during the monsoon season when it starts reclaiming what is being grabbed from its bosom by the very people who depend on it for their livelihood. Governments have conveniently forced the public to believe that the sea wall is the only way to escape from the fury of the ocean. As a result, all along the Kerala coast a huge wall has been constructed almost uninterruptedly, letting the sea destroy it every year, thereby littering these already strained beaches. There is no scientific evidence to suggest that the sea will encroach the whole land if there is no protection. An honest and impartial assessment of this draining of public coffers and slow killing of our natural resources is the need of the hour.

The name 'sea wall' for 'boulder wall' itself is a misnomer because sea wall is a scientific coastal engineering structure built along the coastal seas to protect the properties in the coastal areas. The effectiveness of such scientific engineering structures is highly debated across the world. The Kerala sea walls are, however, constructed just by stacking up all the boulders even without estimating the durability of these structures and their ability to withstand the wave energy. The fact remains that these structures built along the coast, in fact, augment the process of coastal erosion.

Studies have shown that any structure built right on the beach prevents beach accretion and not the beach erosion. Man's alteration of the shorelines especially by construction on the beaches will create unnatural water currents. They have an adverse effect on beaches undergoing retreat, but the effect is more pronounced on beaches undergoing long time rapid shoreline retreat. It is found that sea walls influence the beaches in various ways. Swash that is reflected by a sea wall in a sea-walled beach is directed seaward several seconds earlier than the swash on the adjacent unwalled beach increasing backwash duration and velocity. This means that at high tide when waves hit against the walls waves reflect back towards the ocean with much more energy than if the wall is not there. These reflected waves often cause the sand beach in front of the sea wall to erode twice as fast as an adjacent beach without a sea wall. As the beach continues to erode, the sea wall may also block natural replenishment of sand from dunes or cliffs behind the wall. Reflected waves and the diminished sand supply may also degrade the sand bars and destroy the surf. The underwater part of the beach profile will become steep and deep, sometimes allowing the waves to reach the sea wall without even breaking. Thus, man makes the sea wall and the sea breaks it.

The increased height, energy and current that are assembled in the near-shore areas are managed in a positive way by healthy beaches. It can engage a large storm with minimal damage. Any coastal construction like a sea wall, a groin, break waters or ports should be made only after properly understanding their impact on the immediate beaches as well as on the adjoining coasts. Beaches are the constantly changing formations and any sea defenses built on or near them will influence this natural process. Beaches are the places where the sea dissipates its pent-up energy. The million-dollar question then arises: How will we prevent the coastal erosion? Damaging effects of sea waves especially during monsoon season cannot be prevented just by armoring our shoreline with rock boulders. They only make those who live in the coastal areas feel that they are protected. Disastrous effects of monsoon waves in fact can be minimized by widening our beaches and by not disturbing the natural process of accretion and erosion. There may be some objections to this solution as there is lot of loss of life and property every year due to sea erosion. But the fact of the matter is that we fail to understand where exactly the sea is and where the land is. Though the coastal zone regulation act clearly prohibits settlement within 500 m from the coastline, this zone is most densely populated in most parts of the state with settlements right on the beaches and berms.

Sea walls are not at all the solution. Man cannot fight with nature; rather he should learn to live harmoniously with it. The solution to this problem is very limited. One must understand the fact that beach and berm are parts of the sea. People living in close vicinity of the sea must be evacuated. Man's property must be away from that of the sea by earmarking a buffer zone between the land and the sea, where habitation should be strictly prohibited. For this, a two-way mapping method of coastal area is required. A wave inundation line and monsoon inundation line should be drawn which should be exclusively demarcated as a 'no-encroachment' area. This evacuation will be more cost effective and life saving than the annual ritual of sea wall construction which is draining our financial resources as well as natural security. The governments should think of constructing community apartments out of the demarcated buffer zones for the communities who will be evacuated. This will improve their living condition as well. These are the only feasible solutions if we want to escape the fury of nature. Killer tsunami waves are just an eye-opener and no warning system can save us from such natural calamities. It is not only our property which should be protected; our finite heritages like beaches need protection because this planet we owe to our next generation.

N. M. SHAREEF

Geological Survey of India,
Mangalore 575 001, India
e-mail: shareef_n123@rediffmail.com