loss of employment to farm workers, threats to livelihood, destruction of ecosystems and even human rights violation.

Uncontrolled sand mining from the riverbed leads to the destruction of the entire river system. Sand acts like a sponge, which helps in recharging the water table. Once this layer is removed, the hydrodynamics of the river gets disturbed and affects the velocity of water flow. This also enhances the penetration of sunlight deep into the soil, which aggravates the groundwater evaporation. Excessive instream sand and gravel mining lower the river bottom, which distorts the flow regime leading to the river bank erosion. As the trucks race to the middle of the river to collect sand, a bit of the riverbed dies every day. Such destruction destroys the entire habitat in the area. Depletion of the sand in the stream bed and along the coastal areas causes deepening of rivers and estuaries and enlargement of river mouth and coastal inlets. The direct consequences of this is the easy intrusion of saline, water especially during high tides. Once the saline water intrudes into the stream, it destroys the ecosystem. Widening of the river mouths and tidal inlets may expose the entire area to become vulnerable to storm surges and cyclones.

The booming construction industry however requires sand, as there is no alternative to substitute it. The time has come to explore an alternate to this traditional source, and offshore sand gives a ray of hope. Whenever there is a mention about offshore sand, people have a misconception that its refers to the beach and near beach sand. No doubt, these areas are ecologically highly sensitive and any disturbance to it will have serious implications on the beach and its processes.

Sand occurring beyond 25 m water depth and beyond the territorial waters seems to be the answer to the imperatives. The Marine Wing of the Geological Survey of India has already established the reserves of several million tonnes of construction-grade sand in the offshore of Kerala coast (*Marine Wing Newsl.*, Geological Survey of India, vol. xx, No. 1 & 2, March–September 2006). Such a huge resource, if exploited commercially without destroying the environment, will be a viable substitute for the over-exploited traditional sources of sand. Offshore sand mining will have minimum effect on the physical environment of the sea as it does not affect the wave dynamics and beach profile. Mining them will have minimum impact on the beach process because there is no cross transportation either from the beach to these deposits or vice versa. Also the said resource is beyond 30 km from the shoreline. These sand bodies are remnants of submerged strand line deposits left behind when the sea moved landward during the last transgression. Similarly, the shelf break in the west coast is wider compared to that in the east coast and the gradient of the shelf is roughly 1 m × 500–1000 m. This offshore sand as we understand, is naked sand without any overburden and its extraction will not require any removal of the overburden which may again agitate the sea bottom. The main attraction of these sand bodies is that they comprise all the grades of sand, both for construction as well as for the glass industry.

Although the impact of offshore sand mining on the physical environment of the sea will be minimal, its impact on the biological environment has to be studied in detail before taking any decision. Since sand mining at these depths has not been carried out before, provision must be made to enable scientific monitoring and gathering of information. Specific impact assessment should be done for each area. Understanding the impact of any aggression on the planet earth is essential for sustainable development.

N. M. SHAREEF

Geological Survey of India,
Marine Wing,
Mangalore 575 001, India
e-mail: Shareef_n123@rediffmail.com

Evaluation of present pollution control regime in India

Share of agriculture in Gross Domestic Product is declining over the last couple of decades, and presently it is 22%. On the other hand, contribution from other sectors, i.e. industry and service is rising and it has an implication on conservation and protection of natural resources. With all its developments in various fields of knowledge, India still has 65% of its population depending directly on the primary economic sector. Keeping these facts in mind, resource conservation and protection is vital both for economy and ecology of the country. A brief examination of the present state of affairs is presented in the following.

Absolute control of pollution of any industrial activity, i.e. zero pollution is neither technologically possible nor economically viable. Further, nature has a capacity to treat pollutants to some extent and threshold values differ amongst various ecosystems. Hence, the best option is to bring down pollution in emissions/effluents to a level where nature can treat them without any negative impacts. These safe levels of pollution load in India are developed by the Central Pollution Control Board (CPCB) and implemented by the respective State Pollution Control Boards (SPCBs). These boards were established originally to implement the Water (Prevention and Control of Pollution) Act of 1972 and later on were entrusted with the implementation of a plethora of legislations like the Air Act of 1984 and the Environmental Protection Act of 1986. In case of violation by industries, SPCBs are given powers to prosecute them or even direct them to close their operations depending on the nature of damage. SPCBs are also responsible to develop better control technologies and also create awareness among the community. To augment their resources, SPCBs can collect revenues from industries in the form of Consent Fee.

Any chain is as weak as its weakest link. In the entire gamut of resource protection, the weakest link in India is the legalized standards with respect to pollution control as described below.

Standards are developed by considering mostly practised technology. Therefore, standards neither care for technological advancements nor the ability of receiving body to withstand the pollution load. For instance, the same standards applied for a power plant located on the coast and the river side are meaningless.

Standards are to be complied by every polluting entity. However, as these standards are concentration-based, even if every individual is complying with prescribed standards, the overall pollution load emitted by the sum total of polluting entities could still lead to deterioration of the environment. The best example is dangerous levels of air pollution in Delhi, as a result of exhaust from millions of automobiles, which has led to increase in cancer incidences in that city. This finally has led to the introduction of compressed natural gas (CNG) and mandatory technological adoptions like Bharat II in automobiles.

All our pollution control legislations have recommended standards only for point sources like industrial units or automobiles and are silent on non-point sources like agricultural run-off, domestic sewage, etc.

Ever since their notification for the first time way back in 1974, none of the standards were updated, despite most water bodies are dropping to lower quality across the country. Similarly, ambient air quality standards are also kind of fossilized from 1981.

Due to paucity of time between the Stockholm Conference on Human Habitat in 1972 and enactment of the first central legislation dealing with resource protection in the form of the Water Act in 1974, the Indian Standards Institution (the then Bureau of Indian Standards) prescribed effluent standards which were human health centric, ignoring ecological service aspects.

Success or failure of our legislations is directly dependent on the monitoring network. In contrast, SPCBs and monitoring network form another weak link. For instance, the number of Red category of industries alone will run into thousands in every state of India, apart from units belonging to 'highly polluting industries'. However, manpower trained to conduct either stock monitoring or effluent collection in SPCBs hardly touches two digits.

Though founding objectives of SPCBs clearly spell out the need to develop cost-effective technologies suited to local conditions, none of the SPCBs nor the CPCB has developed any indigenous technology. Most of the pollution control technologies were adopted from elsewhere.

With a number of units both in secondary and tertiary sectors bound to take the lion's share, with existing legislations and state of their implementation, natural resources, be it our finite water resources or ambient air quality, are bound to degrade, reducing productivity rates and threatening livelihoods of those who constitute more than 65%.

Simple, but not so simple, is to apply standards that are applicable to Delhi to the entire country, like supplying CNG to achieve higher energy efficiency and reduction in pollution. Alternately, one should supplement the 'concentration-based standards' with technology and nature of the receiving body. To develop this, SPCBs may need to invest financial resources (most SPCBs have sufficient financial resources) and constant revision of pollution standards, which integrate the number of polluting sources and integrating aspects of 'cradle to grave' during the stage of 'consent of operation'. Liasioning with organizations like Non-Conventional Energy Departments to promote adoption of clean technology is the need of the hour for better resource use and conservation.

K. LENIN BABU*
S. MANASI

Centre for Ecological Economics and Natural Resources,
Institute for Social and Economic Change, Nagarbhavi,
Bangalore 560 072, India
**e-mail: lenin@isec.ac.in*

Sponges: An invertebrate of bioactive potential

The marine environment is a major sustaining part of ecosystem processes, distinguished by unique biodiversity and being the source of interesting structures. Sponges (phylum Porifera) are a significant component of this environment. They are the most primitive multicellular invertebrates representing the phylogenetically oldest metazoans that evolved 750–570 million years ago[1]. Sponges fascinate scientists from different disciplines that vary from chemical ecology, physiology and morphology to isolation of promising bioactive compounds and association with a wide variety of marine microorganisms in their tissues. Sponges have been considered as a gold mine for the chemist[2]. More than 12,000 compounds have been isolated from marine sources with hundreds of new compounds still being discovered every year, with respect to the diversity of their secondary metabolites, which range from derivatives of amino acids and nucleotides to macrolides, porphyrins, terpenoids to aliphatic cyclic peroxides and sterols, the majority of which are related to sponges and associated microorganisms.

In spite of the developments in medical science, there are no comprehensive cures for AIDS, cancer, arthritis, other inflammatory conditions, and a large variety of viral and fungal diseases. Marine natural products could yield new drugs to cure such diseases. The quest for drugs from the sea has yielded an impressive list of natural products mostly from invertebrates such as sponges that are either in the late stages of clinical trials, or have already entered the market. Some of the sponge-derived bioactive compounds presently available in the market are Ara-A (antiviral), Ara-C (anticancer) and Manoalide (phospholipase A2 inhibitor), while IPL512602 (anti-inflammatory), KRN 7000 (anticancer), LAF389 (anticancer), Discodermolide (anticancer) and HTI286 (anticancer) are under clinical trial[3]. Secondary metabolites in sponges are produced in trace amounts and exploitation of sponges from natural resources in bulk is an ethical issue. To overcome this serious problem for sustainable use of marine resource, the following are suggested: (i) chemical synthesis; (ii) cultivation of sponges in the sea (mariculture); (iii) growth of sponge specimens in bioreactors, and (iv) cultivation of sponge cells *in vitro* in a bioreactor[4]. *Luffariella variabilis*, *Cryptotethya crypta*, *Discodermia dissolute*, *Aplisina aerophoba*, *Spongia* sp. and *Isodyctia* are some sponges known for their bioactive compounds.

Besides their pharmaceutical potential, sponges are an important source of com-