added in the case of conventional seeds is available for *Bt* cotton cultivation, though the area under cultivation is considerable. It may be mentioned that GM seeds need more of fertilizers and less of pesticides. Regarding impact of GM technology on environment, particularly on soil health and water in the neighbour-

hood, no scientific report is available. Impact of GM foods on human health has not been studied as yet. All this implies that a lot of scientific experimentation and evaluation remains to be done before a final stand on GM technology can be adopted for commercial cultivation, nationally. Even in terms of the somewhat

prematurely set up regulatory bodies, most often there is no representation of expertise in planning of experiments and analysis and interpretation of results.

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MEETING REPORT

Coastal problems and mitigation measures including the effects of tsunami*

A two-day Indo-Japan workshop on 'Coastal Problems and Mitigation Measures, including the Effects of Tsunami' was recently held at IIT Madras. About 60 engineers and scientists, including six from Japan, participated in the workshop. Twenty lectures dealing with coastal problems and mitigation measures, including the effects of tsunami were delivered in six technical sessions. A summary of the technical papers is as follows:

V. Sundar (IIT Madras) spoke on 'Protection against natural coastal hazards'. He noted that seawalls are the solutions to prevent high-value hinter-land development and protect amenity usage where other solutions are not suitable. Supply sediment to the affected areas, that reduces loads and increases the strength of the structures and bio-shielding are the other options. Another lecture was on 'Protection of Karikal coast from the sea water inundation' by R. Sundaravadivelu (IIT Madras). Various protection measures have been experimented and a few – rubble mound seawalls, walls with box-type cross-section and sand-benching,

cantilever type of protection walls, sand bund with grass-topping, and training walls – are suggested for this coast.

T. Hiraishi (Port and Airport Research Institute, Japan) in his talk on 'Recent wave disaster and its mitigation', explained about large-scale (breakwaters) and small-scale (tidal barriers) mitigation tools which can be used to protect lives and property from natural hazards like the tsunami, storm surge and storm waves. K. Murali (IIT Madras) demonstrated the usefulness of mathematical models for prediction of tsunami propagation and landfall, so that stretches of coastline that are vulnerable would be identified and remedial measures taken. 'Lessons learnt from tsunami effects in reconstruction of houses and infrastructures along Tamil Nadu coast' was the topic of a lecture delivered by C. V. Sankar (Relief and Rehabilitation, Government of Tamil Nadu). He provided statistics regarding the lives and property lost in Tamil Nadu and the number of houses rebuilt by NGOs and the Tamil Nadu Government. In his opinion, retreat or 'building back better' is the suitable remedial measure to reduce loss of life and property. K. S. Neelakantan (Department of Environment, Government of Tamil Nadu) explained post-tsunami mitigation measures and future plans taken by his department. He revealed that coastal vulnerability maps, village cadastral maps and land-use maps (urban areas, ports, industries, rural settlements, agriculture and aquaculture) are prepared as part of the Integrated Coastal Zone Management (ICZM) plan. Seven parameters (elevation, geology, geomorphology, sea-level trends, hori-

zontal shoreline, displacement, and availability of land) recommended by the Swaminathan Committee are taken into consideration while preparing the plan. In his talk on 'Tsunami mitigation measures along the coast of Kalpakkam', J. S. Mani (IIT Madras) discussed characteristics of the tsunami and other parameters to be considered while designing protective measures.

A talk on 'Hydrodynamics and sediment dynamics of mudbanks off Kerala coast: Implications to coastal zone management' was delivered by A. C. Narayana (CUSAT, Cochin). According to him, formation and sustenance of mudbanks in the nearshore region of the central part of Kerala coast are an enigma and they differ from those that occur elsewhere in the world. Onset of SW monsoon waves triggers the formation of mudbanks, as the intense wave and current activity churn the bottom sediments and bring them into suspension. These mudbanks act as barriers for the later part of the SW monsoon waves, and thereby the beaches behind them are protected from erosion. Jun Sasaki (Yokohama National University, Japan), in his lecture on 'Field investigation and numerical modelling of soft mud accumulation in an estuarine embayment', explained the nature of accumulation of organic-rich soft mud associated with formation of blue tide, which is responsible for mortality of benthic animals and also causes damage to fishery in Tokyo Bay. The talk on 'Numerical study of the flow and sediment transport on intertidal flats' by Ken-ichi Uzaki (Port and Airport Research Institute, Japan) explained how intertidal

flats play an important role in the improvement of water quality and maintenance of ecosystem in a coastal zone. He also explained the 3D sediment transport model which can be used to calculate tidal and wind-driven currents and the movement of cohesive sediments. Numerical and experimental results obtained from their study in Japan were in good agreement.

B. R. Subramanian (Ministry of Earth Sciences, Chennai) dealt with 'Coastal zone problems along the Orissa coast'. He explained pollution aspects, degradation of mangroves and other ecosystems, turtle nesting beaches, etc. by taking three major ecosystems – Chilka Lake, Bhitakanika mangrove forest and Paradip port – as case studies. The remedial measures suggested by him for beach erosion and other problems of the Orissa coast are: (i) fixing the set-back line of 200–500 m, (ii) avoiding major infrastructure within 1 km distance, (iii) protection of beaches and mangroves, and (iv) bioshielding using casuarina and other vegetation. R. Ramesh (Anna University, Chennai) spoke on 'Integrated coastal zone management'. He explained the key issues, strengths and weaknesses, study materials and various issues and problems involved in ICZM with reference to the Indian context. According to him, various steps involved in ICZM are: (i) survey on ecology, geomorphology, hydrodynamics, shoreline changes, water quality, coastal vegetation, biodiversity, fisheries and health; (ii) assessment of scientific, engineering, socio-economic, physical and environmental aspects, and (iii) framework for ICZM process – coastal environment and landslides.

The lecture on 'Use of geofabric forms for various applications' by M. Venkataraman (Garware-Wall Ltd, Pune) dealt with the benefits of geofabric forms over conventional systems of construction for coastal erosion control and other hydraulic applications. In his lecture on 'Applications of different types of gabions for coastal protection', C. Suresh (Planck Infratech Pvt Ltd, Secunderabad) explained the advantages of geo-synthetics and metallic gabions, construction methodology and installation procedure with a few case studies.

Hitoshi Tanaka (Tohoku University, Japan) delivered a lecture on 'Monitoring and modelling of short-term morphology change at river entrance'. He brought out the facts that morphological changes are more rapid at small to medium river mouths compared to larger ones. Hence, in his opinion, frequent monitoring is required at small river mouths. Therefore, usefulness of installation of automated digital camera at a river entrance was explained by him. Another talk was on 'Coastal changes due to sediment transport on long and short timescales' by Takayuki Suzuki (Port and Airport Research Institute, Japan). Investigations made on beach topographical variations at the Hasaki coast, Japan were explained by him. The characteristic shapes of berm, their position and spatial distribution of the cross-shore sediment transport rate for berm formation and erosion were also discussed by Suzuki.

B. Manikiam (ISRO, Bangalore) spoke about 'Coastal disaster management system – Space technology inputs'. He dealt with observation of coastal hazards (cyclone, flood and tsunami) by the scientific community and impact analysis by decision-makers. Disaster management needs appropriate information in terms of warning, monitoring, the areas affected, severity and availability of resources. He mentioned how space technology has a key role to play in all these aspects. According to Manikiam, several key elements such as digital database, communication tools, GIS-based decision support, all-weather monitoring with satellite and airborne SAR, etc. are essential for any disaster management support programme. A Decision Support Centre has been set up at NRSA, Hyderabad to act as a single-window service provider of space-based inputs, he revealed. Another lecture on 'Development of long-term hazard planning, management and vulnerability reduction action plan in respect of cyclones' was given by A. D. Rao (IIT Delhi). According to him, determination of physical vulnerability in coastal districts is the backbone of a disaster management plan (DMP) for cyclone mitigation using villages as the smallest geographical units. Determination of social vulnerability (SV) is based on ranking using a weight point system. The maximum possible SV index number in any village would be 100 under this scheme. The higher the index value, higher is the overall vulnerability of the village to cyclone winds and storm surge inundation. It is possible to determine economic vulnerability at the village level if detailed economic data at that level are available. The DMP should identify the roles of all stakeholders, including Central/State governments with all the relevant departments at state, district and village levels, NGOs, self-help groups, domestic and international organizations, banking and insurance sectors and most importantly, local communities and people, international funding agencies, etc.

S. A. Sannasiraj (IIT Madras) explained how wave prediction is important for understanding ocean current and sediment transport patterns, forecasting severe storms, safe navigation and carrying out any offshore/onshore activity. Empirical/numerical methods of wave prediction, physical measurement, applications of buoys and remote sensing techniques in the measurement of waves, directly and indirectly, were also discussed by him. Norimi Mizutani (Nagoya University, Japan) discussed about wave force due to run-up tsunami, investigated by his group with laboratory experiments in Japan.

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