

services, front line demonstration to demonstrate and validate the most effective low-cost, eco-friendly nematode management technologies generated in the project, researches on use of diazotrophic rhizospheric bacteria for their antagonistic role against plant parasitic nematodes, incorporation of nematode-resistant genes into agronomically suitable crop cultivars through plant breeding or biotechnological tools, pest risk analysis to address phytosanitary needs of international trade in agricultural commodities and designing nematode management technologies for organic farming systems.

He explained the status of the project based on the reviews of four Quinquennial Review Teams of ICAR for the periods 1977–83, 1984–88, 1989–94 and 1995–2001. Prof. H. K. Jain Committee, in its extensive review of all ICAR projects has recommended this project, in class A for further continuation.

There were four technical sessions followed by a meeting of group leaders of

the project with the Project Coordinator, AICRP and technical experts. In the first technical session, consolidated report on the salient research findings of the different groups was presented by respective group leaders. The significant achievements on the identification of hotspots and nematode-conducive areas, nematode problems of crops like cereals, pulses, vegetables, fruit crops and their management were highlighted. Decisions were taken on the quantification of nematode population from areas/locations for qualifying them, supply of raw data to the coordinating cell for further compilation, compatibility of nematicides with bio-agents to be studied before their concomitant application in integrated management technology and computation of C : B ratios in demonstration trials.

In the second technical session, there were reviews on research work of cooperating centres after presentation of results by the Principal Investigators (16 nos). Suggestions for modification of the

existing technical programme and new proposals based on the field problems were discussed and finalized.

Recommendations that emerged during discussions were finalized in the third technical session.

In the fourth technical session, technical programmes for the next biennial were presented by the respective group leaders. There were basic studies as well as applied aspects of integrated nematode management in different crop scenarios, with special emphasis on biological control agents, organic amendments, botanicals, host resistance, etc. Biotechnological interventions were also included in chalking out the technical programmes for the next biennial.

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MEETING REPORT

Need for science–policy linkages for river basins and coastal zone management*

Research on various facets of coastal sciences in India is burgeoning. However, scientific writings rarely make it to the public. The reason: missing links between science and society. This issue was debated at a workshop on science–policy interactions on river basins and coastal zone management held at the National Institute of Oceanography, Goa. Sugandha Sardesai had convened this workshop with an overall objective of bringing together relevant research findings on the river basins of Goa for policy makers and administrators, so that solutions for effective and sustainable management of precious water resources could be proposed. In all, there were 29 presentations in five technical sessions. They highlighted

current and changing scenarios mainly in Mandovi and Zuari basins, coastal zone and its resources, including salt production. Current levels of air, water and land pollution, an economic analysis of fisheries and management of freshwater resources in the state were also discussed.

Studies from Goa's large rivers, Zuari and Mandovi, clearly highlighted that the ecosystems of these basins are under pressure from mining, beach tourism, sewage outfall, coastal construction and indiscriminate dumping. These activities have been ascribed, through long- and short-term studies to the deteriorating quality/negative impacts on water, sediments and aesthetic quality. For example, the average nitrogenous nutrient levels have increased substantially from their 1980s levels post-2000. Anoxic environs are more frequent and have become undesirable for the near-shore fish and fisheries in recent years. High nutrient loading during the monsoon is seen as one of the

factors for this phenomenon. The quality of benthic environment is declining steadily, if not rapidly as yet. Both these rivers, the economic lifelines of Goa, are experiencing increasing trends in the concentrations of toxic heavy metals (viz. Cd, Pb, Zn). Their bio-magnification and ascendance through the aquatic food-chain can bring down the quality of fish as food, if their environmental releases are not checked.

Sewage pollution indicating microbial loads and many groups of human pathogenic bacteria are on the rise in lower stretches of both these rivers. Similar is the situation with dinoflagellates (now totaling 78), some of which (about 12) are toxic to fishes and to human beings through consumption of certain shellfishes harbouring the toxic forms. There are indications of invasion of some alien marine invertebrates. Long-term monitoring, spanning 30 years (1972–2002), has indicated that there is drastic reduction in

*A report on the workshop on 'Science–policy interactions on river basins and coastal zone management, Goa' held at the National Institute of Oceanography, Goa during 7–8 March 2006.

population numbers of bivalves, mainly due to mine-reject dumps in both the Mandovi Zuari stretches. Statistics of recent years suggests that fisheries in Goa are not economically viable activities, as seafood exports both in terms of value and quantity have recorded negative growth during 1994–2002 compared to previous decades.

The importance of science policy for dealing with extreme events in coastal belts was discussed with an emphasis on planned approach to hazards rather than crisis management *post-facto*. Relevance of preparedness for coping with natural hazards in the coastal regions was highlighted by comparing coastlines in different parts of the country to bring out the fact that devouring of coastal spaces by human actions such as constructions, sand extraction and tourism-related activities for short-term gains, is dangerous. Trampling of dune vegetation produces loose sand that is blown inland during windy periods. By comparing many coastlines before and after the December 2004 tsunami in the affected regions, it was shown that when people had altered the beach, destructions due to wave run-up were far more severe. Maintenance of sand dunes and coastal vegetation can contain/minimize damages due to inherent natural buffering capacity of coastal systems during extreme events.

New researches such as studies on bio-invasion, importance of particle-associated bacteria (PAB) in sustaining the trophodynamics of, and fish harvests from Mandovi and Zuari, alternatives for replacing TBT-based marine paints (that ought to be phased out by 2008), flow dynamics-simulation and modelling for construction of jetties, etc. in coastal waters as well as demarcation of inland vessel limit by classifying significant wave heights through modelling efforts were also presented. Although not a 'bulk feed' of the fish, the PAB through 'microbial loop' were reasoned out to be sustaining a third of nearly 4000 tons of annual fish harvests from these rivers.

Water management strategies of the Tillari Irrigation Project in North Goa

have apparently brought great benefits by irrigating over 16,000 ha in 73 villages, apart from hydropower generation. The importance of participatory irrigation management (PIM) for maximizing cultivation area, irrigation utilities and regulation steps for 2–3 crop sequences was brought out in relation to the existing practices in the Tillari Project area. The freshwater-scarce regions in the country can work out effective and sustainable use of water through adaptation of such management practices as PIM. Many opportunities for user-administrator interactions for managing this dwindling natural resource were listed. With PIM in place, revenue generation and utilization for local/regional development, resource-sharing on sustainable basis, regulations and cooperation during glut and drought conditions can become acceptable management practices.

Integration of various facets of these researches in evolving suitable management tools for aquatic resources of the nation is yet a challenge. Necessity of legislative and management strategies for integration of natural sciences and policies as well as introduction of markers to measure the progress in the implementation of integrated coastal and river basin management were emphasized. Various issues related to coastal zone management (CZM), the legislations on CZM and the way we are practising them in India as a whole need closer look and deeper analyses. It is important to bring out a scientific framework to avoid conflicts in various uses of freshwater resources as well as the coastline as a whole.

In the present scenario of 'somewhat fairly clean waters and coastal environments' of Goa with rich biodiversity, there are hiccups reflecting in terms of quality and quantity of seafood (reduction in shellfish harvests due to adverse effects of mining dumps), decline in khazan land area and production therein, spoilage in beach aesthetics, destruction of sand dunes and their vegetation. There is an urgent need for evolving policies that will safeguard the nation's coastal ecosystems as also the inland aquatic

bodies. For long-lasting sustainability of our ecosystems, civilized societies need to focus on their values and importance, form policies and encourage cooperation among specialized sectors.

An interactive session at the end of the technical sessions deliberated on the lack of appropriate science policy connections related to coastal issues. However, a downside of this workshop was poor response from policy makers, administrative officials and stakeholders. Such a negative scenario conveys that: (a) fruits of scientific research have not fully percolated the political system, (b) coastal scientists have not yet fulfilled obligations to the society by warning of problems of unplanned shore-front development, (c) the voice of scientists on topics of societal concern appears muted, (d) the absence of scientists as members of government committees needs introspection, and (e) sectoral practices in coastal management do not pay dividends.

As scientific knowledge grows, there comes the need for social responsibility. Further, such knowledge growth becomes available for adaptation in differing situations. There is an immediate need of nationwide consensus to adapt to river and water resources management. We believe that this is achievable through pursuance of scientific studies, 'correct' perception of scientific outputs and, through persuasion of planners and policy makers to develop suitable policies. With reference to coastal systems management in India, bridging natural sciences, social sciences and policies is imperative to further endorse the truism that 'coasts protect those who protect coasts'.

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