MEETING REPORT

Environment and hydrometeorological disasters – land, water and agriculture context*

'Hydrometeorological disasters' is the term used by risk scientists and emergency managers worldwide for distinguishing 'environmental disasters' from civil security threats and technological mishaps. Environmental disasters are floods, coastal hazards, slope erosions/landslides, droughts, desertification, forest fires, pests, mass bioinvasions, and threats of borers, epidemics, man–animal conflicts, genetically modified organisms (GMOs), chemical hazards, etc. Riots, serial bomb blasts, road mishaps, stampedes are the civil/security disasters. Technological disasters include fire, explosion, nuclear, chemical weapons, rail, aviation and naval accidents. Knowledge of environmental structure and function, and skills of natural resource management can play a potential role in reducing the hydrometeorological risk events and their impacts. Climate-change implications along local environmental alterations have increased the risks and vulnerability of land use. The workshop was attended by 39 delegates representing various departments, viz. agriculture, forest, environment, remote sensing, S&T, univ. dept of environmental science and faculty from training institutes, from several states of India.

Inaugurating the programme, P. G. Dhar Chakrabarti (National Institute of Disaster Management) highlighted the need for mainstreaming disaster risk reduction and response to environmental management drawing attention to the close relationship of disasters with natural or artificial environments governing land and water resources. Environmental managers need to highlight the disaster risk reduction benefits and emergency management issues in the land, water, atmosphere programmes. Water, land and atmospheric aspects of environment are closely related to hydrometeorological risks and socioeconomic vulnerability that result due to loss of resources and livelihood. In certain countries, the nodal agency for disaster management is named as the Ministry of Environment, Natural Resources and Disaster Management. Emergency humanitarian response is a skill-based discipline of incident command management and is distinct from risk management that focuses on pre-disaster prevention and mitigation.

Anil K. Gupta (NIDM) presented an overview of environment–disaster linkages in the LWA context with examples of various hydrometeorological disasters. Changes in geomorphological, atmospheric and biological systems within natural or human-managed systems (agriculture, forestry, reservoirs, mining, etc.) develop conditions of disasters – flood, drought, desertification, coastal erosion and flooding, besides mass contamination and disease outbreak. The film *Wrath of Nature – Flood and Drought* (Centre for Science and Environment, New Delhi), was screened to spark insights for discussion.

Santosh Kumar (NIDM) spoke on principles and strategies involved in evolution of disaster risk management and emergency response. Environmental degradation reduces bioproductivity and environmental supplies which results in socioeconomic vulnerability. Anil K. Gupta presented case examples of environmental management and disaster risk reduction. Geomorphological and ecosystem processes, when altered give rise to environmental hazards that may trigger a sudden or creeping disaster.

The session on second day focused on environmental laws and strategic issues. Sreeja S. Nair (NIDM) discussed constitutional and legal provisions – Environmental Protection Act (EPA), Air and Water Act, Acts and Rules on hazardous waste, chemicals, emergency preparedness, solid waste, biomedical waste, plastics, GMOs, public liability, environmental tribunal, motor vehicle, transboundary movement, etc. Anil K. Gupta spoke on application of tools like EIA (Environmental Impact Assessment), auditing, ecological footprint, cost–benefit analysis, strategic environmental assessment, site assessment and environmental standards in disaster management and emergencies. Disaster implications of climate change and adaptation–mitigation convergence framework were discussed in the context of hydrometeorological risks. Vinay K. Sehgal (Indian Agricultural Research Institute) discussed agro-ecosystems in relation to disasters. Hydrometeorological conditions are also responsible for pest attack, disease outbreak, forest fire, borers, epidemics, etc. with direct implications on agriculture, post-harvest and nutrition management.

During the day-3 session, Vinod K. Sharma (Indian Institute of Public Administration, New Delhi) enumerated environmental degradation that causes or aggravates drought situations; local aspects of hydrological cycle, rainwater harvesting, land-use, water-bodies, catchment/watersheds, desertification and community interventions. He suggested that the Ministry of Environment and Forests and other environmental institutes should focus on management of natural disasters as a core mandate. Flood hazards and disaster risks were discussed in relation to environmental management of catchment, river-basins, bank-erosion, wetlands, vegetation, etc. (Anil K. Gupta). SWOT analysis of environmental policies and notifications, viz. national conservation strategy, policies on environment, water, land-use, coastal zone, agriculture, forests for the provisions and issues related to disaster risk reduction and emergencies, was conducted.

The 4th day of the workshop focused on environmental information system applications. Sreeja S. Nair gave a talk on geoinformatics application in environmental vulnerability and disaster risk analysis (case study of coastal Orissa). Anil K. Gupta discussed application of modelling and models in prediction, forecasting and early warning of flood, drought and coastal hazards and disaster risks management in water resources and hydropower projects. UNEP-UNOCHA and ISDR guidelines on environmental situation assessment in disasters, rapid EIA of disasters, post-disaster environ-

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mental needs assessment, EIA for damage assessment and economic evaluation of environmental impacts were discussed. Ram Boojh (UNESCO) spoke on environmental education – role of NGOs and community capacity environmental action in disaster risk reduction.

Sessions on day-5 highlighted environmental responses in disasters, viz. shelter, water, sanitation, vector control and environmental health (Jugal Kishore, Maulana Azad Medical College) and coastal environmental disaster risks and mitigation challenges (A. L. Ramanathan, Jawaharlal Nehru University, Delhi). The group exercise-2 analysed different environmental programmes for their role in disaster management: watershed management, joint forest management, wastewater application, waste-management and river-basin management.

The valedictory session (presided over by P. G. Dhar Chakrabarti, NIDM) focused on the need for developing better understanding of environment–disaster linkages and implementing programmes and propagating the knowledge through case studies, seminars and publications.

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RESEARCH NEWS

Milking diatoms – a new route to sustainable energy

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As the world is moving towards cleaner and more sustainable energy alternatives, biofuels have gained a lot of importance, mainly because they are 'carbon neutral'. The carbon released by burning biofuels is only that which plants had previously absorbed from the atmosphere, thus making the net change in carbon content of the atmosphere zero. Many plants such as *Jatropha*, *Camelina*, maize, soybean, oil palm and algae, and fungi such as *Clonostachys rosea* f. *rosea* have been examined over the years as possible sources of biofuels as coal, petroleum and other fossil fuels are fast getting depleted. But, these 'sources' of fuel would require a lot of investment in terms of land, irrigation, fertilizers, protection against pests and pathogens, transport, etc. Other challenges include efficient conversion of polysaccharides like cellulose in these plants to fuels like ethanol and neutralizing the effect that cultivation of such plants may have on land, agriculture and food prices.

Recently, a novel technique to use diatoms (a kind of unicellular algae belonging to the algal class Bacillariophyceae) as a sustainable source of energy has been proposed by a team of scientists from India and Canada, comprising T. V. Ramachandra, D. M. Mahapatra and B. Karthick of the Energy and Wetlands Research Group, Centre for Ecological Sciences (CES), Indian Institute of Science (IISc), and Richard Gordon of the University of Manitoba, Canada. They have proposed ways of harvesting oil from diatoms using biochemical engineering, and also have introduced the design of a solar panel containing genetically modified diatoms that would actively secrete oil products, so that one can directly 'milk' gasoline from the solar panel on a regular basis[1]. A remarkable aspect of this approach is that it addresses two burning issues – global warming (and consequent climate change) and fuel oil crisis. Diatoms are responsible for about one-fifth of the photosynthesis carried out on earth, and, like other primary producers, sequester carbon. They are estimated to fix at least 30% of the global carbon dioxide. Under culture conditions, algal populations can double in size in a few hours, and are more effective absorbers of carbon than higher plants.

For many years now, researchers from all over the world are trying to use various algae – from cyanobacteria to sea weeds – as potential sources of different forms of renewable energy, including methanol, ethanol and hydrogen. In the 1950s, researchers proposed cultivation of algae in wastewater in order to produce methane gas. In 1978, the Aquatic Species Program, a research effort under the Biofuels Program initiated by the US Department of Energy, studied the possibility of using algae to produce hydrogen, and later, in the 1980s, started focusing on their use in the production of transportation fuel, particularly biodiesel[2]. Scientists at National Aeronautics and Space Administration (NASA), USA, have recently proposed a method of using offshore plastic membranous bags filled with sewage for cultivating algae. The algae fix carbon dioxide as they grow and also clean up the sewage water. They can then be used to extract oil[3]. Scientists at Newcastle University, UK and Pennsylvania State University are examining the potential of phytoplanktons (*Chlorella*) and macroalgae (*Ulva*) in bioelectricity production[4]. Efforts are being made in China to use microalgae as carbon sequestering agents in coal fields. Carbon from gasified coal is fed to algae grown in bioreactors near the coal fields, and oil that is produced by them can be harvested every day. Much time, thought and money have been spent on identifying efficient strains of algae for production of energy, and also for developing ever improving systems for optimal cultivation of algae – from open pond systems, that were used in the beginning, to closed algal bioreactors that are used widely today. But extraction of oil from algae is expensive and would require energy input. This is a major drawback in efforts to use algae as well as other plants as sources of renewable energy. The concept developed by T. V. Ramachandra *et al.* using diatoms seeks to address this issue.