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Hydro-meteorological Disasters & Climate Change

(1) Cyclone, (2) Flood, (3) Drought and (4) Climate Change

Draft Outcome Document

Introduction

Hydro-meterological disasters cover about 85 to 90 % of the total natural disasters in India and also account for 70 to 80% of the property and financial losses and also cause environmental damages. Disaster risk reduction has become part of sustainable developmental agenda. A major hydro-meterological disaster temporarily arrests development efforts. Thus preparedness, early warning systems, disaster relief and disaster mitigation efforts of the disaster management agencies ought to remain focused on hydro meteorological disasters which occur all the year round. The Congress has focused on the Hydrometerological disaster in four themes viz., floods, cyclones, drought and climate change in which key note addresses and research contributions were presented by 65 speakers in different thematic sessions held on three days of the Congress. All the four themes covered under hydro metrological disasters are multi-disciplinary in nature and the success of societal applications would critically depend upon integrating the efforts of multi-disciplinary agencies. Knowledge gaps in different themes were identified and all imbedded in thematic recommendations.

Highlights of the Technical Session on Flood:

In the session 12 presentations (key note, invited & contributory papers) were made. The invited papers and key note addresses were focused on the development of researches and present status of the areas and provided glimpses of what needs to be done to address the challenging problems in respective areas. The contributed papers in the session on **Floods** were broadly focused on structural management of flood related problems mostly in the Ganga and Mahanadi basins. Problems associated with urban flooding due to heavy rains, use of dynamical flood forecast technology, meso-scale weather and its forecasting, flood risk management and mitigation strategies were also addressed in other papers.

Recommendations:

1. Flood control should be considered in overall perspective and for this purpose, the existing bilateral arrangements, mechanisms and treaties signed between India and the neighbouring countries need to give a boosted momentum to achieve the identified goals.
2. The approaches of erosion control and construction of coffer dams need to be considered based on techno-economic considerations utilizing locally available manpower and materials to the extent possible with tactful strategy
3. An effective regional cooperation needs to be ensured for a proper strategy for flood disaster risk reduction.
4. Better understanding of physiological and hydro-meteorological features of the catchments is essential for success of a disaster risk reduction and preparedness programme.

5. The flood risk reduction programmes should be holistic in approach and incorporate the local issues like family planning, health, local knowledge, micro credit, self-help groups, economic enhancement and area specific risk reduction programme.
6. A proper analysis of strength and weaknesses of disaster management mechanisms associated with the failures of dams including landslide dams should be done and our future disaster risk preparedness and mitigation programmes should be re-oriented considering the results of such an analysis.
7. Proper maintenance of already created assets should be given priority.
8. Proper documentation of disaster management processes should be done.
9. Vulnerability analysis, based on economical and flood educational status, is crucial input for flood hazard assessment.
10. A proper combination of structural and non-structural measures should be considered for effective flood management. Flood forecasting plays an important role during floods; which should be based on modern technologies and catchment-specific needs.
11. The available modern methods of rainfall prediction are useful in improving the forecasting ability of hydrologists but a judicious selection based on specific operating conditions is required for application of a particular model of rainfall prediction.
12. There is need to take effective steps against unplanned urbanization in the form of illegal & unauthorized colonies and encroachment on natural drainage systems to avoid future flood risks.
13. The urban floods have harmful effects on human lives and the environment as a whole. The natural watersheds should be duly considered in development of a strategy for urban flood management and city development planning.
14. The latest scientific methods for assessment and simulation of flood inundation, hydrological models, GIS based models and L-moments approach for estimation of floods of different return periods should be used in view of need of a good analysis and a reliable database for study of climate changes.

Highlights of the Technical Session on Cyclone:

In the session besides four lead talks, 18 contributory papers were presented. In the areas of Tropical Cyclone besides lead talks 10 papers were presented dealing with the genesis, forecasting and societal implications, storms surge prediction, application of space science technology to tropical cyclone monitoring and predication, land fall predication of cyclones etc. Modern predication technology is mainly based on the application of modern large scale and meso scale dynamical models for understanding and predication of cyclones in the Indian Ocean basin. Storms surge associated with land falling cyclones in the region of low bathymetry (Deltic regions) cause tremendous loss of life and property. Dynamical models for predication of storm surges and the near-costal inundation caused by the surges, developed by the faculty by the IIT Delhi, were addressed in one lead talk and one contributed paper. The subject of severe local thunderstorms in the Gangetic West Bengal were covered in three papers in which empirical techniques as well as high resolution dynamical prediction system was applied. The impact of data assimilation, including data from Dopplar weather radars on the skill of high resolution mesoscale models was covered in one paper.

Recommendations

1. Enhancement of observations over data sparse oceanic regions as well as establishment of mesoscale-network of observations over vulnerable regions.
2. Implementation of better assimilation techniques utilizing all available data including land surface, remote sensing (satellite, DWR, UAV, aircraft) data etc. for initialization of mesoscale models.
3. Extensive use of coupled mesoscale atmosphere-ocean-wave model for better track and intensity prediction of tropical cyclones.
4. Preparation of probability forecasts for striking potential of cyclones using multi-models for effective and reliable warning system.
5. Better prediction of storm surges and associated costal inundation along with providing information on river and estuarine water level height.
6. Identification of risk / vulnerability zones of coastal regions.
7. More intense and systematic interaction among scientific community, disaster managers and society.
8. Awareness, community involvement & preparedness and social defense mechanism need to be strengthened.
9. Introduction of disaster management courses / special subject in all graduate level technical education.
10. Improved techniques for mangroves generation and maintenance to reduce causalities.

Highlights of the Technical Session on Drought:

In the session on **Droughts,** 4 lead talks and 7 contributed papers were presented mainly, dealing with drought assessment, drought evaluation, drought management strategies including early warning system, impact of drought on food production, drought in relation to climate change and drought as a development issue in Afro-Asian region and sharing of inter-regional information on drought related issues to build inter-regional partnership. The broad spectrum of papers presented covered different aspects of scientific, agricultural and socio-economic aspects of the slowly evolving drought phenomena and its management in agragarian economies. The panel discussion in the session gave an opportunity to the participants to interact with the expert panel.

Recommendations

1. Creation of Knowledge-base covering all aspects of droughts and establishment of national and international knowledge network on drought management.
2. Documentation of lessons learnt on drought management.
3. Documentation of knowledge on community based drought management practices.
4. As drought frequency may increase under climate change, efforts to be devoted to introduce drought resistance crop verities. Fresh water scarcity leads to societal strives and as such modeling ought to be promoted for assessing water stress under climate change scenario.

Highlights of the Technical Session on Climate Change:

In the session on **Climate Change** 2 key note, 6 lead talks and 10 contributed papers were presented covering diverse aspects of currently hotly debated subject of climate change which is attracting attention of nations all over the world. Climate change on global scale has been

virtually accepted by experts and policy makers. However, there is uncertainty about the magnitude of change on national scale as well as the regional impacts of the climate change. The problem of glacier melt, recession of glaciers, glacier lake out flow floods, climate change and health, climate change and water resources, food security and climate change, prediction, predictability and early warning systems for hydro-meteorological disasters in the context of climate change were emphasized in different papers. The on going revolution in the science of climate prediction and weather prediction on different scales are likely to bring about a sea change in the next two decades. But the success would depend on introduction of petaflop computing power and the quality and density of observing systems using modern atmosphere-ocean technology as well as fast communication systems. It was emphasized that India should march hand in hand with international community to reap the benefit of the emerging horizons in the emerging seamless weather and climate prediction system. The climate change scenarios project increase in the incidence of extreme weather and climate events, and this increased variability in weather and climate would make the challenge of prediction more complex. Modern society needs higher predictive capability of disaster events for disaster risk reduction. The communication of weather and climate related warnings to the end users for the disaster reeducation become very important as timely warning help disaster management agencies to take appropriate actions for risk reduction.

Recommendations

a. Scientific and Technical

1. Setting up of high density observational networks suitable for detection and monitoring of hydro-meteorological disasters on priority
2. Deployment of high resolution global and regional climate models which to be run on petaflop computing systems
3. Improving the accuracy of weather forecasting and short-term climate prediction for high impact weather events.
4. Development and implementation of Early Warning Systems for all hydro-meteorological disasters
5. Up-gradation of communication systems for improving dissemination of warnings

b. *Infrastructural*

6. Establishment of a State-of-the-art Regional Centre at international level for Climate Change Research through multi-national cooperation

c. *Capacity Building*

7. Urgent need to train young scientists in the best available Institutes or acquire trained manpower available across the world in the field of climate science and provide them exciting opportunities to march forward hand in hand with advanced countries to extend the frontiers of weather and climate prediction adopting state of the art dynamical predication, system possibily on a seamless scale.

d. *Policy*

8. A national policy for sharing and access to meteorological, hydrological, geological and environmental data and products within the government, research organziations and among the communities. Use of data by diverse organizations adds value to the data which enhances the image of organizations who generate and provide data.

e. *Outreach*

9. Launch of massive Public awareness Programmes to address people at grass-root levels (Farmers, Workers, NGOs, community level organizations, local administrators/ disaster managers, etc) using mass media and other media. Efforts should also be made to launch TV /Radio Channels on weather and climate information. A better coordination and interaction of disaster predication and disaster management agencies and print and electronic media is needed. This would enhance the image of media in the eyes of the society.

f. *Adaptation and mitigation actions*

10. Launch of programmes to enhance coping capacity of community (including alternative livelihoods) to reduce risk from disasters under climate change scenarios.
11. Launch of programmes for assessing sectoral vulnerability of climate change impacts based on future climate change scenarios
12. Involvement of state/district level communities in the areas of water resources, food productivity and conservation of bio-diversity in the face of climate change.
13. Involvement of civil societies, educational institutions, and religious organizations in the climate change related adaptation and mitigation actions.

Action Points

1. Risk reduction of hydro-meteorological disaster rests with better monitoring, better modeling efforts and better communication of threat perception in a probabilistic manner for which public awareness is to be progressively promoted. The role of media governmental agencies and NGOs becomes all the more important for creating awareness about the hydro-climatic disasters as well as about the efforts of Disaster Management System for disaster risk reduction.
2. Evolving the adaptation strategies in order to combat the future challenges in agriculture, water, health and other sectors due to climate variability and climate changes particularly in dealing with disaster management in a most effective manner.
3. Focused research studies on projecting climate change and its impact on different sectors with more reliable and better data sets for prediction models for effective and realistic policy planning.
4. Vulnerability assessment and assessment of increasing resilience to hydro-meteorological disasters is a powerful tool for the examination of societal well-being in the face of climatic change. For better disaster management there is an urgent need to integrate knowledge about the environment (climate, ecosystems, water, associated pollution and climate change) with knowledge about humans and their activities (agriculture/forestry/fishing, resource management, political governance, energy use, and culture). Such efforts would contribute to determination of a holistic picture of how sensitive particular places are and how resilient they are and likely to be in future to the kinds of changes that might be associated with climate change.
5. Efforts to bring together stakeholders in climate change and disaster management have begun and opportunities for further integration of efforts are present and must be exploited. Challenges however lie in harmonizing diverse institutional structures, distinct sectoral planning & policies etc and also in communications between the communities about practices at global, regional and national levels.
6. Sustainable alternate livelihoods in an important pathway to enhance resilience to adverse impacts of climate change.

7. Efforts will have to be made towards necessary policy support for developing appropriate water management strategies, crop varieties, farming systems etc and development of disaster management linkages at local, district, state and national levels.
8. For improving weather predictions on short, medium and extended-range scales and climate predication on Inter-annual, decadal and even centennial scales, direverse models are in use but the future perhaps lies in the adoption of high resolution seamless prediction models. Such models would need very very high speed computers on petaflop basis. There is a need to adopt such models and march hand in hand with advanced countries towards enhancing research potential applications of such models. India would do well if an international, regional climate research centre is established in India with very very high computing facility providing exciting environment for young scientists who would work on the frontier research area of climate science. Reliable disaster prediction is the most sensitive part of disaster risk reduction. It requires constant monitoring of hazard parameters and precursors as well as application of tested skillful dynamical weather and climate prediction models. Marked improvements in the observational systems for atmosphere-ocean-land environment is likely to take place in India in the next two or three years in the organizations working under the Ministry of Earth Science (IMD, INCOIS). These improvements in quality and density of observations would lead to timeliness and advance lead time of hazard warnings. These would be largely driven by the scientific and technological advances as well as use of high speed computer systems and communication technology and are likely to improve the effectiveness of disaster early warning system. The need of the hour is to integrate the efforts of national weather services, National Ocean Services, disaster management, disaster-related research institutes, research organizations and universities engaged in weather and climate research and application so that their efforts result in social benefit such as disaster risk reduction.
9. Building of hydro-met disaster network over Afro-Asia-Pacific region.
10. There is a need to have an annual workshop under the guidance of NIDM to discuss the effectiveness of disaster preparedness warning and management system against major hydromet disasters which occurred in the previous year in the presence of all stake holders.