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Risk to Resilience

Strategic Tools for Disaster Risk Management



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Risk to Resilience

Strategic Tools for Disaster Risk Management

2010

Proceedings of the International Workshop

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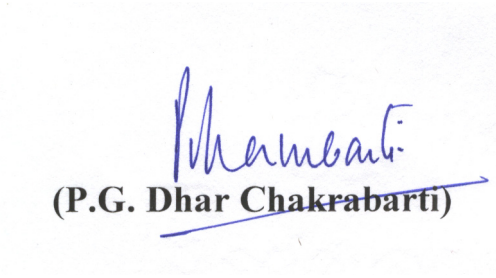
PREFACE

National institute of Disaster Management (NIDM) in collaboration with Institute of Social and Environment Transition (ISET) and Winrock International India (WII) organized an international Workshop on Risk to Resilience: Strategic Tools for Disaster Risk Management in New Delhi on 3-4 February, 2009. The purpose of the workshop was to initiate a dialogue on the findings of recent action research in South Asia, particularly in India, Nepal and Pakistan, on various strategic tools for Disaster Risk Reduction, including hazard projections, vulnerability mapping, Cost Benefit Analysis of disaster mitigation and structured learning process. Important lessons were learnt through pilot research projects which need further testing, validation and upscaling in the region.

The international workshop provided an opportunity for intensive brainstorming discussion among the researchers, practitioners and policy makers from the region across sectors.

We are happy to release the proceedings of the workshop, which, I am sure, would he useful for developing further policies, plans and programmer for reducing the risks of hydro-metrological disasters in the changing climate of South Asia.

New Delhi
10.12.2009



(P.G. Dhar Chakrabarti)

ACKNOWLEDGEMENTS

The international workshop on **"Risk to Resilience"** was organised by the National Institute for Disaster Management (NIDM), New Delhi; the Institute for Social and Environmental Transition (ISET), Colorado, and Winrock International India (WII), New Delhi, as a case study sharing forum and to identify ways of integrating strategic tools of disaster risk reduction into current policy, decisions and planning. The workshop, and the case studies and research presented at the workshop, were supported by The ProVention Consortium, hosted by the International Federation of Red Cross and Red Crescent Societies, The U.K. Department for International Development, (DFID),The Canadian International Development Research Centre (IDRC),The U.S. National Oceanic and Atmospheric Administration (NOAA).

The workshop was organised under the supervision of Mr. P.G. Dhar Chakrabarti, Executive Director of NIDM and Dr. Marcus Moench, President of ISET. The organising team acknowledges the cooperation of dignitaries of the inaugural session; Prof N.Vinod Chandra Menon, Honbl'e member NDMA, Dr. Anand Bose, Addl. Secretary, MoAg & Coop., Dr. S.P. Sharma, Advisor, MOEF.

The contributions of luminary speakers and chairpersons of the technical sessions, and the policy level round-table session, Ministries and Agencies of the Government of India, especially Environment & Forests, Agriculture, Rural Development, Science & Technology, Earth Sciences other strategic partner organisations, and Scope-complex management, who made the workshop a success, is gratefully acknowledged. Contributions of the reviewers, Prof. Santosh Kumar, NIDM and Dr. Reinhard Mechler - International Institute for Applied Systems Analysis (IIASA), have been important in finalizing these workshop proceedings.

The organising team also acknowledges the sincere support and cooperation of Mr. Anurag Mittal and Ms. Sanyogita Rawat of WII and Mr. J.N. Jha, Mr. Surinder Bisht, Ms. Geeta Sharma and other staff of NIDM, throughout this process.

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Introduction

A 'disaster' is a severe disruption to a community's survival, resources and livelihood systems that result from vulnerability to hazard impacts and results in loss of life, property or environment on a scale which overwhelms their capacity to cope unaided. Over recent decades human and financial losses due to natural disasters have increased dramatically and, in many cases, fundamentally undermined progress toward development objectives.

Disaster Management encompasses two major domain functions, *viz.* 1. risk management, and 2. emergency response. Millennium development goals (MDG), Hyogo-framework for Action (2005-15), UN-IDNDR (1990-99), World Summit of Sustainable Development (WSSD, Rio+10), as a sequel of Agenda-21 adapted at UN-CED, 1992, have made the global community realize and recognize that no development is sustainable if human life, resources and capital are vulnerable to major disaster risks. Thus, disaster management is a core component of sustainable development. Developing resilience in the resource support system (natural and anthropogenic) and socio-economic functions is a prime concern for reducing vulnerability and for preventing or mitigation hazards from producing a disaster situation.

When it is globally accepted that the focus of 'risk management' as well as 'emergency response' has to be assessed, organized and implemented very distinctively in a result oriented fashion to demonstrate the success models that can be further replicated and experiences proliferated. Clarifying that the action time-frame for Disaster Risk Reduction (DRR) as compared to emergency response is greatly different. Therefore, the DRR focus stems at (a) preventing or reducing the hazards, (b) reducing the vulnerability of resources of the people (life, environmental reserves, supply and services, infrastructure, capital) (c) increasing resistance (resilience, tolerance, avoidance) and reducing exposure (d) and, strengthening natural/environmental relief resources. The paradigm shift, brought out worldwide, has been institutionalized in India through Disaster Management Act 2005, wherein risk mitigation and multi-sector involvement in disaster management has been provisioned so as to emphasize the initiatives and resources that are basic to sustainable development. The regime provoked by the climate-change adaptation era has lead to realization that the disaster reduction has to go in an infused way in all the layers/sectors dealing with environmental resources, services and livelihood support systems.

Aim and Objectives

Workshop was aimed to discuss methodologies for evaluating DRR strategies for hydro-meteorological hazards, including those likely to emerge as a consequence of climate change, and to mainstream these in the policy process. Insights from

works on other hazards were also presented, where they have specific relevance to the main focus of the meeting.

Key objectives of the workshop were the following:

- to deliberate on needs, concepts and challenges in estimations and mapping of risk and cost-benefit analysis of DRR strategies
- to share international and national experiences and view-points on tools and techniques in DRR strategy design, advocacy and financial mobilization for implementations
- to discuss and deliberate the policy and regulatory framework on various environmental/ natural resources, and human development aspects that help facilitate and provide for such DRR tools
- to evolve and workout an acceptable approach for such tools and the functional mechanisms to adapt such tools to specific contexts.

Key Concepts

Risk to Resilience: Climate Change Adaptation and DRR strategies

Geographic and regional Climatic conditions in the developing nations of South-Asia, viz., India, Pakistan, Nepal, Bhutan, etc. make them prone to multiple hazards especially the ones related to water, climate, land, etc. Shifting focus from "reactive response to losses and/or disasters" to "developing resilience to probable hazards" has been brought to fore-front as an adaptation agenda to climate-change implications. It has been clarified now that the centre of resilience needs to focus on "hazards" rather than 'disasters". DRR strategy-making involves the cycle from identification & assessment of likely hazards; developing resistance (through prevention, avoidance, mitigation or tolerance); capacity development and evaluation, and designing implementation framework. The exercise involves data processes, application of environmental system tools for predictions and forecasting, mapping and presentation tools, and feeding to relevant strategic instruments.

Planning and Implementation challenges

A plan is the roadmap for the actions for implementing a delineated programme. Planning and strategising disaster management focused on risk reduction, faces a range of challenges especially those related to estimation and quantification of costs and benefits, and the changes over temporal and spatial scales. Planning tasks are taken up at spatial scales like eco-physiographic region e.g., river basin, agro-climatic zone, or administrative division, state, district, block/taluka, or village level, whereas on the temporal front it may be decadal, five-year, or may be annual plan.

However, the planning to address the risk reduction objectives involves integration with many environmental and developmental programmes including welfare focused, e.g., addressing the poverty alleviation/livelihood, soil/water conservation, watershed, drinking water, livestock, agriculture, command area, joint forest management/ afforestation, grass & fodder, lake restoration, waste lands, medicinal & oil plants, housing, health, etc. However, integrating the core component of disaster risk projections and DRR strategies into all the on-going and proposed programmes/ projects, has an investment costs. In order to administer DRR organization at various levels/ scales the basic need is financial mobilization and mechanism, and it calls for understanding: the cost-benefit matrix for various projected hazard/scenarios; current and likely vulnerability patterns; planning and implementation modes; evaluation criteria and techniques.

Strategic Tools for Disaster Risk Management

(a) Hazard Projections and Scenarios

Identification and assessment (through monitoring, observations and projections) of emerging hazards and associate risks are vital components for appropriate land-use planning and sustainable socio-economic development. It facilitates the administrators and planners to identify the hazard prone areas and prioritize their mitigation/ response efforts. Efficient methodologies specific to the local scenarios to accurately delineate the hazard areas and generating scenarios based on magnitude, intensity, frequency etc., help in coming up with futuristic scenarios/ projections. For example, collection and analysis of past disaster data can be extremely useful in analyzing the trends and also to derive future scenarios besides modeling techniques based on environmental system analysis and system-dynamics. This method helps in understanding how developmental projects/ environmental / social factors have increased or reduced the disaster risk over a period of time. For example, the urban flooding incidences, dam induced seismicity, can increase due to changes in environmental regimes, land-use modifications, etc. GIS approach of "Environmental Microzonation" offers risk-sensitive land use planning and mitigation centric development.

(b) Vulnerability Mapping and Indices

Vulnerability mapping is a systematic approach for assessing and integrating the impact of various factors, namely, the geographic environment involving several levels of dependent and independent, qualitative and quantitative information in graphic and pictoral form. Methodology for computing a composite index for hazards derived from geo-environmental parameters, land cover, socio-economic and population related data can facilitate understanding the combined scenario effectively. Integrating the data to prepare such indices in a multi-layer approach is much effective and cost & time effective through use of GIS system. Such indices computed using GIS (with some field checks) can not only incorporate susceptibility of each area to hazard but also can account for the factors that are inherently related to emergency management indirectly.

(c) DRR Strategy Making

The paradigm shift in disaster management worldwide influencing national policies, as well as the climate-change adaptation regime highlight the focused need to address the pre-disaster phase *i.e.* actually "hazard risk reduction" broadly understood as "DRR (disaster risk reduction)". The making of DRR strategy for an administrative unit or an eco-geographical region, need to incorporate following components: (a) hazard identification and assessment (b) assessment of vulnerabilities (c) identification of hazard reduction and impact mitigation options (d) analysis,

evaluation and cost-benefits of options (e) integration with environmental, developmental and welfare programmes of different departments/missions (f) mainstreaming into socio-economic development (g) reviewing the expected outcomes from the viewpoint of Climate Change Adaptation and DRR and (h) implementation and monitoring plan.

(d) Cost-Benefit Analysis

Cost benefit is an approach of "Impact Assessment" in terms of economic efficiency of a proct. Cost Benefit analysis requires a complete enumeration of all gains/benefits and losses/costs associated with a project. Cost-investments, financial mobilization, motivation and decisions regarding any proposed major actions/projects has always been a major evaluation and assessment criteria to decide the costs as against the projected/expected benefits. Many proponents of disaster mitigation (both structural and non structural) claim that it offers potential benefits in terms of saved lives and property far exceeding its costs. To provide evidence for this, and to justify the use of public funds, agencies involved in mitigation can use benefit cost analysis. Such analysis, if well done, offers means of evaluating and comparing projects, it helps decision makers choose between mitigation projects, and provides means to assess the way public funds are spent. For example, it could be used to assess the extent to which construction of dam can reduce impact of floods or droughts. CBA forms a part of comprehensive Feasibility Analysis and environmental like EIA and Auditing especially in case of mitigation projects like Dams, Highway etc.

(e) Structured Learning Process & Policy Dialogue

DRR is still a new concept, in the wake of 'paradigm shift' from reactive to proactive approach. Shared learning process is key to develop a DRR strategy based on proper hazard, risk and vulnerability assessments and past experiences. It involves multi-stakeholder and participative approach and is useful for inculcating understanding of risk and promoting convergence of DRR in various environmental, developmental and welfare programmes. They may be multi-tier at local, district (or regional) and state level, where strategic decisions and plan clearances are issued. Notions of DRR are distinguishable in the environmental settings of developing countries as compared with those to developed ones.

(f) Evaluation Techniques

Overall purpose of evaluation is to ensure the expected project outputs are achieved and the objectives accomplished; obtain an overall view of the relevance, effectiveness, efficiency and appropriateness of the project activities; propose strategies for continuation of these activities by the national and sub national agencies and documentation the practices and lessons learnt.

State of the Art Tools and Technologies

As of now, the tools of DRR strategies and CBA in developing countries, the multi-hazard vulnerability analysis, risk mapping, and evaluation of mitigation strategies, etc. are at nascent state and under experimentation. Besides this, the concepts/ case studies are at varying levels and scales. Establishing the core concepts for the objectives and scope of such tools is a key component in designing such methodologies that are flexible to adapt to region-specific bio-physical and socio-economic settings. UNDP-DRM programme has been implemented in India, in 169 multi-hazard districts and under this programme district level disaster management plans were formulated. Although efforts were made to incorporate the component of multi-hazard vulnerability and disaster risk reduction in these plans there still remains a huge gap. Understanding and incorporating climate-risk and resilience is still a concept in pipeline to be realized at least at project levels. A GTZ-MoEF project on Climate Change Adaptation in rural areas of India is recently under implementation. There are few case studies on vulnerability of coastal areas and hazard mapping at various levels with varying degrees of details. Cost-benefit analysis of response mechanism and measures is developing a place in emergency response system, however it's far from understanding in the context of Disaster Risk Reduction (DRR) where it is most required. Environment Impact Assessment (EIA) and Feasibility Analysis of mitigation projects/measures are to be further evolved to emphasize vulnerability to various environmental and public risk, prevailing and projected.

INAUGURAL SESSION

Introduction to the international workshop on "Risk to Resilience" organized by NIDM, ISET and Winrock International India was given by Dr. Anil K. Gupta, Associate Professor, NIDM. He appraised the delegates about the objectives and structure of the two days workshop aimed to bring various researchers, policy planners, professional and key government departments at a platform to discuss the tools and methodologies for evaluating DRR strategies for various hydro-meteorological



hazards in climate change relevance and to mainstream these in the policy provisions for addressing sustainable development.

Inaugural session was presided over by Hon'ble Member of the National Disaster Management Authority, Prof. N. Vinod Chandra Menon. Executive Director of the National Institute of Disaster Management, Mr. P. G. Dhar Chakrabarti delivered the welcome address. A thematic address was delivered by Dr. Marcus Moench, President of Institute of Social and Environment Transition (ISET). Dr. Anand Bose, Additional Secretary, Ministry of Agriculture, Government of India and Dr. S. P. Sharma, Statistical Advisor, Ministry of Environment & Forests, Government of India, delivered special address.

There were four technical sessions, viz. (a) Core Concepts & Challenges (b) Case Studies (c) Techniques for Evaluating the Costs and Benefits of Disaster Risk Reduction (d) Tools and methodologies to inform Policy, Availability & Critical Gaps. The technical programme was followed by a high-level round table brainstorming session to take the key message and to draw suggestions for integrating the strategic tools and cost-benefit methodologies in the present policy and planning framework. Mr. B. M. S. Rathore, Senior Advisor of the Winrock International India extended a formal vote of thanks at the end of the inaugural session.

WELCOME ADDRESS

P. G. Dhar Chakrabarti
Executive Director
National Institute of Disaster Management,
New Delhi



South Asia is one of the most critical hotspots of disasters and climate related risks in the world today. South Asia carries the burden of more than 23% of the global population with less than 8% of it land resources and 3% of global wealth. It has layers of hazards, vulnerabilities and risks embedded into its geography, geology and climate that make deadly combination of disasters. Global Disaster Report of 2007 released by the Centre for Research in Epidemiology of Disasters shows that six of the top ten top disasters in the world occurred in the South Asia. In 2008, three of the top ten disasters of the world took place in South Asia.

There is a serious need to understand the costs and benefits of a mitigation measure that will enable to take correct decisions. It will help in ensuring better adaptation measures, along of convergence of disaster risk reduction along environmental management within the overall development framework in South Asia region.

The natural hazards in the fragile ecosystems of the Himalayas that is still evolving have been compounded by the risks of climate-change, melting glaciers and increasing incidences of flash floods and glacial lake outburst flood and all these are resulting in further environmental degradation of various types and scales, by loading the rivers with the silts reducing their carrying capacity, catchment denudation, bank erosion, etc. Floods are becoming almost a recurring phenomenon in almost every country of the regions.

Hydro-meteorological disasters have increased significantly in South Asia particularly during the last 30 years and this trend gives a clear indication of the impact of climate-related events. There are recorded evidences of sea level rising in areas like in Bangladesh where large part of the coastal land is getting submerged. The atmospheric depressions and cyclonic storms are increasing as a result of rising oceanic temperature impacting the coastal ecology and habitation.

Problems are enormous and the approach to deal with these is a key challenge. In South Asia, we have for a long time looked at natural disasters with an attitude of fatalism and helplessness, considering these as manifestations of the “anger of the God” or “Wrath of Nature”. The South Asian countries didn’t have any defined policy on disaster management until recently. There was little emphasis to deal with these hazards in a pro-active manner, for reducing the risks of disasters. It is only after

recent mega disasters like the earthquake in Gujarat and Kashmir, cyclones in Orissa and Bangladesh, Indian Ocean Tsunami in India, Sri Lanka and Maldives, etc. that concerted efforts have been made to workout policies and approaches for dealing with the risks of such disasters. The Disaster Management Act of India created the institutional and legal framework for holistic management of disasters. Similar law has been enacted in Sri Lanka, Pakistan, Afghanistan and draft legislations are ready in Nepal, Bangladesh and Maldives. Many countries have announced their disaster management policies. Disaster Management Policy of India is in the process of being approved.

There is nothing like 'natural disaster'. Every disaster is a 'man-made disaster' - it is our failure to understand and manage the hazards that lead to disasters.
Approach to the management of disasters is passing through a paradigm shift from a 'reactive' to 'proactive' measures which would help to reduce the risks of disasters..

But we do not yet have a clear approach for mitigating the risks of disasters and mainstreaming the disaster risk reduction into developmental framework. There is much rhetoric but very little concrete actual action is visible on the ground. There is a serious need to scientifically assess the risks at the local level, explore all possible options for mitigation and understand the costs and benefits of mitigation and other risk reduction measure that will enable us to take correct decisions. There is a need to ensure that scarce resources are optimally utilized by convergence of parallel initiatives for environmental management, climate change adaptation and disaster risk reduction. All these initiatives should be integrated within the framework of sustainable development in the region.

The South Asian countries have adopted the South Asia Regional Framework for Disaster Risk Reduction in tune with the Hyogo Framework of Action and every country has developed its own national frameworks, but the methodologies, tools and techniques for analyzing various options for mitigation in specific circumstances are not available. In this context, the International Workshop on 'Risk to Resilience' will provide an opportunity for sharing the valuable lessons learnt from recent research and case studies and the tools and methodologies that have been developed, tested and applied through action research in various parts of the region.

This two days international workshop has been organized jointly by three organizations – Institute of Environment and Social Transition (ISET), Winrock International and the National Institute of Disaster Management (NIDM). The purpose of this workshop is mainly to present the findings of the research carried out by a collaborative group led by the ISET in India, Nepal and Pakistan and to brainstorm on the concepts, tools, approaches and methodologies for risk reduction. Representatives from academic and research institutions, central Ministries of Agriculture, Environment & Forests, Home Affairs, Earth Sciences, Science & Technology, State Government Departments of Disaster Management, Relief,

Environment & Forests, Planning, Agriculture, etc. and grassroots level agencies and NGOs working in the area of environmental management especially climate-change adaptation, water and land resources are attending this international workshop.

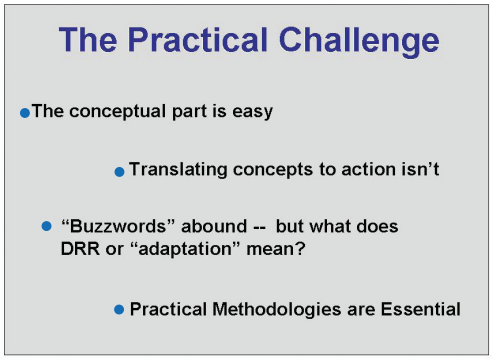
I am sure this Workshop shall provide a good opportunity to discuss the findings of the case studies and develop strategies for deciding further course of action for integrating some of the lessons learnt into development policies, planning and programmes for reducing the risks of various hydro-meteorological disasters in South Asia region.

THEMATIC ADDRESS

Dr. Marcus Moench
President
Institute of Social and Environment Transition
Colorado, USA



The Thematic Presentation, was a quick review of some of the results from the "Risk to Resilience" collaborative project on strategic tools on ***moving from concept to action***. There are lot of discussion on DRR and broad recognition of need for it, but globally people are a little tired of hearing about DRR and they want to know what one is actually doing and how it is being done and same goes with Climate Adaptation. During a meeting held in UK in January 2009, the Chief Metcorological officer of UK presented some of the clear evidence of increase in GHG emission. There is clear evidence of climate change shown by results from IPCC and there are discussions on need to adapt, but there are no clear ideas of what adaptation means and how does one translate it into practice. The project was supported by DFID and NOAA. Information generated from NOAA projects and studies by the network of partners from India, Nepal and Pakistan really looks at how to translate broad concept of risk reduction or adaption into action.



The Conceptual Challenge: Weather related events are a high proportion (70%) of existing disasters; disasters are widely recognized as contributing to poverty; projections of climate change suggest increased variability and extremes; and, it is known that climate change will occur regardless of reductions in greenhouse gas emissions. So, as a result, DRR is essential and also central to adapting to climate change. The conceptual part is easy but translating that into action is really not. The buzz words around climate adaptation and disaster risk reduction abound but practical methodologies for the same are lacking.

The project encompassed case studies from Rawalpindi (urban) in Pakistan, Rohini river basin in Uttar Pradesh and Bagmati river basin in Nepal and partly into Bihar (India). The collaborative partners led by ISET included ISET-Nepal, IIASA (Austria), KCL (UK), WII (India), GEAG (India) and PIEDAR (Pakistan).

Methodology: The basic idea was how do you translate anything into action? As everybody knows, disasters are local hence the idea was to have sets of dialogues to bring together global scientific information with local information to scope out what can be done in local area. Couple that with detail analysis of vulnerability and identify disaster risk reduction options thru sets of Shared Learning Dialogue (SLDs) for scoping the same. We had qualitative focus of identifying major areas of costs and benefit through transects, another set of SLDs and secondary data considered together. Then, we did a detailed survey to understand site characteristics and exposure of assets to understand what really is at risk and what might be the loss. To put in Climate Change information we attempted climate downscaling in some of the locations. In some we tested the ability to downscale the results to check for accuracy. Additionally, we undertook the flood analysis, hydrologic modeling to assess specific impacts; and, a backward and forward looking cost benefit analysis—backward looking at what happened in past and forward looking at what is the probability of events happening.

Results of detailed CBAs indicate investment in risk reduction can generate high rates of return.
Not all approaches are resilient under changing climatic conditions. Not all approaches benefit everyone - particularly the poor.

Some examples of results from the project:

- In UP flood management case, if we used a straight engineering approach, the B/C of the centralized option of embankment construction (which is dependant on threshold of flooding) was as high as 4 that might decline due to Climate change (CC). But if we take into account lot of indirect impacts the ratio declines dramatically. The B/C ratio of maintenance of embankment is 2 and seems very robust in CC. And then, people were talking about alternatives, hence we looked at distributed set of community level interventions. It gave higher B/C ratio (2.5) and seems to increase in CC, primarily because this set of interventions give annual benefits and do not depend so much on what is happening due to CC.
- In the UP drought management case some of the interventions to remove risk through groundwater irrigation had a high C/B (1.5) and might increase in CC. Other intervention of insurance cover gave higher B/C ratio but might decline in CC as we do not know the probability. While the combined approach really seems to give stable returns even in CC.
- Rawalpindi Urban flood management (Pakistan Case), the approximate cost benefit ratio of Expressway/ Channel is 1.88, Communtiy Pond 8.55, river improvement 25, early warning 0.96 and Relocation and restoration is 1.34.

So, the results of detailed CBA analysis indicate investment in risk reduction can generate high rates of return but not all approaches benefit everyone - particularly

the poor. It is true but overly simplistic and not all approaches are resilient under changing climatic conditions.

If you look at CC, differing levels of information on events (different probabilities), they have sensitivity to threshold much depends on negative externality. If you look at effects of embankments again, whether or not they will work depends on what the flow is and if you do not know the flow then when it hits the threshold it causes large scale damage. Adding negative externalities, waterlogging and other things, the costs overrun the benefits.

So, not all approaches benefit everyone. Structural protection often displaces impacts on those outside protective structures & can lead to behaviors that increase vulnerability. The Kosi breach is an example in this case. You have a lot of impact in areas flooded recently by Kosi for areas where people have been protected by embankments for long time built up in those areas. Insurance can benefit but it is hard to get to the poor but it costs money, and hence not everyone will benefit due to high costs. Early warning, again, may not reach all groups and what you can do with early warning is often a question. If it leads to negative behavior then perhaps it will not benefit everyone. Groundwater development as evident particularly benefits the large and medium farmers as not everyone can afford irrigation. So, the core issue in most approaches is that it involves social tradeoffs.

Robust approaches tend to address the systemic factors creating vulnerability. Particularly important where we found the largest benefit came out was by responding to recurrent sources of variability. It depends on long lead time and so on, so very difficult to tell whether a particular approach will be robust. In addition, robust approaches have low dependence on specific climate projections. They become more important given the inherent uncertainty in climate projections and associated issues of projection for a local area. Hence, robust approaches are the ones which have least dependence on specific local conditions. Many such approaches, though far from all, are community based.

Questionable DRR approaches are the strategies that are characterized by; high dependence on specific event characteristics; particularly questionable if they have long lead times; have high initial investments; longer-term institutional dependence; and, large distributional consequences—impacts where some benefits while others lose. The point here is not to say they are not useful in some context, but the above characteristics trigger for additional evaluation before investment.

If you look at it from the climate context, the core message coming out of lot of this is- it is essential to have mix of strategies: distributed CBDRM do not produce the same benefit as embankment but embankment may be essential in urban areas for protecting concentrated assets of high value; need strategies that address systemic issues of vulnerability, for example, whether or not people have access to insurance, as well as targeted strategies such as early warning systems for specific area or a

group; need financial & institutional as well as infrastructure; and, need strategies of risk spreading such as insurance as well as risk reduction, for example through groundwater development. Further, we need approaches that are tailored to specific contexts and sources of vulnerability, and that is where the Shared Learning Dialogues help in bringing together global scientific information and local information. Overall, we need tangibility rather than generalizations, specifically what do we specifically do and how do we do.

SPECIAL ADDRESS

Information Networking for Effective Disaster Management

Dr. S.P. Sharma
Advisor,
Ministry of Environment and Forests, Government of India,
New Delhi



It has been recognised now that total prevention of natural disasters is not fully possible but their impacts can be minimised. With the help of scientific research and development and with the use of latest tools and technology it is possible to reduce the impacts of disasters to great extent. For example, drought in the year 1965 was a catastrophic event but more severe drought in 1979 had not much impact because of developing resilience. There was a very good stock of food grains. There are many countries which are more prone to earthquake but the losses are much less. Earthquake of relatively less magnitude can result in significantly higher damages to life and property particularly in the case of a highly populated countries like India. Environmental modifications and land-use conflicts make the vulnerability more complex and serious, because of causing ground instability and reduction in the structrural strength. Such damages and losses can be reduced to great extent by implying risk mitigation measures and better preparedness.

Salient aspects of disaster management include vulnerability assessment; assessment of preparedness, prevention, mitigation, adopting appropriate recovery and rehabilitation strategies, reconstruction/ development, enhancing preparedness for future and documentation of experiences. A clear cut disaster management policy has be put in place and monitor the status of implimation of the policy.

Promoting culture of prevention by spreading education, awareness for higher preparedness for reduction of risks is important. Disaster mitigation by most modern but environmentally sustainable technologies available and extensive application of the same is the need of the time.

In the case of major disasters all sectors of the society are affected. Social and economic functions are disrupted because of damage to their resources be those based in natural or human-managed environment, for example, agriculture, forestry,

horticulture, medicinal products, aquacutlure, fisheries, water and land resources, recreational, aesthetic, etc. So, developing and establishing inter-linkages among Government, Corporate Sector, Media, NGOs and the public to ensure speedy and effective relief particularly to vulnerable sections and to plan for disaster-resilient system of production, distribution, and consumption with higher concern from all responsible sectors and segments of population to underline higher responsibility in the society for improving well-being of the people, is a great need.

Unless we have an effective planning and implementation it is not possible to mitigate the impact of disasters. Planning depends upon the information. Information has to be credible, timely and good quality.
Disaster Management Information System (DMIS) has to be integrated to holistic Environmental Information Systems (ENVIS) at various levels i.e. National, state and district level and DMIS can be linked with ENVIS network of theme specific nodes and SoE ENVIS at states/UTs.

Developing information and knowledge Network is most crucial for disaster management planning and emergency response. Planning depends upon the information. Information has to be credible, timely and good quality Speedy, reliable and timely information is must for Disaster Management. Planning depends upon the information. Information has to be credible, timely and good quality. Information Improves knowledge and helps in procuring material and human resources and leads to quick response and more efficient and optimized relief measures. Besides information promotes awareness and reduces chances of unwanted rumors. Such networking facilitates team work by sharing well defined and classified responsibilities and increases community participation and optimizing use of resources and time. For example Kosi experience although was a sudden event the impacts could have been reduced further if there was better networking and information management in place.

In the case of preperation of disaster management plans of Chemical disasters the data bases required are GIS map of major production units of hazardous chemicals; hazardous substances produced and handled by the unit/ consumers by location and type-transporation modes and routes with likely risk factors and population en-route with high risk and average transportation cost, time by mode and type with other incidental vulnerabilities. Disaster Management is also a interdisciplinary subject and intergration of various information in GIS is very helpful in decision making.

Information for appropriate preventive measures include: (i) Land-use planning i.e. updating the present situation and analysing the optimum situation as per the conditions (ii) for preventing habilitation in risk zone, mapping the risk prone areas by size, class of habitation and production activities (iii) identifying the alternate areas to reallocate in a phased manner economically with least cost- by input-output

Information for Appropriate Preventive Measures

- Measures to eliminate or reduce the incidence of severity of emergencies/ disasters.

  -Land-use Planning-updating the present situation and analysing the optimum situation as per the conditions;

  -Preventing habilitation in risk zones-mapping the risk prone areas by size, class of habitation and production activities;

analysis (iv) information on disaster resistant structures in current situation context vis-à-vis the optimum along likely time-frame for implementation, and (v) community awareness and education, level and spread by section, sector and region. Cost benefit analysis is being done for roads, bridges, dams etc and now there is a need to do the cost benefit analysis of disaster mitigation projects. With the past experience of the expenditure on relief and rehabilitation it is possible to estimate the intensity of the damage due a particular disaster can do a cost benefit analysis if the disasater can be prevented by adopting a suitable mitigation measures.

Both structural and non-structural interventions are required for reducing risks. Mitigation measures include Techno-legal frameworks i.e. documentation of building codes and by-laws; incentives and financial frameworks – Government grants for Food For Work Programmes, Insurance to be put in public domain,It involves long term measures to reduce the effects of disaster causing phenomena;It includes constructing disaster resistant houses, afforestation, and plantation on the river banks and road-sides.

Documentation of experience gained from past successful cases helps in Disaster Management and lessons can be learnt from past practices for more efficient dealing in future. Detailed account of limitations, constraints and mistakes as well as innovative practices are useful for helping effective planning and management which will help in coordinating with various related line Departments. There is a need for development of a Disaster Management Information System (DMIS) similar to Environmental Information Systems (ENVIS) at various levels i.e. National, state and district level and DMIS can be linked with ENVIS. Environmental Reports are being prepared at various levels and a state of Environment Atlas is also been prepared.

For developing national level Knowledge Nework portal various institutions *i.e.* Science and Technology Institutions, research and development Institutions, Universities, Media, Information Technology Institutions, Non-Government Organizations-by type and specilisation, Corporate Sector in the concerned field and nodal Disaster Management Authorities etc has to be involved. Status of Awareness among the stakeholders i.e. knowledge about the safety aspects in dealing with hazardous chemicals, understanding about Dos and Don'ts, safeguards during production, transportation and use, availability of awareness material to the

potential affected groups in accessible medium in local language and precautions at the time of emergencies. For different risk prone areas awareness generation of all the key stage holders has to done as a priority for reducing the disaster risks.

Standards of quality control has to be assured i.e. euipments of quality and standards and measures to ensure maintenance of quality control standards, status of packaging and transportation norms vis-à-vis the norms; documentation about specific cases of violation of standards and the resultant cases of accidents and mishaps.

SPECIAL ADDRESS

Dr. Anand Bose
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Drought being the slow onset disaster or a creeping phenomenon, it involves various departments and different levels of government to implement the long-term mitigation measures effectively. Government of India has put in place several innovative and people centric programmes like National watershed development programme, Drought prone area programme, Desert development programme, Dryland farming programme, and recently constituted a National rainfed area authority. However, year after year drought happens in one part or the other of this vast country. In recent past, we have had severe drought in 1987 and in 2002. The mitigation efforts of the government and the others have been documented well. The documents indicate that the approach was primarily relief oriented. It is also felt that the role of government by easing distress has tended to make the drought affected population more and more dependent on the externalities for prevention and mitigation.

Primary effects of drought are visibly felt in agriculture and particularly on rural communities. But the secondary effects of drought are also felt on other sectors, for example in hydro-power generation. Low water level in reservoirs affects power generation, in-turn affecting the productivity in other sectors. There is a strong relationship between agriculture sector and industrial growth. For a strong hydrological cycle, the protection of aquifers is important. During rainy days, we allow the excess rainwater to go down the drains. Recently the state government of Gujarat has constructed check-dams with the help of local communities which helps in better conservation and water management in the time of drought effects and distress. Many local initiatives like this are being reported in different parts of the country. The impact of climate change is another phenomenon which is affecting the agriculture. The abiotic stresses like drought, temperature extreme, soil salinity, water logging, flood, mineral toxicity and nutritive deficiency threatens the agriculture production globally. The Govt. of India has sanctioned a National Institute of Abiotic Stress Management, to be situated at Malegaon of Maharastra, with a budget of Rs. 73.5 crores in the XI plan, aimed at developing strategies and tools to mitigate abiotic stress to agriculture. To move forward from the current relief based administration primarily emergency preparedness and response, to risk reduction management approach, there is an emphatic need for “integrated drought management” policy. This policy emphasizes development of capacities of early

There is an emphatic need to adopt the methodology of Cost-benefit analysis and highlight the benefits by propagating the investment in the risk reduction education and mitigation measures in a sustainable and effective manner.
Livelihood and agriculture related components have to be seen in direct integration with environmental management of land and water resources and also the developmental activities especially in rural areas, and it will prove to be a long-yielding strategy in reducing the drought related devastations.

warning and real time drought monitoring system, development of strong decision systems for adequate response as per the severity of drought, identification and implementation of timely mitigation actions, education and training of policy makers, natural resource managers and the public and easy to use dynamic drought mitigation planning upto the village level which should trigger out the creditable and reliable timely actions for neutralizing the most serious effects of drought risks. National Executive Committee (NEC) under the Ministry of Home Affairs, constituted under Disaster Management Act 2005, is already looking into the aspects of developing plans for all disasters including drought. National Disaster Management Authority set up in the country as an Apex body is already working in this aspect. The national plans to be reviewed regularly to be a broader policy document on for guiding the nodal departments.

We need to assess the best practices adapted world wide, we have many, adapted worldwide for drought risk reduction and preparedness in terms of quantum of investments and outcomes of impacts in risk reduction management approach. There is an emphatic need to adopt the methodology of Cost-benefit analysis and highlight the benefits by propagating the investment in the risk reduction education and mitigation measures in a sustainable and effective manner. Results of this workshop shall be very important strategic knowledge which shall be received well. The tools of Disaster Risk Reduction Strategies and Cost-benefit Analysis methodology are certainly needed to be adopted within the risk education and planning actions. These tools are not yet been accepted widely in their own countries, United States for example. The gaps of disaster risk management and the implications of climate change are to be analysis in the country's context and the tools to be identified with approach for their implementation within the drought risk mitigation and disaster management. There is a big gap in policy, planning and implementation. Institutional systems should be made more reliable and functional mechanisms. Institutionalizing the community based organizations is equally important. Weather forecasting for near real time at the sub-district level in a network and mission mode is emergent need. This workshop is also expected to deliver the approaches for global cooperation on technology and knowledge sharing.

Linking environmental sustainability and natural resource management with the drought risk mitigation as proactive approach rather than only relief and response is

the current focus. Livelihood and agriculture related components have to be seen in direct integration with environmental management of land and water resources and also the developmental activities especially in rural areas. It will prove to be a long-yielding strategy in reducing the drought related devastations.

INAUGURAL ADDRESS

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At the outset the working papers, Volume I to IX, under the title "Risk to Resilience" prepared by the team of researchers and academicians were appreciated by Prof. Menon. Some methodological approaches of Cost-benefit analysis and social cost-benefit analysis are discussed herein the studies reported in these volumes. There are quantitative approaches and in some cases qualitative approaches where the quantification is not possible. Many of the tools attempted in the study 'risk to resilience' will be certainly useful to the practical roadmaps, especially those related to estimation and quantification of costs and benefits. However, an example of the *value of statistical life* in reality, that relates to compensation paid to the family, for instance to an air accident victim as compared to a road accident victim. Compensation of an air accident victim is much bigger than the road accident victim. This needs to be re-looked in the light of possible implications on how this system of compensation has been arrived at. Certain standards are to be looked for and to be worked out as approach of calamity relief fund besides mean variance, reference period, expected utility framework etc. Suggestions for looking at risk at three different possibilities: risk avoidance, risk sharing and risk transfer, and many of the attempts are reported in some of the countries in the world. It is important to review the risk reduction approach and changing perceptions and projection of disaster possibilities around the world in the last 5 years. After the 9/11 experience at the world trade centre, the approach of the national governments to disaster, in visualizing the disaster risk and counter measures along preparedness has grown. These issues and solutions are being looked in India also, in relation to risk transfer, risk sharing, etc, being worked out by the insurance companies and re-insurance companies. Terrorism is now being looked as a disaster risk.

Evaluation of Hurricane Katrina at New Orleans, recorded in 2,70,000 pages on what went wrong. So, documentation of not only the good practices but of the practices or assumptions that actually failed is equally important in disaster risk reduction and response preparedness. Analysis of the supply-chain management in relation to disaster preparedness is another aspect of study. After 9/11, one of the most serious devastating disasters the world saw was Indian Ocean Tsunami on the 25th December 2004 which affected 14 countries of the world. It devastated the countries like India, Sri Lanka, Maldives, and even the far remote countries from the epicenter like Indonesia, Sumatra, etc. More than 2,28,000 people died due to Indian Ocean

Tsunami in 14 countries. Impact of the Indian Ocean Tsunami in case of India affected 1.8% of the GDP whereas in case of Maldives it affected 98% of the GDP. So, the ways in which communities are affected by a disaster are someway reflects the level of the resilience of national systems. There is a World Bank statement that in average about 2 to 15% GDP lost due to disasters. There have been instances where 236% of the GDP was lost to one Hurricane. There is a wide variation on how disasters can affect the economies of countries depending on their own levels of resilience. There were two major disasters following the Indian Ocean Tsunami, in 2005 the Muzaffarabad earthquake in Pakistan that killed about 100,000 people and then the Hurricane Katrina in New Orleans. In the year 2008 on May 2 & 3 there was Cyclone Nargis in Myanmar, which devastated the Irrawaddy delta in Myanmar, and within a few days on 12th of May it was the Situawan earthquake. International humanitarian sector and agencies were negotiating with the Myanmar government about the aids, response and actions. High Power Committee (HPC) was setup in the year 1999 with a group of experts from different fields with deliberations and discussions all over the country, with an objective of 'disaster free India'. There was an argument then that the disasters are realities and there can not be 'disaster free India' but resilience may be possible. Now, the Government of India is also convinced that we may aim at the disaster resilient India which may be actually achievable. Resilience is the capacity to bounce back. There are several categories of damages in case of disasters which include not only the physical damages but loss of assets, resources, livelihoods, etc. The losses may be social and environmental losses besides economic and direct physical losses. Quantification of these losses under various categories and their relatedness is a challenge. Resilience in terms of adaptation and coping capacity for the disasters is another dimension. Impact of disasters and coping across generations is a dimension, for example in the Assam, Orissa or West Bengal people in flood prone areas where floods are recurrent phenomenon. Some ways to document the resilience and community initiatives is very important. There are many examples of community capacities, role of Banks in Central American region, Mexico, Canada, etc. where regional platforms and cooperation have emerged towards developing resilience. If we had this kind of regional cooperation the disaster like Kosi flood could have not created this kind of havoc. A system of regional cooperation in terms of early warning, forecasting, adequate preventive maintenance, etc is a basic need. Real

There are several categories of damages in case of disasters which include not only the physical damages but loss of assets, resources, livelihoods, etc.
The losses may be social and environmental losses besides economic and direct physical losses.
Recovery has a broader perspective where normalcy is a sub-optimal level and the aim has to be risk reduction for the future. This includes not only the physical recovery, but the recovery of systems and resources, livelihoods, services aimed at better quality of life through good governance.

time forecasting and monitoring shall be connected to the decision support systems, that may use remote sensing or other measures for broader observations and modeling. 'Resilience' also relates to 'building back better' means the recovery phase should not aim at bringing only the normalcy and bringing back the risk but shall focus on 'building back better'. Thus, recovery has a broader perspective where normalcy is a sub-optimal level and the aim has to be risk reduction for the future. This includes not only the physical recovery, but the recovery of systems and resources, livelihoods, services aimed at better quality of life through good governance. Good governance does not mean the governance by the state alone. It also relates to the governance by the community, civil society, corporate sector, etc. Ideally the role of Government should be restricted to the financial, banking and defense sector, law and order, infrastructure, etc. In rest of the other areas, there has to be involvement of community, civil society or corporate sector. Talking of the disaster risk reduction, the motivation draws reference from the Hyogo Framework of Action (HFA) for the period 2005-15. There are various platforms – global platforms, regional platforms, etc. but the problem in the operationalizing the same is that it doesn't touch upon the communities at risk. It is a major challenge in addressing the vulnerability.

There is a disconnect between the disaster risk reduction of HFA and the vulnerability reduction under the Millennium Development Goal (MDGs). The planning and academic community have to understand the relationship between the vulnerability reduction and disaster risk reduction.

The vulnerability and capacity index visualized in the present work under 'risk to resilience' project has a link to this. There is a disconnect between the disaster risk reduction of Hyogo Framework of Action (HFA) and the vulnerability reduction under the Millennium Development Goal (MDGs). The planning community and academic have to understand the relationship between the vulnerability reduction and disaster risk reduction. There are certain areas where disaster like flood is a recurring phenomenon. In 2004 we had 34 million people affected by floods in Bangladesh. Similar year we had 22 million people by floods in Bihar and 12 million people affected by floods in Assam. So, just in two of the states of the India, we had 34 million people affected by floods. The concept of scale has to consider of the fundamental issue of defining disaster for example EMDAT considering loss of life of 10 people to be a disaster. So, the loss of life as criteria for a disaster definition is in question. Hurricane may be cause of loss of less then 10 lives in case of some of the Caribbean Island, but it may devastate the economy by affecting the farms, land and other natural resources, productivity, and other assets. So, in terms of impact on GDP it may be very serious but it may be very less in terms of human deaths. Vulnerability reduction has relation with the capacity building. Community capacity in terms of reducing dependence on the external actors has to be seen as a measure of vulnerability reduction. Social and cultural background of the affected population

also plays a role in the resilience. Vulnerability reduction and decreased dependence on the external factors also helps in developing social capital.

An important observation in the study 'risk to resilience' that disasters normally happen due to design failures. Lack of maintenance of assets, infrastructure, dams and embankments, are the examples which constitute the approach of design strength. Rent Control Act in Mumbai has led to poor maintenance of the buildings and this led to building collapses. Thus, rent control became a disincentive for the people that resulted in poor maintenance of the buildings. It is a new dimension for consideration. Maintenance is a non-negotiable issue, breach of which shall lead to vulnerability. While discussing the preparation of National Guidelines for Earthquake Risk Management at NDMA, the approach of zero tolerance to avoidable deaths was discussed. Although this is an aspirational aspect but at the same time it is achievable also. Is the 21st century the last century for humanity is a question? A debate (as in the website called www.ted.com). Some arguments like 10 ways to end the world, and many such issues may be real issues as well. It is true that the entire humanity may be threatened may be by the biological or genetically modified pathogens or other disease causing organisms. Many new strains of malaria, chikanguniya, dengue are coming up which are known to pose serious challenges, are the examples. New strains of these diseases are making our medical system failing from proper and adequate response to the emerging threat scenarios.

TECHNICAL SESSION 1
Core Concepts & Challenges

This session was focussed on the underlying conceptual issues involved in evaluating the technical, social and economic feasibility of risk management strategies in the contexts where social and environmental conditions, including those associated with climate change, are evolving rapidly. Discussion were focussed on the array of qualitative and quantitative methodologies available for shared learning and strategy identification, assessing vulnerability, and evaluating the benefits and costs of risk management strategies and key challenges associated with quantitative vulnerability analysis.

Moderator: Dr. Marcus Moench

Pinning Down Vulnerability: From Narratives to Numbers

Dr. Sara Ahmed and **Dr. Eva Saroch**
ISET

Vulnerability is multidimensional, differential, scale dependent and highly contextual, and changes over a period of time, hence it is not a fixed index.
Given its conceptual variability, measuring vulnerability is an ongoing challenge.

The term vulnerability which in broader sense has both bio-physical and social attributes was the starting point of the presentation. Since the term vulnerability has range of definitions, the team, that comprises of people from cross disciplinary perspectives, decided to adopt the most comfortable definition provided by Hyogo Framework: "*Vulnerability is a 'set of conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of a community to the impact of hazards"* (the Hyogo Framework 2005-2015). It was also recognized that there are different schools of thought around the concept and that vulnerability is multidimensional, differential, scale dependent and highly contextual, and changes over a period of time, hence it is not a fixed index. Given its conceptual variability, measuring Vulnerability is an ongoing challenge. There are number of qualitative community Vulnerability and Capacity Analysis (VCA) carried out by various NGOs and those in academics. Woodrow and Anderson did VCA 10, years back, participatory

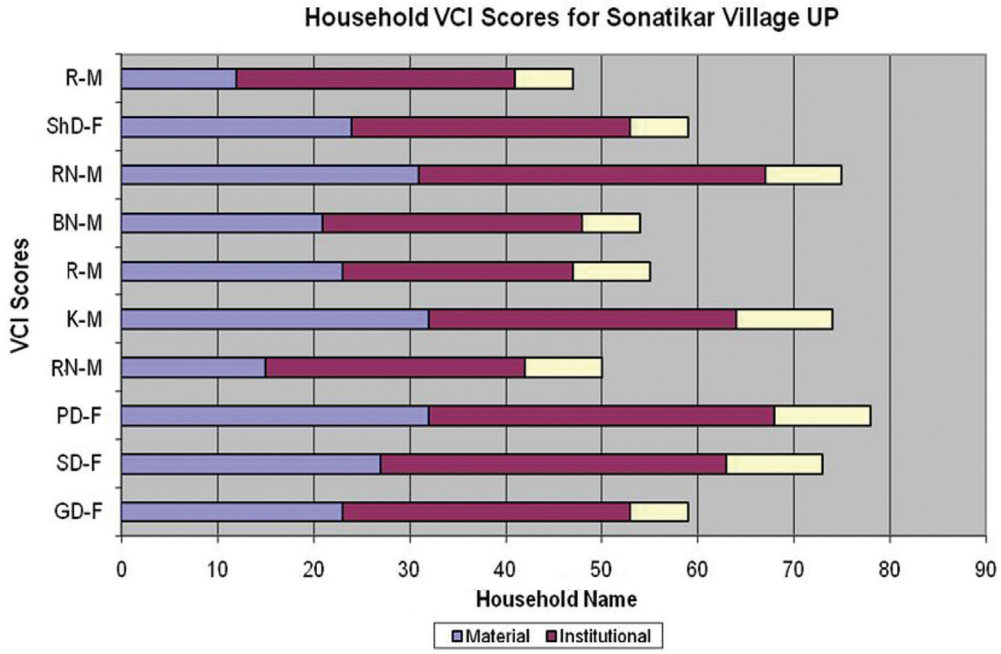
VCA study was undertaken by Oxfam, Action Aid and at macro scale GIS modelling was used in VCA by DFID.

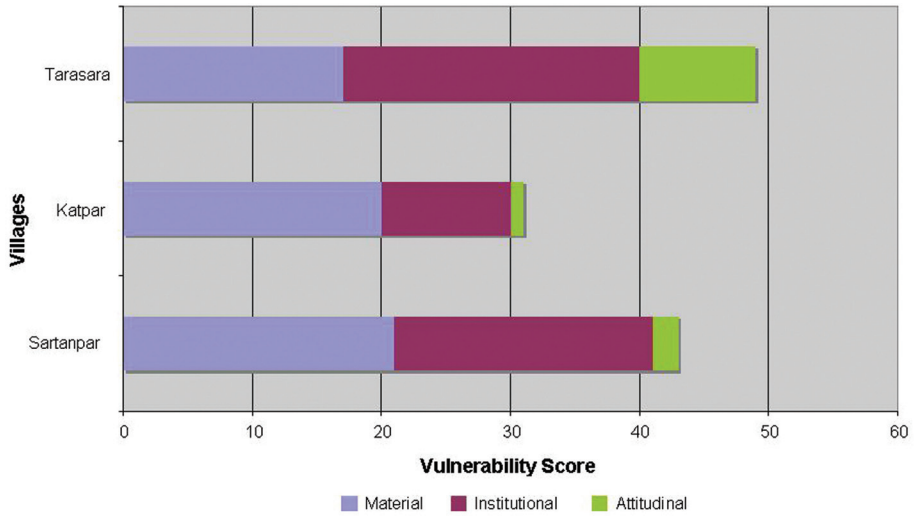
In order to capture the differential patterns of vulnerability or in other words to capture the multiple overlapping geographies of vulnerabilities, there are 11 indicators across three categories: Material, Institutional and Attitudinal

But these approaches and many of the quantitative understanding of vulnerability fails to take the nuanced understanding or qualitative understanding, of a what the community thinks of vulnerability and how it needs to be taken up into climate change or DRR works. There was also a need to bridge the gap between qualitative and quantitative vulnerability approaches. Lastly, policy makers need a tool that is simple, can be monitored and base line information can be provided. These were the challenges that were kept in mind while developing the VCI tool. Work on VCI started in Gujarat and Eastern UP in the year 2007, and it is still in progress.

The tool is being tested, reworked and indicators are questioned. In India, the VCI was tested in rural context (coastal villages Gujarat and flood prone areas of Eastern UP. Whereas, in Pakistan the Index was tested at urban scale: the Lei basin. In ISET, however, various hybrids of measuring vulnerability were also used in Nepal and coastal Tamil Nadu. In order to capture the differential patterns of vulnerability or in other words to capture the multiple overlapping geographies of vulnerabilities, there are 11 indicators across three categories: *Material, Institutional and Attitudinal.*

Insights from the field





All the indicators and the categories are given weightage that are based upon a rational supported by literature review. There are Indexes for testing rural and urban vulnerability at household and community level. Also there is slight modification in weightage keeping in mind the context. In India, to understand the variability in vulnerability the Index was tested at two sites: multi-hazard coastal villages of Gujarat: namely Katpar, Sartanpar and Tarasara and in the flood prone villages of Eastern Uttar Pradesh, namely, Sonatikar, Chinutua and Lakshmipur. The VCI index was tested by using a questionnaire and a sample size was 10-11 household per village was used. The selection criteria of the household was both purposive and there existed a common understanding of the underlying factors that create vulnerability, like, geographical location of the household, type of household, the women headed household, income profile of the village, organizational network in the village and social exclusion. The household VCI scores of Sonatikar village were briefly discussed. The VCI enabled to identify the most vulnerable household in village Sonatikar, that of Parbati Devi, belonging to boatmen caste and staying in a kutch house located at low-laying area of the village.

Her scores in all the 11 categories suggested highest vulnerability amongst the 10 household in the village. This is mainly because she is sole earning member of the family, and supports 7 school going children. Also her income source is highly susceptible to hazard, is unstable and taking credit is her only coping strategies during normal times and during floods too. In contrast, Ram Das household VCI score was very low mainly as he has diversified permanent income sources that support 14 members of the family. Also he has a pucca house that is located in highland of the village. The Index not only tries capture differential patterns of the vulnerability, helping us in identifying who is vulnerable from what, where, when and how but also helps to identify what are the entry points for adaptation.

Methodological Challenges

- Capacity building of field team on understanding vulnerability, gender, poverty linkages – takes time, resources
- Design of the questionnaire – keep it simple, open / close ended questions, narratives
- Working with key informants – members of vulnerable groups, community institutions
- Discussing scores and their rationale in the team – some consensus needed, subjective?

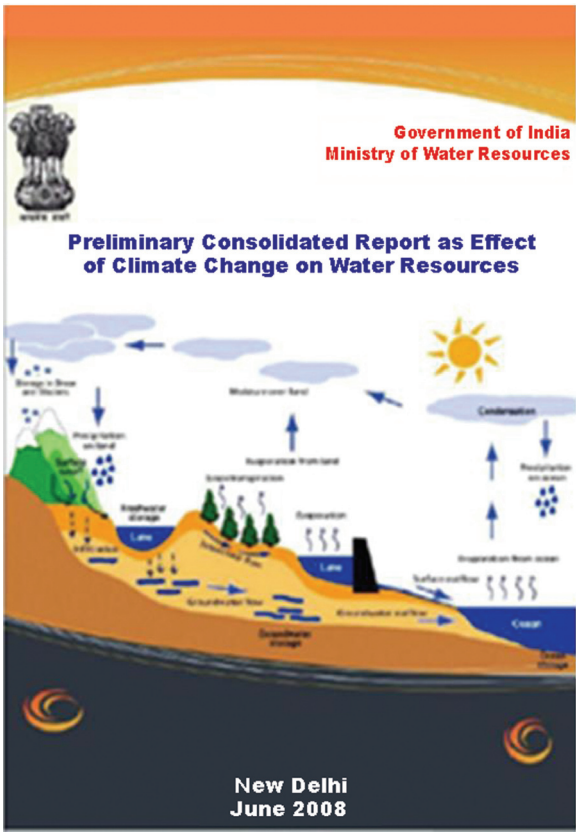
In order to capture the vulnerability of the community as a whole, the community VCI scores of the coastal villages of Gujarat were also carried out. A focused group discussion with maximum participation of the women formed the basis of community VCI. The final scores suggested that among the three villages—Katpar, Sartanpar and Tarasara— Katpar and Sartanpar villages have the lowest vulnerability scores. The main reason being their low attitudinal vulnerability score, reflecting the nature of local governance and the inclusiveness of diverse community institutions. These village have active panchayats and well-respected sarpanchs who have been able to negotiate with district level government departments for basic facilities such as a secondary school so that girls can continue with their education, and primary health care facilities. In Sartanpar, there are seven women members on the panchayat and, according to other community members, they do participate actively in decision-making, raising issues about potable water, sanitation and drainage in the village. In contrast, the Tarasara village, which faces the same physical hazard risks, has the highest community VCI score. There are no community organizations and village politics are clearly divided into two factions – BJP (Bharatiya Janata Party) which is the ruling party at the state level and the Congress which is part of the ruling United Progressive Alliance at the national level. Factional politics are so strong that it has been difficult for the local NGO to facilitate even the basic SHG, nor does anyone question the functioning or otherwise of the panchayat. The presentation concluded with brief note on methodology. As per the team, it took a while to come out with Index, and by that time a lot of work on CBA was already initiated. Hence we could not link the VCI with the CBA that was done in rest of the project. Part of it was also with the capacity of building of the team, what this concept is all about what is poverty, gender a little bit more tangible than what vulnerability is. The questionnaire needed to be close ended to get right answers, and also we need to maintain a fine balance with qualitative inputs. It is also important that the scores need to be decided and discussed with the team, and get some kind of consensus on it. Taking VCI in DRR, the work is in progress. ISET's local partners like UTTHAN and Gorakhpur Environmental Action Group (GEAG) have to certain extent been able to through the index identify the most vulnerable households in the villages and design adaptation pilot accordingly. In terms of calculating scores, positive and negative scores were being used for capacity and vulnerability, particularly after field work in Pakistan; it was decided to keep only single score rather than making it more complex.

Flood Forecasting & Warning in India

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Central Water Commission,
New Delhi

CWC is doing best to protect the states and people and it is the responsibility of the states to use this inputs.
Climate Change is definitely going to be key concern and its impact has to be assessed accurately for mitigating the effects.

Central Water Commission is a premier Technical Organization of India in the field of Water Resources and is presently functioning as a technical arm of the Ministry of Water Resources, Government of India. Water resource management is a state subject. The Commission is entrusted with the general responsibilities of initiating, coordinating and furthering in consultation of the State Governments concerned, schemes for control, conservation and utilization of water resources throughout the country, for purpose of Flood Control, Irrigation, Navigation, Drinking Water Supply and Water Power Development. CWC also undertakes the investigations, construction and execution of any such schemes as and when it is required. Flood forecast by CWC has been used by district administration and state department for decision making.



River Management Wing of CWC is responsible for managing water related disasters also. CWC is having a network of 978 Hydrological data collection stations and Hydro-meteorological data collection at more than 400 rain gauge stations for all the river basins. This wing is responsible for, collection, compilation, storage and retrieval of hydrological and hydro-meteorological data including water quality monitoring, formulation and issue of flood forecast on all major flood prone rivers and inflow forecasts for

selected important reservoirs, providing guidance to States in technical matters on different aspects of river and flood management in the country and regulation of multipurpose reservoirs.

Flood Forecasting Network of CWC

Basin-wise FF Stations

SN	River-system	Level	Inflow	Total
1	Ganga & Tributaries	77	10	87
2	Brhamaputra & Tributaries	27	-	27
3	Barak-System	5	-	5
4	Eastern-Rivers	8	1	9
5	Mahanadi	3	1	4
6	Godavari	14	4	18
7	Krishna	3	6	9
8	West flowing Rivers	9	6	15
9	Pennar	1	-	1
	Total	147	28	175

Honorable Prime Minister of India has announced a National mission on climate change, under which there is a component called "water mission". Various studies were carried out on impact of climate change on water resources by eminent scientist and engineers from various Academic and research institutions. Scientific bases are required for assessing the impact of climate change on Water Resources. Status report on various studies has been compiled into one volume called "Status of Climate Change Impact on Water Resources". Bridging the gap between the technical people, policy makers and administrators, 6 professorial chairs were established at various institutions, 4 in Indian Institute of Technology (IIT) and 2 in national institute of technologies. These researches will be funded by Central Water Commission and the inputs will be utilized for framing policies and programmes to mitigate the impact of climate change at various levels. Compilation of studies so far showing that 3 Himalayan rivers *viz.* Indus, Brahmaputra and Ganga, are going to be more affected by Climate Change. Melting of glaciers will severely deprive the water availability in these basins. Glacier melting data of last 40-50 years shows that they are receding at a rate of 20-25 meters/year. Glacial receding is not that alarming as it was presented in media but is a matter of concern. So strategies have to be developed for more storage of water. But states are not coming forward to such projects. Drought is going to be a severe problem in the coming years. Per-capita storage in India is only 60-65 days. But in USA it is more than 3 and half years. This forum is not appropriate for advocating dams and last storages although it is the key to adapt to climate change. Other ways of storing water is difficult.

CWC have well laid down policies for managing floods. And both Structural and non structural measures were suggested to the States but the status implementation is poor. Model Bill called Flood plain zoning bill was passed but very few states it has been implemented. Three different zones are proposed based on frequency of floods and different activities suggested for each zone.

Flood Forecasting & Warning Services

Central Water Commission at present operates Nation wide Network of 945 Hydrological Observation Stations. Out of these 945 stations, 246 are Gauge Sites, 282 are Gauge and Discharge Sites, 115 are Gauge Discharge and Water Quality Sites,

FLOOD PRONE AREAS



41 are Gauge, Discharge and Silt Sites, while the remaining 261 are Gauge, Discharge, Silt and Water Quality Sites. The Advance knowledge of incoming floods play an important role in reducing flood damage as also better planning of rescue/relief operations. Flood forecasts help in optimum regulations of (multipurpose) reservoirs with or without flood cushions in them.

This service has since been expanded by CWC to cover almost all major flood prone inter-State river basins of India. At present there are 145 level forecasting stations on major rivers and 27 inflow forecasting stations on major dams/barrages. It covers

9 major river systems in the country, including 65 river sub-basins pertaining to 15 states viz. Andhra Pradesh, Assam, Bihar, Chhattisgarh, Gujarat, Haryana, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Tripura, Uttaranchal, Uttar Pradesh & West Bengal and one union territory Dadra & Nagar Haveli and the National Capital Territory of Delhi. Normally forecasts are issued 12 to 48 hours in advance, depending upon the river terrain, the location of the flood forecasting sites and base stations.

Central Water Commission has been issuing Daily Flood Bulletins and Special Flood Bulletins during the flood season every year based on the information collected from affected State Governments and its own field formations. On an average, 6000 forecasts at various places in the country are issued during the monsoon season every year. Level forecast is considered reasonably accurate with a difference between the forecast and the corresponding actual observed river level lies within +/- 15 cm. Accuracy is about 95-97%. More mathematical and computerized models and better communication systems are now the focus and this will help in affective management of floods.

Specific studies related to Climate change, Glacial and snow melt and Glacial Lake Out-burst Floods hazards are also been carried out by CWC. Impact of Perachu lake burst flood was modeled by CWC and accurate warning was given to administration and that helped administration saving lives Rampur beyond up to Barkra dam. Every year there is flood in Bihar, mainly because of trans-boundary water management issues. CWC is implementing strategies with the neighboring countries for sharing flood related. Now data getting from China for the nearest sites in Brahmaputra River in Chinese territory.

During 1995-96, the Government of India and nine States entered into a development credit agreement with the World Bank to implement “Hydrology Project” under a joint financing arrangement, whereby the Government of Netherlands provided related technical assistance in the form of a grant. Under the Hydrology Project-I, a comprehensive hydrological information system comprising the physical infrastructure and human resource to collect, process, store and disseminate data on hydrological, geo-hydrological and hydro-meteorological quantity and quality variables have been established in the Central Water Commission covering the entire peninsular region of India.

CWC is doing best to protect the states and people and it is the responsibility of the states to use this technological inputs. Climate Change is definitely going to be key concern and its impact has to be assessed accurately for mitigating the effects.

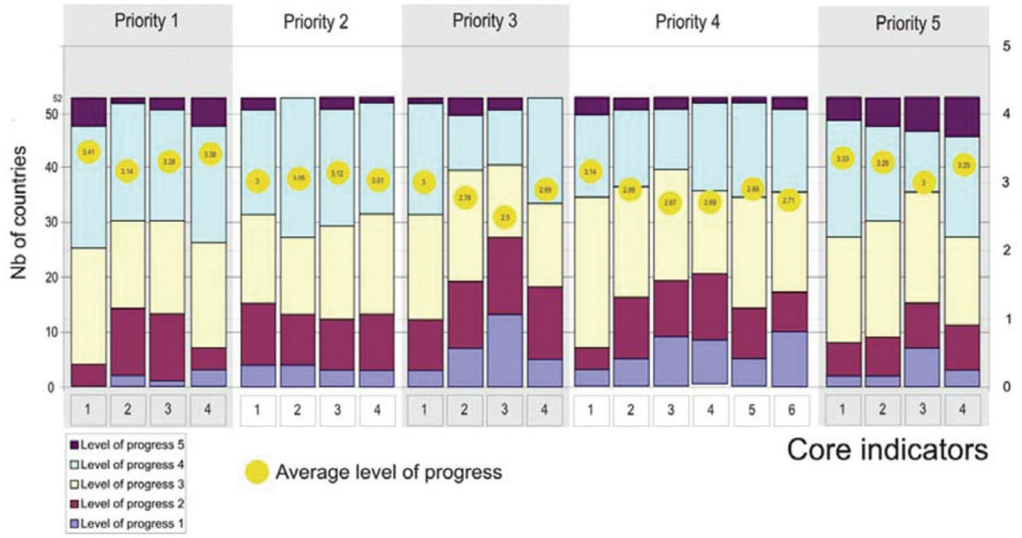
Challenges and Issues in Disaster Risk Reduction

Dr. Ian O'Donnell
ProVention Consortium, Geneva

Globally 168 countries around the world have committed to promoting disaster risk reduction through the Hyogo Framework for Action (HFA). Since 2005 when the HFA was adopted, many countries have established disaster risk reduction and climate change as national priorities and have developed significant legislation, policy and institutional frameworks. Yet it is also clear that in terms of progress on the ground to reduce risks and increase adaptation, there has not been consistent implementation, enforcement, and incentives and disincentives. In effect the current systems for development are configured for vulnerability of the poor. Instead they need to be configured for building resilience.

There have been discussions about the need to translate concepts into concrete action plans, but conversely there are also good examples and approaches that have helped to generate success on the ground – that can be used to enrich the broader conceptual level thinking.

One is the recognition that there are different drivers of risk in different locations highlighting the need to isolate the relevant risk drivers where we are working. Many place in world have actually seen new risks being faced and we are struggling even to keep up with the new risks being created. Especially in the differences between urban and rural areas is quite stark in the way what is really driving the risks. In rural areas it is more of an economic challenge while in urban areas the



population growth gives rise to all kinds of environmental impacts and other negative impacts on human health, education, livelihoods, etc. There is a need to see how this growth of population in urban areas can be absorbed safely.

Localizing the HFA

	Kyoto Protocol	Hyogo Framework for Action
National commitment	Ratified by 180 nations and the EU	Ratified by 168 nations
Local commitment	902 mayors have signed on to the U.S. Mayors Climate Protection Agreement in support of the Kyoto Protocol	

Addressing underlying risks is a complex challenge and requires all of us to partner robustly to make sure that all critical stakeholders are involved in designing and maintaining effective solutions. Risk reduction is often seen as a cost; instead we need to highlight the value of risk reduction as an investment to protect our development gains, both communally and individually. There are also many other initiatives linked to development and we need to be careful to ignore the noise of these various dialogues and focus on the shared interests that represent the opportunities for meaningful collaboration rather than the differences that often make for good polemic debate. From local levels where risk is happening to multiple level where we need to address risk reduction strategies there is a need for systems that probably support lots of different actors a different levels like civil society organizations, private sector, national and local authorities, and private sector.

Presentations in this workshop have focused on the results of trials of potential tools to facilitate local attention and action on risk reduction and adaptation. This workshop should also be seen as an opportunity to also highlight potential gains in effectively leveraging global dialogue on these issues – particularly this year (2009) when there are so many key events taking place.

These include:

(i) The Global Platform on Disaster Risk Reduction, where there is a chance to promote local action plans for DRR and adaptation and to increase national commitments.

(ii) The revision of the *"SPHERE"* standards which provides with an opportunity to outline principles on risk reduction and adaptation.

(iii) Climate Change Convention activities where the DRR community can work together with partners like UN ISDR, UCLG, and ICLEI to promote the role of local authorities and other local stakeholders in both mitigation and adaptation and lobby to ensure access to new international adaptation funding mechanisms by a wide variety of stakeholders including civil society and local authorities to get as many people working on the problem as possible

There is much that the DRR community can learn from the Kyoto Protocol process over the last decade, particularly in the way that these Protocols have provided a vivid and tangible set of goals to which not only countries, but also increasingly cities and civil society organizations, have pledged their commitment.

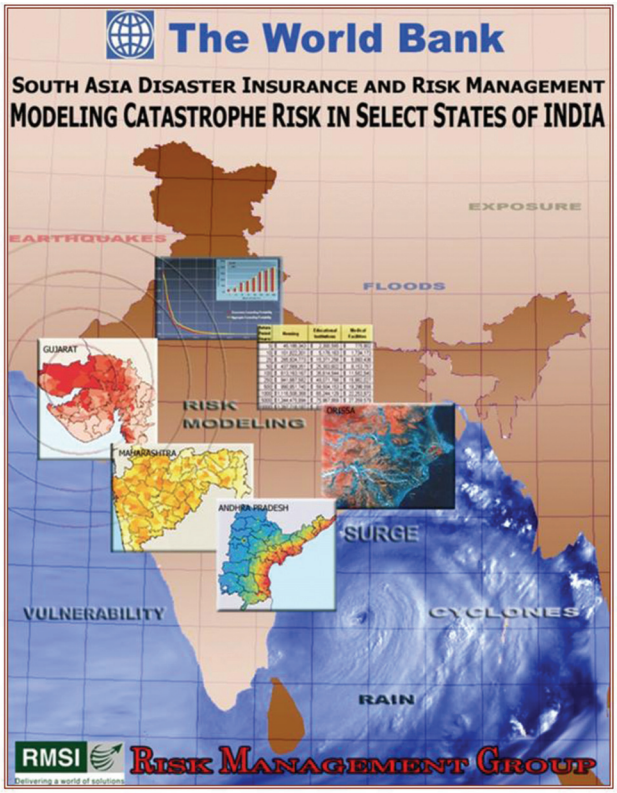
There is an urgent need to advocate for a similar course with the "Hyogo Framework of Action" to increase the relevance and tangibility of the commitments, relate them to the Millennium Development Goals, and ensure that are well-linked to the adaptation goals outlined for the successor to the Kyoto Protocol that will be drafted later this year. This is an opportunity to bring forward the key lessons that are gained from the DRR work at community level across the globe and support the development of stronger enabling environments at national and international levels.

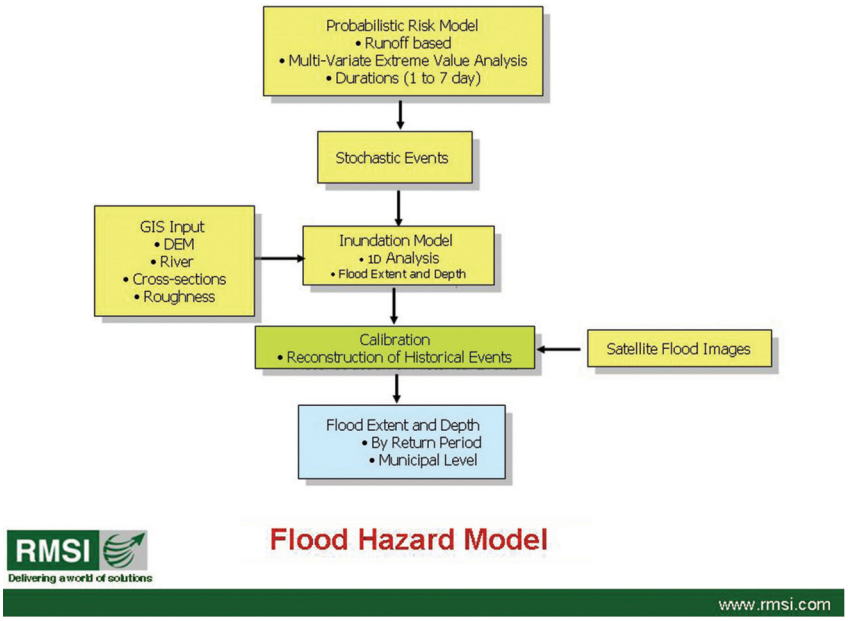
Modeling Catastrophic Risks in India

Indrajit Claire, *Vice Président*
Dr. Irfan-Ullah, *Senior Manager*
Risk Management Software India (RMSI) Limited, Noida

RMSI is a company that provides applied GIS and modeling techniques and solutions for assessing the risk due to natural disasters like floods, cyclone, earthquake, earthquake and Risk due to climate related disasters like floods and drought. The company has successfully carried out a pilot catastrophe risk assessment study for four Indian states, viz. Andhra Pradesh, Gujarat, Maharashtra, and Orissa, as part of World Bank's regional initiatives for risk transfer in Asia in 2001. The purpose of this World Bank initiative is firstly to assess the financial risks of natural hazards including the exposures, and vulnerabilities of countries in this region to catastrophic shocks; secondly, to evaluate the existing post-disaster funding mechanisms in the region, including catastrophe insurance and reinsurance arrangements; and thirdly, to explore methods of funding the direct costs of natural disasters outside the national budget.

The project involved a comprehensive risk assessment study of the four Indian states pertaining to the assets of housing and public infrastructure against natural catastrophes like cyclones, earthquakes, and floods. RMSI successfully developed several probabilistic risk models for hazard assessment, vulnerability analysis and financial implications as part of the study. The comprehensive report submitted to the World Bank consisted of various results that help in decision-making such as exposure value, average annual loss (AAL), probable maximum loss (PML), exceeding probability (EP) loss curves, and hazard/risk mapping.



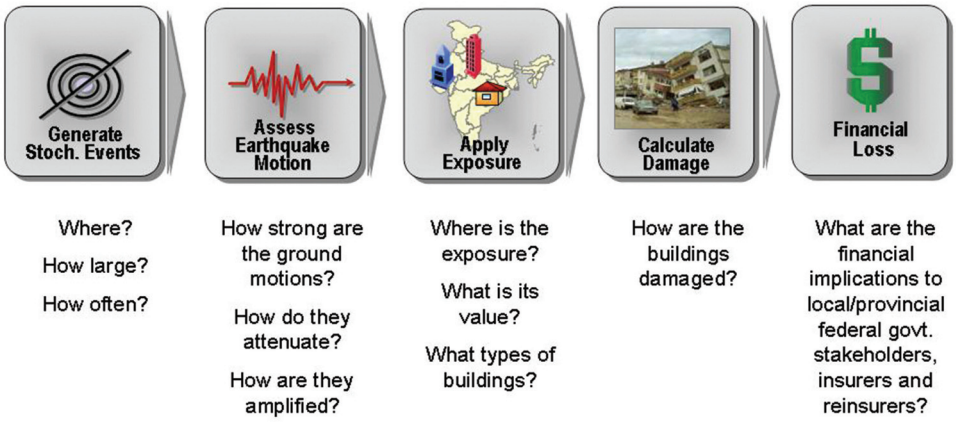


The findings of the study are expected to serve as key inputs for further analysis & research related to risk transfer and financing of catastrophe risk in India. The study involved hazard modeling of windstorm, rainfall, storm surge, earthquake and riverine flood, vulnerability modeling, exposure development, loss estimation and financial analysis. The WB planned to use the findings of the study as a key input for further research into financial risk management. Objective of the was to do the study at smallest administrative levels. Key constraint was the lack of data.

The framework for probabilistic risk modeling consisted of four modules - stochastic, hazard, vulnerability and financial modules. These modules work in a funnel fashion, with the output from one module acting as the input for the next.

Key activities included in the Stochastic Module are generation of stochastic events from the characteristics of historical events using simulation techniques and simulation of all events likely to cause damage to assets based on the occurrence parameters of a peril and the probability occurrence.

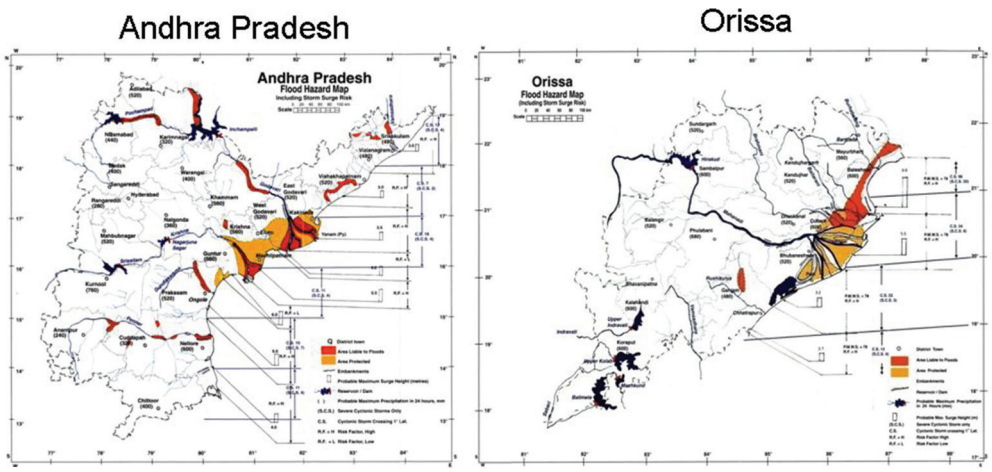
The hazard module analyzes and computes the intensity of each stochastic event at each analyzed location. The starting point for hazard modeling is the compilation of an historical events catalogue, including catalogues for earthquakes, cyclones and floods. These catalogues were sourced from local and international authorities and cleaned for gaps and erroneous values. The key activities included are use of simulation modeling techniques such as Monte Carlo and stratified sampling to generate stochastic events, application of spatial modeling techniques to model specific components of hazard phenomena, including separate modeling of hazard



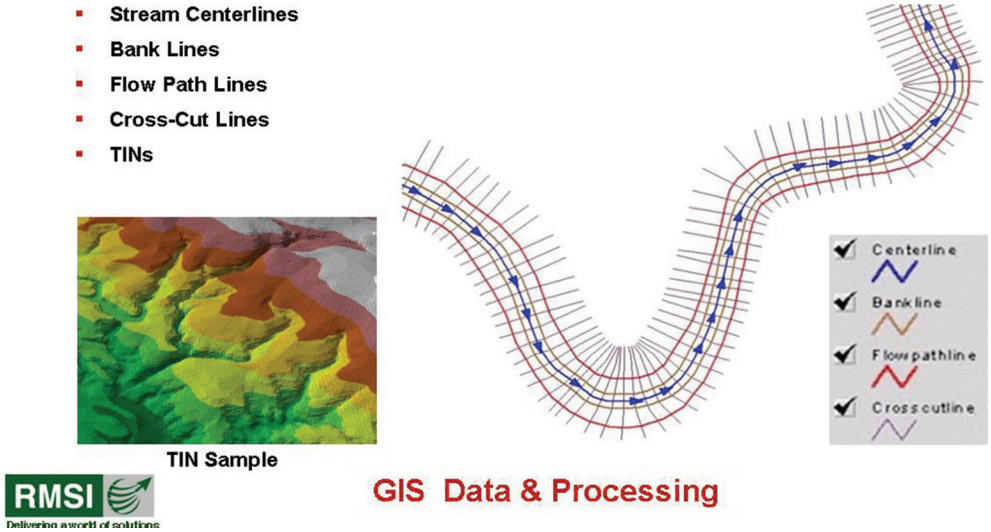
Probabilistic Framework for Risk Modeling

phenomena such as wind, rainfall and storm surge and Modeling off the vulnerability of assets exposed to each hazard by defining relationships between hazard intensity and consequent damage.

Vulnerability and financial module focus on quantification of the damage. The vulnerability module calculates the mean damage ratio (MDR) and the financial module translates the MDR into monetary units. Due to high levels of uncertainties associated with the input parameters, developing the vulnerability functions was a complex process and involved Development of vulnerability functions for a complete set of building classes, based on combinations of wall material, roof material and

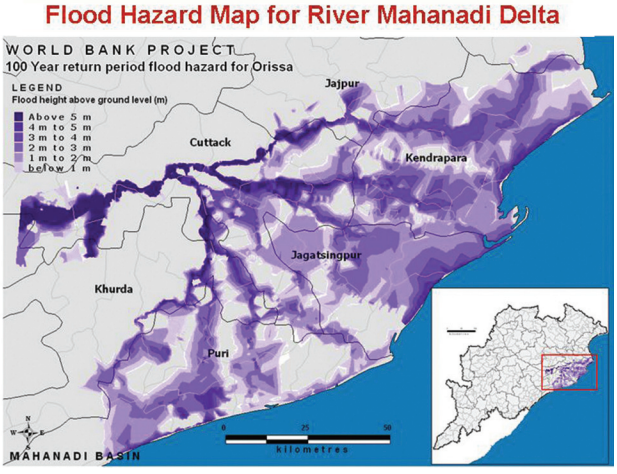


Historical Floods

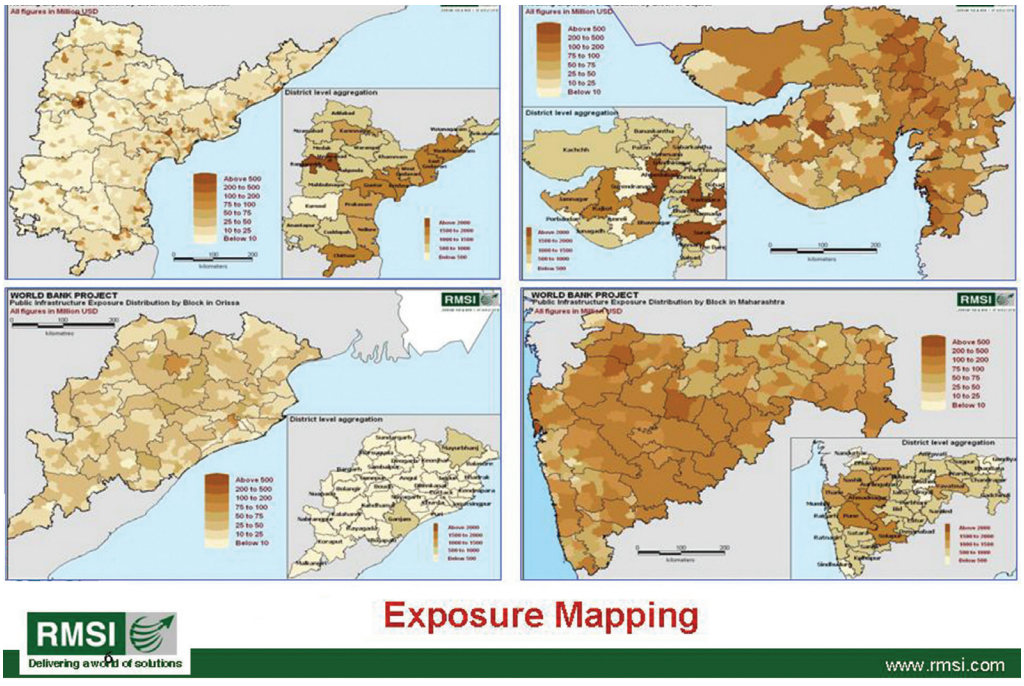


roof shape, calculation of exposure, the basin input in any loss estimation model, defined as total value or replacement cost of assets that are at risk from a loss causing event and computed by applying a unit cost factor to the inventory of assets, use of several secondary sources such as Census depart of India, Vulnerability Atlas of India and damage reconnaissance and reconstruction reports derived data and information on inventories and vulnerabilities and validation of the models by using observed hazard intensities and loss profiles from documented historical events.

Model Calibration has been done by Gumbel extreme value distribution for annual peak flows, generate discharge events for key return periods, generation of steady state water surface profiles using HEC – RAS and determined the flood extent and flood depth at grid level resolution for the study area.



Considering the historical cyclone catalog during 1891-2001 the number of cyclones that made landfall on the four states – Orissa, Andhra Pradesh, Gujarat and Maharashtra were 100, 71, 21 and 6 respectively. The last cyclone that hit Maharashtra was in 1966. Hence, it was observed that the cyclone activity on Maharashtra is very low and the state will not suffer from significant losses on average annual basis.



For wind storm the parameters used are Storm Track, Forward Velocity, Heading at Landfall, Central Pressure, Radius to Maximum Wind and Filling Rate after Landfall. Surface roughness and fetch affect wind speed estimation. Terrain features affecting the wind speed are roughness of the terrain which causes larger frictional effects on the wind speed and the distance or "fetch" over which wind travels over land from "effective" coastline.

For Integrating Disaster Risk Management into the national, regional, and local economic development it is necessary to under take detailed risk and vulnerability assessment studies to gather accurate information for ex-ante pre hazard risk management. It is important to understand the country's hazard exposure, what is the nature of hazards and their disruptive characteristics, where is the risk concentrated, what can be the economic and social losses, who are the people at risk – individuals and groups and what economic activities are vulnerable.

Benefits of Risk and Vulnerability Assessments are in-depth understanding of the potential economic losses, to review the physical, human, and financial exposures and to determine the level of risk that can be accepted and the level of risk that should be mitigated. In summary risk and vulnerability assessments can lead to a paradigm shift by changing fate to choice, reactive to proactive, recovery to mitigation, wait and watch to anticipate and prevent, ex-post to ex-ante, crisis management to risk management, Ad-hoc efforts to comprehensive approach and development at risk to sustainable development

TECHNICAL SESSION 2
Case Studies on Cost Benefit Analysis of Mitigation Projects

The session was focused on detailed case studies on the costs and benefits of disaster risk management from India, Nepal and Pakistan. Cost benefit analysis has been emerged as an emerged as an important tool for justifying investments in mitigation projects in both developing and developed countries for making better investments of public and private sector resources. There is always an argument that what ever the investments made in mitigation would save the resources on post disaster operations and hence they are interlinked.

There are several tools emerged for cost benefit Analysis and is important in strengthening disaster Risk Management System. There is always an argument that there are lots of issues and debates regarding the application and various variables and with the relevance to developing counties. We need to refine the tools and make them more relevant.

Moderator: Dr. Krishna Vatsa

Evaluating Costs and Benefits of Flood Risk Reduction under Changing Climate Conditions

Dr. Daniel Kull, *IIASA,*
Dr. Praveen Singh, *WII* and
Dr. Shiraz Wajih, *GEAG*

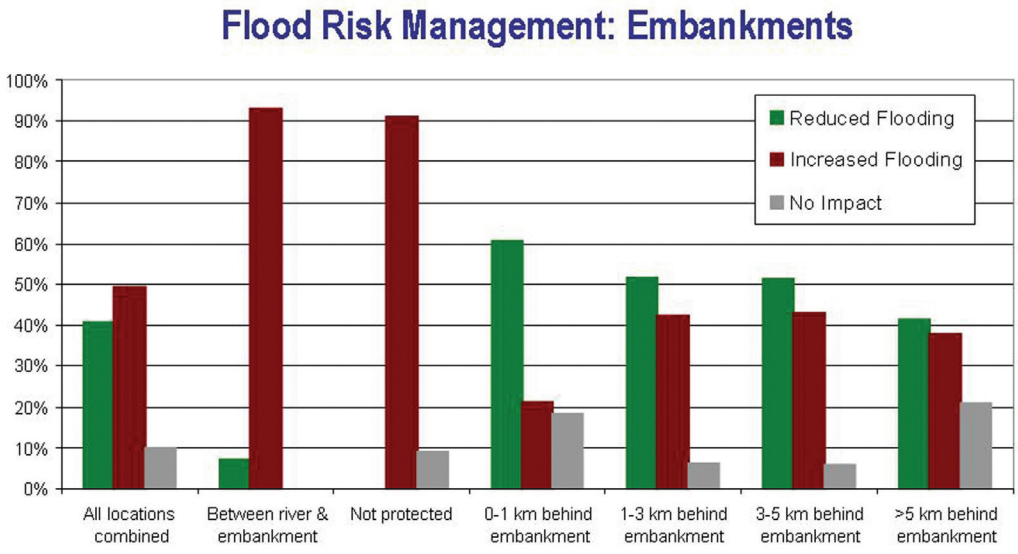
This presentation discussed the detailed evaluation of the costs and benefits of alternative strategies for flood risk management along the Rohini Basin in eastern Uttar Pradesh, India, and highlighted substantial differences in economic returns.

The study area is characterised by very high population density (about 1000 persons per km2), low human development indicators compared to national/state averages: 30% below poverty line, compared to UP: 26% and India: 22%, Agricultural economy (paddy, wheat, vegetables), 50% of households < 0.4 ha of land and occupations are



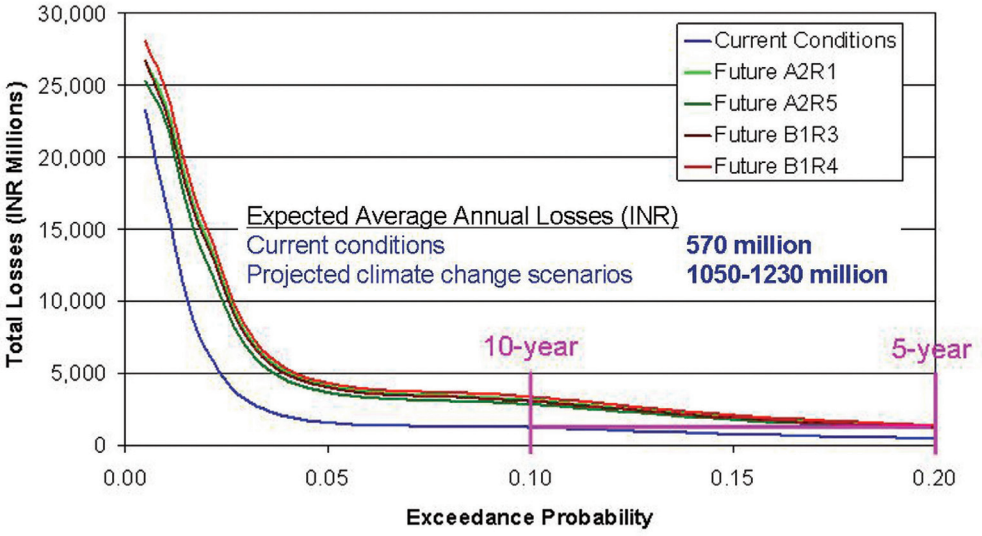
farming (65%), agricultural labor (14%), non-farm wages (14%), business (4%), service (2%), and animal husbandry (1%). 60% household earn income from local opportunities and 22% migrate for compensating household income. These figures depict the very high socio economic vulnerably of the area. Area is perennially affected by flooding and major floods: 1954, 1961, 1974, 1993, 1998, 2001, 2007. Embankments cause water logging & drainage congestion in the area often.

Construction of embankments for flood control has been the primary strategy for risk management in India. The speakers stated that a detailed analysis of embankments demonstrates that this investment cannot be concluded to have been economically beneficial. When analyzed from a social welfare perspective in which all costs and benefits are considered, the benefit/cost (BC) ratio from past investments is about 1; that is the costs have equaled the benefits.



Household perceptions of embankment performance (survey results)

Rohini Basin Direct Losses



It was argued that the projected impacts from climate change would further reduce returns. But it was also argued that since investments in existing embankments represent sunk costs, investments in proper maintenance of those embankments would, however, generate high economic returns (benefit/cost ratios in the range of 2) under both current and future climate change scenarios.

In contrast to structural measures for flood control, the speakers argued that scenarios based on a more "people-centered" resilience-driven flood risk reduction approach perform economically efficiently. BC ratios for such strategies range from 2 to 2.5 under both current and future climate change scenarios. It was further reinforced that since such strategies have low initial investment costs in relation to annual operation and maintenance. Consequently, these returns are not sensitive to discount rates or assumptions regarding future climate conditions. Overall, economic returns from portfolios of people-centered strategies appear highly resilient under a wide variety of conditions and assumptions.

The speakers reiterated a word of caution while looking at the results even though the conclusions appear robust. This is because limitations on data availability and quality constrained the analysis. Consequently, the outcomes from BC analyses depend heavily on key assumptions and data. BC ratios and other quantitative outputs are most meaningful as order of magnitude estimates rather than absolute values, especially when the inherent uncertainties in climate change projections are considered. But BC analysis has benefits that go beyond the quantitative economic results generated.

If undertaken in an inclusive stakeholder-based manner, the process of undertaking a cost-benefit analysis forces participants to systematically evaluate the details of risk management strategies and the assumptions underpinning them. This analytical process can ensure that the strategies ultimately selected are socially and technically viable, broadly owned and likely to generate solid economic returns. It can also ensure that the distributional consequences of strategies are addressed. Without inclusiveness, debate and iterative learning among stakeholders, cost-benefit analysis can easily be manipulated and thus misused.

Costs and Benefits of Flood Mitigation in the lower Bagmati Basin: Case of Nepal Terai and North Bihar, India

Ajaya Dixit
ISET-Nepal

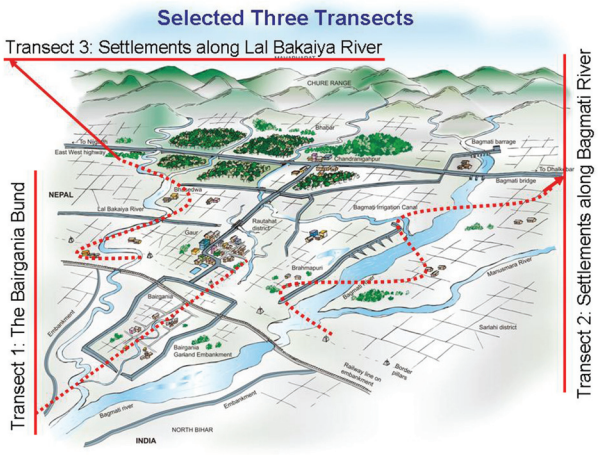
The objective of the study was to assess the costs and benefits of the mitigation measures. Difficulties in the study were - data were not available and collection of primary data was time taking, and therefore qualitative.

The Rohini river starts at the Shivalik range whereas the Bagmati river starts from the Kathmandu in Nepal. The study did not involve extensive data collection that actually IIASA team has visualized. It was more on the qualitative basis. Disasters give the opportunity to analyze the failures and mistakes, so that the lessons for the future may be taken up. However, none of the learning that we present has been internalized by the Governments – India, Bihar or Nepal. Tendency has been to repeat the same mistakes and the risks get more complicated. Low lying areas were always been allowed for settlements despite of clear knowledge of risks.

Looking at the Google map, the two yellow points show where the Kosi breached on 18th August and started flowing on its old course. However, it was not actually its own course. The old course on which Kosi was flowing before 1950 is been encroached upon by urbanization, roads, embankments, etc. and the river as an option started flowing in another course as passive mode in the alternative way. In this process it

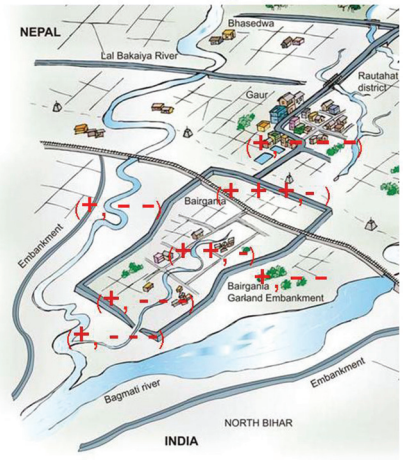


filled the low lying areas of the other sides of its new or rather adapted course. The 'blue line sketch' showing where it started to flow on the other side of embankments i.e the breach. Blue shade is where the Kosi was flowing, almost about 2 kms breached and after 5 months later this breach is being flood. The river is now flowing through the course of the new channel. But the flight of the victims continues to the Nepal, Tarai and Bihar. Temporary relief camps lying on the riverbed itself and as the monsoon approaches they have to be evacuated to the safer locations. Photographs are showing the destructions due to flood. Perception and observation as an environmental and structural engineer indicates the maintenance and construction actions in the name of mitigation to be very poor in quality and standards. Mitigation of flood becomes more crucial with the climate-change becoming more and more sensitive issues by their implications on such environments. Continuing the business as usual in one option and the another way is to be more planned and systematic. Unlike the Rohini case, the lower Bagmati was selected, a margin area, and a border area between Bihar and Nepal, was selected for the study.



The Bagmati river starts in the Kathmandu and flows in the Nepal Tarai and into Bihar on the area close to Nepal-Bihar border. Characteristics of the region are: it has variable rainfall, rivers are very dynamic – constantly change plant form, brings down heavy silt-load, embankments have been built, drainage congestions, data on natural ecosystems very limited and fragmented, managerial and administrative constraints in terms of lack of data, coordination, etc. The objective of the study was to assess the costs and benefits of the mitigation measures.

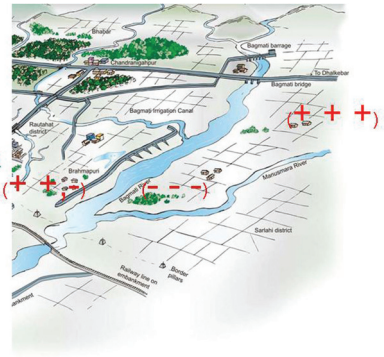
Transect 1: The Bairgania Ring Bund



Findings

Difficulties in the study were – required data not available and

Transect 2: Settlements along Bagmati River



Findings

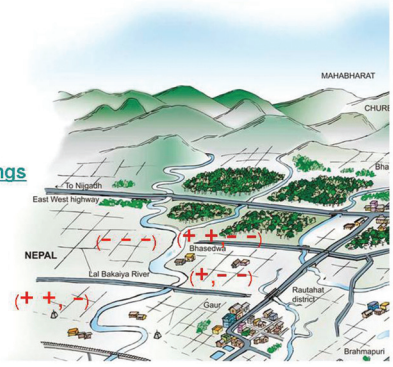
collection of primary data was time consuming, and therefore it was decided to undertake qualitative analysis. Political turmoils in the Nepal Tarai area also constrained the study especially for field visits. The first stage of the study was the scoping with the users involving the shared learning dialogues in the particular regions. Specific interventions were identified for assessing the costs and benefits, in relation to different groups of people. Interventions were relatively ranked involving the user groups, with plus or minus values, and in the reference to climate-change related impacts.

Three transects were selected for the study, (I) Ring embankment (Transect1), (ii) Embank-ments -close to and away from rivers (Transect 2) (iii) Forest as buffers for bank protection (Transect 3) and locally built flexible bridges and wooden boats and raised plinths and platforms.

Villagers and reseachers qualitatively weighted costs and benefits using +/- symbols to indicate relative magnitudes.

Scenarios considered, for example, higher magnitude floods become more erratic, etc. The mitigation measures selected are ring embankment near village Burgania in Bihar, forests that provide buffer to floods, locally built flexible bridges, raised platforms and plinths, boats, etc. and noted the villagers ranking these in relation to risk reduction.

Transect 3: Settlements along Lal Bakaiya River



Findings

There are a large number of embankments created there and those were ranked by the benefits to the villagers in the region on the basis qualitatively. Three transects were selected for evaluating the costs and benefits of various interventions. Ranking were done by assigning plus or minus values to the each through a shared learning dialogue. The Bergania ring embankment, for example, was evaluated and ranked beneficial in the upper, northern area. However, in the middle area benefits were countered by the negative impacts. Negative ranking still increased going down the embankment region, due to the impacts like water logging, etc. However, higher positive values were arrived for the interventions like early

warning and communication system, etc. as compared to measures like embankments. Thus, the present study suggested the usefulness of qualitative estimation with systematic assessment for assessing the costs and benefits of various risk management interventions.

The study has helped in obtaining a first cut impression of the benefits and costs of each set of interventions and also helped in getting a perspective of trade-offs. Major costs appear to overwhelm benefits of embankments or similar structural measures in the region. Distributed approaches involve less initial capital investments and there are few major externalities. Smaller scale "people-centered" interventions are perceived as having relatively large benefits in relation to costs and will be relatively resilient under a wide variety of climate change scenarios. In case of embankments, negative consequences are likely to increase more rapidly than the benefits as climate change proceeds. Under similar condition benefits of distributed interventions is likely to be higher.

Evaluating the Costs and Benefits of Disaster Risk Reduction under Changing Climatic Conditions: A Pakistan Case Study

Fawad Khan
ISET-Pakistan
and
Daniel Kull
IIASA

Cost-benefit analysis has been a practice for assessing dams as generally large investments are involved and benefits projected to be huge in terms of irrigation, power, etc. Similar to the Rohini basin study in methodology, this case study was carried out in the Lei basin in Pakistan which runs central of Rawalpindi. It a rather hands-on, non-technical analysis and did not involve much of the details like involving hi-tech modeling. It covered a stretch of 15 kilometers of river, with severe pollution problems, dumping grounds, marginalized people staying in the banks of the river, etc. Owing to a major disaster event, a set of useful information for analysis was available for the study related to reducing flood risk and impact management.

Some of the proposals were implemented and some remain unimplemented. There were proposals related to construction of roads along the river bank, river-engineering options, afforestation, etc. after the 2001 floods.

Interventions evaluated in terms of costs and benefits included river engineering approaches such as upstream retention ponds and some channel improvements.

CBA: Quantitative Data Issues

Key Data Required	Issues
Past flood losses	Secondary data incomplete, survey data likely not representative of full basin. Only two events available.
Maps of flooded areas	Some satellite photos available, insufficient resolution for analysis.
Basin topography	Topographical maps of insufficient and mismatched resolution. Only one cross-section available for the entire river.
Hydrometeorologic time-series	Rainfall data was available only for the Nepali side of the Rohini Basin, but its validity was unknown. Significant gaps exist in the streamflow data of the Rohini River and the record is short. Both rainfall and streamflow datasets had to be corrected and estimates used to fill significant gaps.
Embankment details including past performance	Failure data limited, specific maintenance information not available.
Demographic information	Recent census at village level but projected future trends only available at state level.
On-going flood risk reduction activities (explicit and/or autonomous)	Very limited information, some trends on autonomous risk reduction could be inferred from surveys (primarily housing dynamics).
Climate change projections	Downscaling of regional climate model results and transformation into changes in flood regime highly uncertain.

Aspects of their maintenance and their carrying capacity in the time were considered within the assessment. Benefits of the early warning system are enormous but not easy to be quantified. Economic losses are very serious because despite of early warning the assets can not be evacuated or shifted to safer locations. However, early warning is important for saving lives.

Economic losses resulting from loss of livelihood, environmental damages and losses are the examples which are important but not adequately processed in the cost benefit analysis. Benefits of the early warning system are enormous but not easy to be quantified. qualitative estimates.

An assessment of the costs and benefits was carried out to understand exactly what measures are better in saving the lives and property. The shared learning dialogues were utliized to develop a quantitative estimate based on qualitative indicators as well. It also helped making women a part of the process and decision support.

In the assessment, some major aspects could not be covered, for example the indirect economic losses and risks, such as loss of livelihood, environmental damages etc. Climate change implications are also not directly incorporated.

The economic performance of the various flood risk management interventions were analyzed over 30 years under a range of discount rates (0-20%). We find, that given the high value of assets in such an urban area, almost any initiative to reduce risks will be cost effective, although the B/C varies greatly between the different approaches. While it proved impossible to generate direct estimates of flood changes that are likely to occur as a consequence of climate change, these are expected to increase and, as a result, the economic efficiency of all proposed measures to reduce such risks should as well. The early warning system was analyzed in terms of moveable assets saved, thus not considering lives saved. Cost efficiency analysis however yielded the cost of the system to be around PKR 3 million (USD 44,000) per life saved. This does not mean much in absolute values, as putting an estimate on the value of a life is a matter of much debate and raises moral issues. However, this can be useful for comparing DRM strategies, for example verses the cost of saving a life by providing clean drinking water and sanitation. Floodplain relocation has a lower B/C than the early warning system, yet a much higher NPV. This indicates that

Conclusions & Lessons Learned

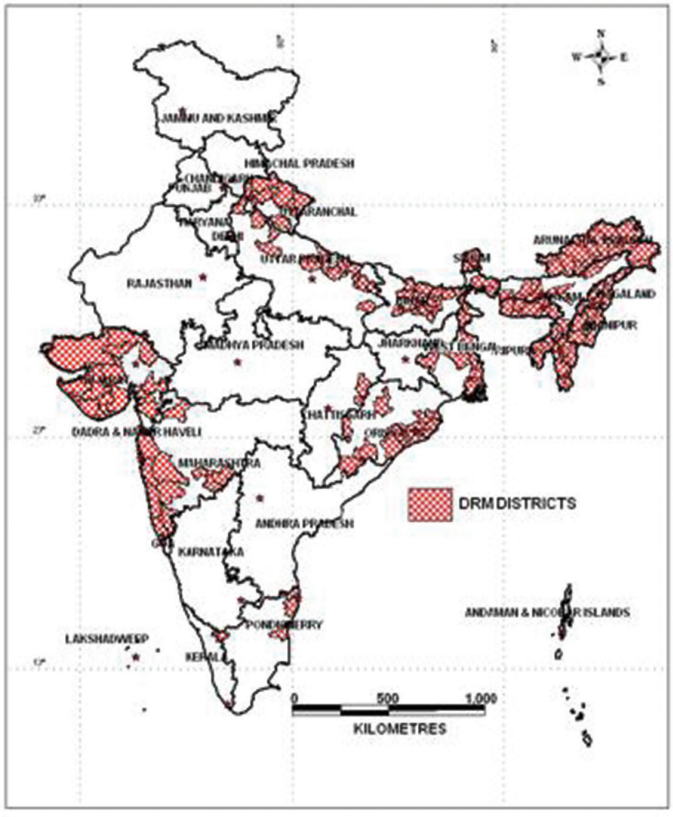
- Past embankment performance cannot be concluded to have been economically efficient
- Projected climate change negatively impacts future embankment performance
- People-centered strategy economically efficient, more robust in terms of projected climate change impacts (does not depend on specific flood magnitudes)
- Some people-centered benefits accrue regardless of flood patterns (discount rate less important)
- Vast uncertainties in data and assumptions – results only in orders of magnitude
- Distributional aspects not captured
- Data acquisition effort likely not worth it for quantitative CBA (but for other insights)

while early warning may be slightly more economically efficient, floodplain relocation is projected to generate greater benefits. This must be considered in the decision-making process, also in reference to the intervention costs, which are far greater for floodplain relocation.

Evaluation of UNDP-Disaster Risk Management Programme in India

Prof. Santosh Kumar
National Institute of Disaster Management
New Delhi

The work was assigned to NIDM by the Ministry of Home affairs, Govt of India and UNDP India office jointly. The UNDP DRM programme was the first organized intervention for disaster risk reduction with community approach as main focus.



The goal of the programme was to contribute towards social and economic development goals of the National Governments and State Governments in two sub national networking hubs to minimize loss of development from Natural Disasters and reduce vulnerability". As per the design, the expected output of the program is to demonstrate a "sustainable model" for mainstreaming disaster risk management (DRM) at different levels with special focus at District and Community Level. The core theme however, is to strengthen capacities of communities, local self-governments and districts to deal with future disasters. The projects indicators of achieving the objectives were:

a) Risk reduction factored in rapid disaster recovery
b) disaster mitigated and development gains protected
c) disaster risk considerations mainstreamed into development
d) gender equity in preparedness

Sustainability of the DRM project efforts after the project period ceases was a major question. Sustainable challenges included economic, environmental and social sustainability.

The DRM program is first of its kind both in terms of its intent and scale. Though the stated aim and objectives of the program are very wide, the actual program implementation is relatively modest in its approach and focus. Capacity building of key stakeholders, particularly communities and Panchayati Raj Institutions (PRIs), and preparation of DRM plans at various (village, GP, taluka, district and state) levels are the major thrust areas of the program.

The stated aim of Government of India-UNDP Disaster Risk Management (DRM) is to contribute towards the social and economic development goals of the National Government and enable 12 State Governments to minimize losses of development gains from disasters and reduce vulnerability. The program goal is sustainable disaster risk reduction in 169 most multi-hazard prone districts across 17 states (5 more states undertaken subsequently) in India.

Evaluating a single project in a multi-activity multi-factor environment is not an easy task because there are certain other projects or schemes in place that address DRR or sustainable development issues directly or indirectly.

The purpose of this evaluation exercise was to carry out a rapid qualitative assessment of the Phase I of Government of India-UNDP Disaster Risk Management (DRM) Programme implemented across Bihar, Orissa and Gujarat. The evaluation has twin objectives of learning and application of learning to improve the programme performance. At a wider level, it is an attempt to assess the relevance and appropriateness of the programme design and implementation in the context of the overall policy perspective and priorities in disaster management, as evolving at the national level in India presently. At another level this exercise also seeks to assess the efficacy of the programme approach and strategy in integrating disaster risk reduction concerns into mainstream development initiatives.

Goal

- **Sustainable reduction in disaster risk in some of the most hazard-prone districts in selected States of India**

Objectivities

- **National capacity enhancement to institutionalize the system for disaster risk management [DRM]**
- **Multi-hazard preparedness, response and mitigation plans for DRM at State, District, Block, Village and Ward levels in 169 most vulnerable districts in 17 States**
- **Environment building, education, awareness programmes and strengthening capacities at all levels for DRM & sustainable recovery**
- **Networking knowledge on effective approaches, methods and tools for DRM, developing and promoting policy frameworks at state and national Levels**

The stated programme strategy was 'to support national and state efforts in disaster management with emphasis on the most multi-hazard prone districts by strengthening the capacities of the communities, local self governments and districts

to deal with future disasters'. The capacity building at each level-community and local self governments in both urban and rural areas, district and state administration and national institutions-is at the core of the programme strategy

Evaluating a single project in a multi-activity multi-factor environment is not an easy task because there are certain other projects or schemes in place that address DRR or sustainable development issues directly or indirectly.

The first critical issue was to how to make the DRM programme truly community based by ensuring people's substantive involvement in hazard/vulnerability/capacity/risk assessment and creating an ownership of the plans by people at the village level.

Another critical issue was to how to create and sustain interest and involvement of the people in those areas where they have not experienced any major disaster in their recent memory and hence do not have a felt need to be prepared in advance.

The programme is better received in those areas, which have experienced major disaster in their recent memory such as the areas hit by super cyclone in Orissa (1999), and by earthquake in Gujarat (2001). There also has been a better appreciation of the programme benefits in areas in Bihar, Orissa and Gujarat, which experience floods almost every year. But it is extremely challenging to create an acceptance for the very need to have a disaster management plan among those rural/urban communities, which have not experienced any major disaster in their living memory. This highlights the need to integrate disaster management concerns into regular development programmes and initiatives in order to create a larger ownership of these concerns from a primarily development perspective. For example, in Khagaria district of Bihar, Indira Awas Yojana beneficiaries were convinced by the block officials to construct their houses in a cluster (ranging from 100-250) with a common roof to help them use it as their common shelter during floods and gain more lead time till they could be evacuated to safer places. Many more linkages of this nature need to be conceived and brought into effect to optimize the benefits of the DRM programme on the ground.

Gender mainstreaming efforts and outcomes were uneven across the states, for example Gujarat was very good and Bihar was not found to be considered as good. However, it generated the concern about gender mainstreaming. Building a gender equitable DRM process requires that this should be translated into a project cycle with clear actions, aims and outcomes at each stage i.e. awareness, mobilization, Committee and Task Force formation, Risk Assessment and Planning and Operationalizing the DRM plan. This process should be clearly sequenced and benchmarked in terms of results/outcomes for gender equity.

Points to ponder

- Application of some quantifiable tools of evaluation for such programme which are non structural in nature is needed (CBA analysis)
- Difficult to gauge the depth of the impact
- Challenge is to identify- whose risks are reduced
- Which individual ?
- Which men ?
- Which women ?
- Depth of risks and its mitigation are not addressed.

The sustainability of the project at the district levels was a major problem. When the programme ended, there was no system to inherit the tasks and issues of DRM at district level. DRM needs to be a continuous ongoing process. The exit strategy needs to be worked out in consultation with district and taluka officials and in the same manner at the GP and village level. Program implementation strategy (Phase II) has to include linkages to development plans.

In order to mobilize and sustain community interest (which is identified by implementers as a challenge, particularly in those areas where there has not been any recent disaster) there is a need to identify and link development programmes and resources which communities can access to address vulnerabilities. Local priorities and needs in terms of restoration of livelihoods, markets, basic services and infrastructure that connect people to markets and services are critical in the context of disaster. Similarly roles, capacity building, skills, information and human resources need to be built in a manner that enables communities to continually upgrade and refine their skills in a development context so that they can be drawn upon in the context of disaster.

Achievements of the key indicators can not be solely credited to the DRM project alone because simultaneously the Disaster Management Act came, and the High Power Committee being set up. The project was mainly dedicated to the non structural issues except for the setting up setting of EOCs. It is very difficult to quantify the costs and benefits.

KEY ISSUES AND RECOMMENDATIONS

(i) Data and Practical Issues: Data for quatitative analysis of cost and benefit is lacking or is very limited. This issue is common in areas like Rohini Basin, Bagmati Basin and Leh basin in Pakistan. Data considerations are the practical constrains in understanding climatic risks at regional and local levels. Cost benefit analysis have been put in practice usually to justify the project under political or other social pressures. There should be some alternate mechanism to counter check such analysis. There may be lapses in the data used for such analysis or the interpretations. With the enactment of RTI Act such opportunities are available. This will help in creating the environment for better and more realistic CBA.

(ii) CBA results and interpretations: Issues regaring the cost benefit analysis of structural mitigation measures shows that all the embankments and irrigation projects are invariably supported by a cost benefit analysis. The government do not approve any project with out performing CBA and all are justified to the scenario. But many of the projects later results in some problems due to complexity of impacts or inadequacy in feasibility studies.

(iii) Clarity of CBA notions: CBA may yield different results if carried out from different properietary angles and its poses a question on its application. For example, Mumbai 2005 flood is an example where the flaws in river engineering with in the river premises was one of the causes. The airport authority wanted to save the costs and they bend the course of the river and made the runway although they could have constructed a water way. It was very cost effective solution for the airport authority but the population in large was affected and huge damages and losses took place. Thus, it is a lesson that there must be clarity of notions of interest groups or the parties. There are also difficulties and uncertainties in assignining monetory values in such assessments. Kosi embankment had a very good CBA when its was considered as a developmental project. But on DRR grounds it may fail to satify the CBA yardsticks. Besides, it is also difficult to quantify the non-strutural inteventions as well.

(iv) Environmental and geological concerns: Indian Rivers in their flood plains have lots of embankments, roads and other other structures. British engineers were at some point against the construction of embankments. Hydro-ecology of the region does not support embankments i.e high rainfall, siltation and sedimentation rate, high groundwater and population density. Choice of technology is a key question in decisions. It is also important that the peoples perceptions, aspirations and choices change over the time. Certain areas are highly vulnerable to climate change and the people living in such area are poor and basically agrarian communities. There are also signs of high rate of migration and hence high vulnerability.

(iv) Beneficiaries of Mitigation Projects: In case of embankments, is has been common experience that it benefitted large number of people away from the embankments. Whereas it resulted in mass suffererings to people living near to the embankments. There is a strategic risk of the strong political economy behind the construction of embankments. There are simple tools to analyse the impact embankments e.g. (1) Area under water logging/floods(based on historical data (2) reduction in crop area (3) decrease in productivity due to salinity (4) Rate of migration (5) rate of displacement (6) impact on livelihhod. Most of the migration in India is observed in areas where large number of embankments are constructed. Therefore, it is a basic need to identify the target settings for the costs and benefits of such structural measures.

TECHNICAL SESSION 3
Techniques for Evaluating the Costs and Benefits of Disaster Risk Reduction

This session was focused on the core methodological issues involved in forecasting and early warning and quantitatively evaluating the benefits and costs of risk management strategies. Issues in forecasting and modeling as well as conducting CBA for disaster risk management was discussed in detail including the implications of climate change for probabilistic approaches. The applications and challenges of CBA for project formulation and decision-making was also discussed during the session.

Moderator : Dr. Janakrajan, MIDS

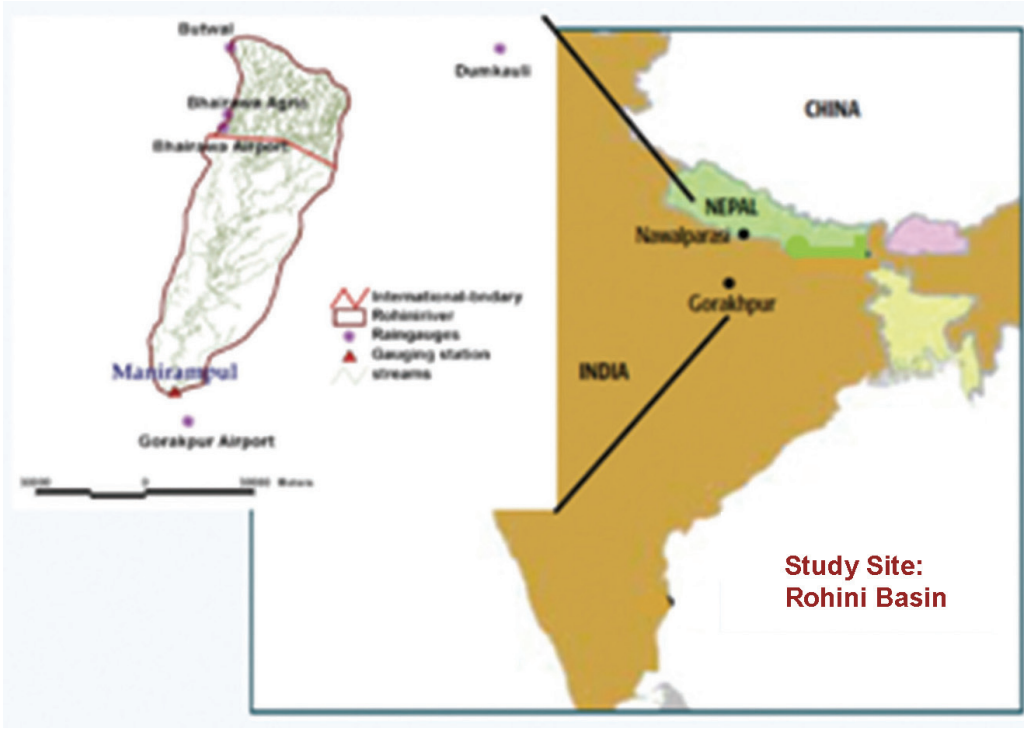
Downscaling: Potential Climate Change Impacts in Rohini Basin, Nepal and India

Dr. Sarah Stapleton, ISET, Colorado, US

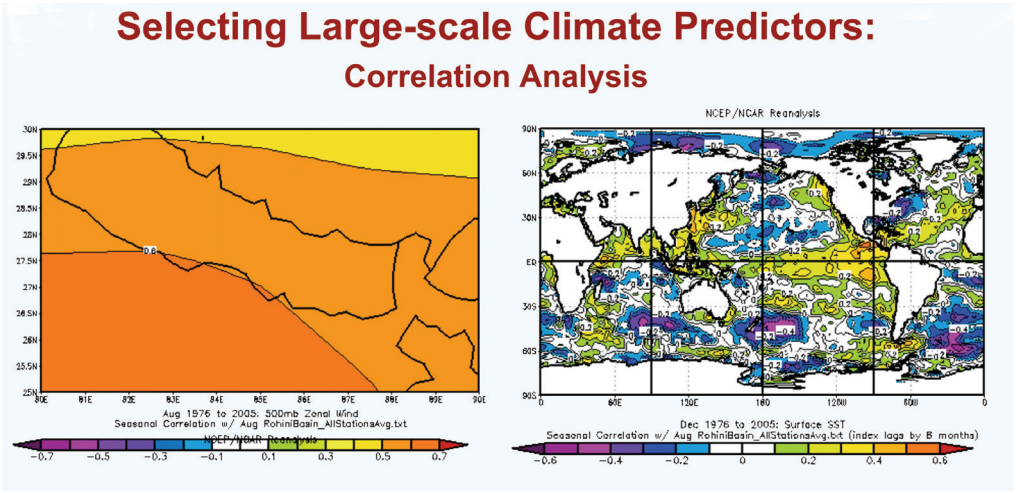
The key objective of the study is to identify and evaluate the cost and benefits of proactive flood and drought mitiagtion strategies in the Rohini basin and to assess the potential impact of Climate Change in the basin hydrometeorolgy. For that there was a need to undertake downscaling of climate predictions in the river basin. The study site Rohini basin is a cross border study where 30% of the basin is in Nepal and rest in India.

Several steps were involved while taking a review of climate change downscaling and to make it more effective. The large scale General Circulation Model (GCM) on which the IPCC reports are based generate climate results at global scale and the smallest resolution of these models is from 100-200 kms which tend to miss out the fine scale climate features that are necessary in river based modelling particularly in the monsoon areas.

The large scale general circulation model that are observed at a higher level need to be translated to finer scales. This is usually done in two ways – numerical models and statistical models. Numerical models look at physical relationships between

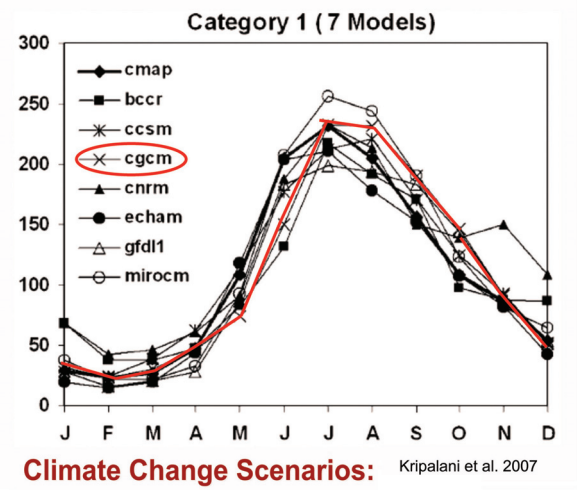


soil, ocean and atmosphere. Numerical models are complicated, expensive and require a lot of data and time (may take from a couple of months to a couple of years depending upon the resolution and parameters). In the Rohini river basin these were not available. Due to lack of data availability, a statistical model was used which might not be refined as a numerical model.



Several statistical methods are available but the choice depends upon the type of data availability and a long term metric analog method was used. The analog statistical downscaling methodology provides a robust means of translating large-scale climate change scenarios generated by GCMs to potential scenarios at smaller geographic scales.

The full impact of climate change cannot be fully quantified because there is a synergy between climate processes and human behaviour/choices. And since we simply don't know how humanity will continue to act and choices that it will make we can't really say

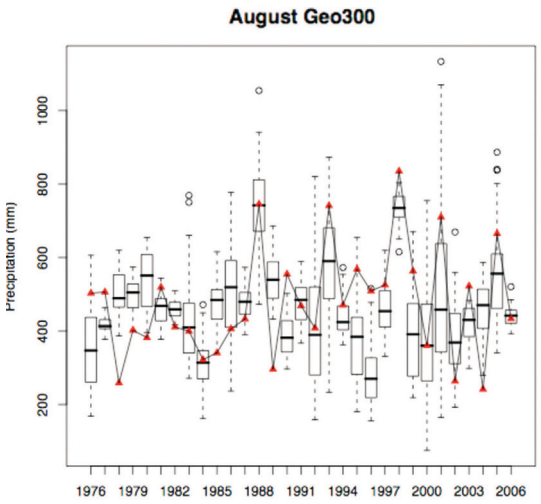


Climate Change Scenarios:
Appropriate GCM

Kripalani et al. 2007

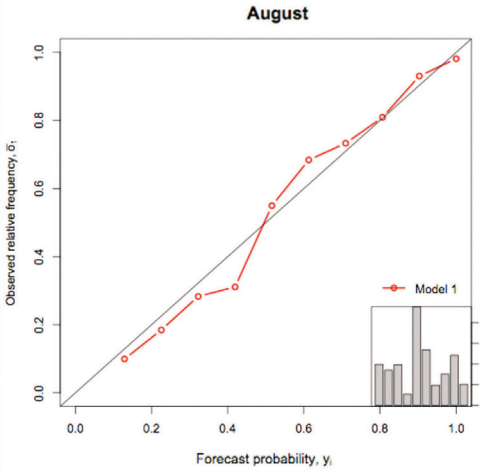
The final step was deciding which climate change scenario to pursue. All CC scenarios as per IPCC report are based on estimates of future human behaviour depending upon the emission scenarios. An envelope of higher range and lower range scenarios as predicted by IPCC models A2, B1 and A1B were selected for downscaling exercise undertaken in this study.

The steps involved in actual downscaling exercise are (a) acquisition and verification of data, (b) selection of large scale climate predictors (both from the historical and future perspectives), their relationships and drivers like pressure field, temperature, wind, etc for the local area, (c) model test run and verification, and (d) model future rainfall scenarios using the IPCC large scale climate predictors. This dictates which climate model is chosen and this downscaling was pushed only to 2050. For future scenarios there were five model runs per scenario and each of these model runs were down scaled to have a simple ensemble generation.



Climate Change Scenarios:
Testing Period 1976-2006

- Model Verification:
  - RPSS
  - Correlation Analysis
  - Reliability Diagrams
- Observations:
  - Model performs well in all months but January, September and October
  - RPSS and Reliability Diagrams confirm that length of dataset insufficient to capture full climatology of basin



Climate Change Scenarios:
Testing Period 1976-2006

The first step of a statistical climate model is to try and find its relationship with large scale climate predictors which is conditioned on two sets of assumptions. The first set is based on the necessary atmospheric conditions that allow for convective activity, from which most the

Rohini's rainfall is based on:

- Changes in air pressure that lead to atmospheric instability (measured through geopotential height)
- Moist air (measured through specific humidity)
- Warm air (measured through air temperature)
- A transport mechanism to move the warm, moist air (measured through winds)

The physical relationships between the large-scale climate indices and the basin rainfall are established using correlation analysis. Correlation analysis was performed between each month's rainfall and various large-scale climate features (geopotential height, specific humidity, air temperature, and meridional and zonal winds). The correlations were tested for significance and the feature that had the highest correlation with the month's rainfall were identified and used to form the predictor set.

The final step was which GCM output to choose, there are 21 GCM models but only seven of them replicate the key features of the South Asian monsoon. Of the seven, the Canadian Third Generation Coupled Climate Model (CGCM3) was chosen as it was somewhere in the middle of the suite of identified models.

The model is simple analog method which starts with a historical time period and finds a relevant large scale climate feature in a given year and then makes a

comparison from future large scale climate projections provided by the 3rd generation Canadian models. Then it is compared back with the historical period and then resample with the rainfall of the historical period.

The first thing done is run the model over the test period using a drop-one, cross-validation method to see the fit of rainfall in the remainder of the dataset. The model performs well in most months except January, September and October. The reason probably is that they are the transition months. Then we go back and test the generated rainfall to and see how well it compares with the observed rainfall and suite of verification techniques is used and also help determine whether or not the timeframe of the historical rainfall data that you have is actually sufficient enough to capture the whole basin climatology. The data set available was not long enough that was a severe limitation.

It was found in various scenarios that in general in monsoon months of June to September the average rainfall is expected to increase as a keeping the variability in rainfall which is consistent with the IPCC report. However the two scenarios cannot be compared exactly as the IPCC projections consider a large area of South Asia. But the main point to be noticed is that the rains seem to be drying out in all months of the year except the monsoons. This is also consistent with some other downscaling projections available for other basins. The potential implications of this need to be kept in mind. The most important thing to realize about climate downscaling is that it is never going to be possible to predict exact climate change information for any location. For example the information on the Rohini basin rainfall series is too short and the data between 1976 – 2006 is not available and there was a major phase change shift in the pattern in 1976 and this has not been captured in the model.

The other limitations are that the IPCC projections by the time they are printed and are accessible to public are already old! The most cutting edge projections are generally not publicly available and it is very difficult to model projections over locations like mountains. Then there is the question about how realistic are these CC scenarios that the IPCC releases. The other thing not very certain is that large scale climate relationships are starting to change. It can be seen that the wind patterns are shifting globally and so we can be sure of that the large scale climate relationship between rainfall and ENSA will continue to hold up in the future.

Finally, the full impact of climate change cannot be fully quantified because there is a synergy between climate processes and human behaviour/choices. And since we simply don’t know how humanity will continue to act and choices that it will make we cant really say exactly where climate change will take us.

The Cost-benefit Analysis Methodology

Dr. Reinhard Mechler

IIASA

The presentation discussed key methodological aspects and findings of conducting a CBA of DRM and provided the backdrop for the different case studies carried out in India, Nepal and Pakistan. Dr. Mechler concluded that CBA can be a useful tool in DRM if a number of issues related to conducting a CBA assessment and using the findings are properly taken into consideration.

CBA can be useful as a tool for identifying, estimating, organizing and presenting risks and benefits of risk management. However, in many circumstances the role of CBA in decision-support.for DRM may be more pertinent to process rather than outcome

Why did we use Cost benefit analysis in our assessment of disaster risk reduction interventions? A key reason has been the lack of systematic analysis and evidence. A number of studies have demonstrated that disaster prevention can pay high dividends and found that for every Euro invested in risk management, broadly 2 to 4 Euros are returned in terms of avoided or reduced disaster impacts on life, property, the economy and the environment. Yet, despite the benefits, DRM measures are still insufficiently taken and there is for the most part a reliance on after-the-fact approaches. This low level of investment in prevention can be explained inter alia by a lack of understanding and concrete evidence regarding the types and extent of the cost and benefits of preventive disaster risk management measures.

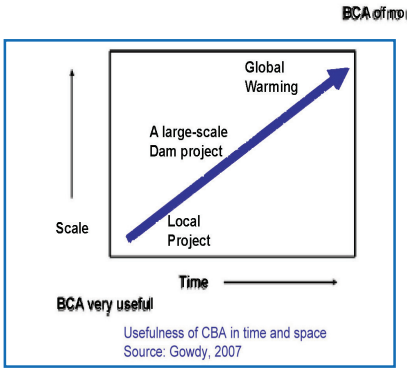
Limitations to CBA - generally

Which benefits to include? Use vs. abuse…

Lack of accounting for the distribution of benefits and costs in CBA

Challenges with monetarizing non-market impacts

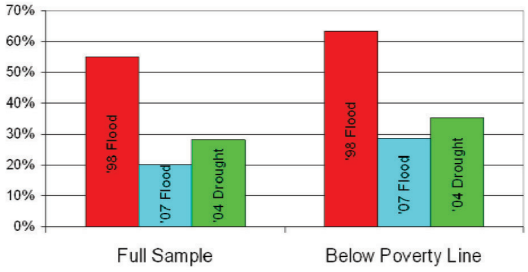
Time and scale



Usefulness of CBA in time and space
Source: Gowdy, 2007

Cost-benefit analysis (CBA) is an established tool for determining the economic efficiency of development interventions. CBA compares the costs of conducting such projects with their benefits and calculates the net benefits or efficiency (measured by the net present value, the rate of return or the benefit-cost ratio). While the benefits created by development interventions are the additional benefits due to e.g. improvements in physical or social

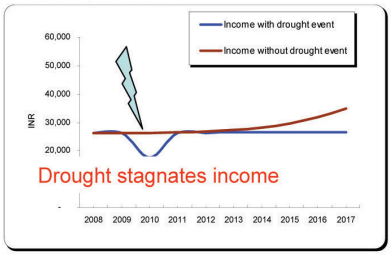
Uttar Pradesh drought: Indirect risks and development impact important

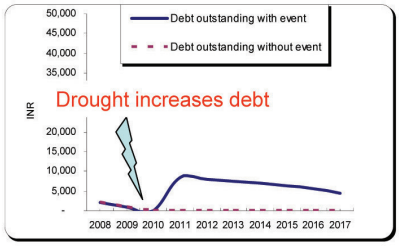


Survey: reported impacts of droughts and floods on rural livelihoods in Uttar Pradesh, India (losses as percent of income)

Indirect income-debt relationship crucial, informed by survey

Model representation





infrastructure, in disaster risk management the benefits are mostly the avoided or reduced potential damages and losses, including the benefits of the primary development interventions. It is important to note that CBA is usually not used for selecting the specific project but looking at certain range of project alternatives, for example, how high to build the dam, how wide to build the road etc. The actual decision whether to do the project or not is rather political,

Numerous limitations to CBA have to be acknowledged. One important issue is the lack of accounting for the distribution of benefits and costs in CBA in effect lumping together changes in welfare for “winners “ and “losers” with compensation between these two groups is not required. Moreover, as often perceptions on who is losing or winning can be subjective, CBA cannot resolve strong differences in value judgments that are often present in controversial projects (for example, nuclear power, bio-technology, river management, etc.). This distributional issue has been a major reason for the Risk to Resilience project to ensure distributional factors are incorporated in the qualitative analyses and shared learning dialogues discussed in the summary and the case studies.

A difficulty with CBA is the challenge associated with assessing non-market impacts such as on health and the environment. Although methods exist for quantifying such values, this often involves difficult ethical judgments, particularly regarding the value of human life, for which CBA should be used with caution. Another important issue is the issue of discounting. In economic efficiency calculations, future

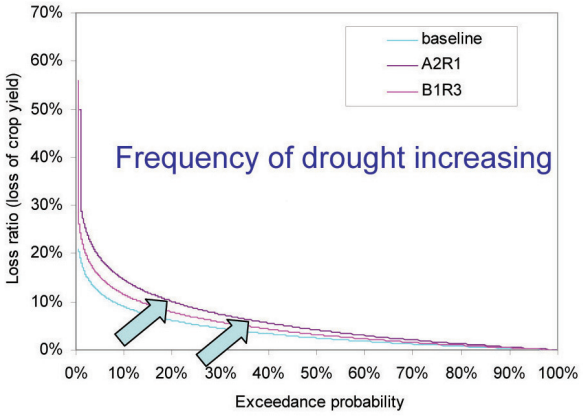
benefits are discounted in relation to current benefits to reflect an (empirically confirmed) preference for living and consuming today versus doing so in the future. Applying high discount rates, as often suggested particularly for development cooperation, expresses a strong preference for the present while potentially shifting large burdens to future generations assuming future generations will be better off and able to deal with those burdens. Yet, this underlying key assumption is not valid when impacts are large-scale and irreversible, and consequently the application of a discount rate demands careful scrutiny.

Time and scale of projects are important considerations when doing a CBA. While originally strictly focused at the project level, it has been used substantially to inform larger-scale investment decisions such as dam construction, other large scale infrastructural development such as the siting of airports and nuclear reactors, and even for global climate change policy informing the UNFCCC negotiations. For example, for the past performance analysis of embankments in the UP flood case, when following strictly an analysis that focuses on engineering benefits only, high benefit/cost ratios in terms of flood losses avoided are calculated. Yet, given the many disbenefits such large-scale infrastructure can cause (waterlogging, health disamenities etc.) and associated uncertainties with such estimates, it cannot reasonably be concluded that embankments have historically performed economically satisfactorily. Generally, as the scales and time horizons of projects and thus uncertainties increase, it is important to question the usefulness and robustness of CBA, as shown in the following chart

Under the methodological framework developed by Dr. Mechler and colleagues, there are four steps. The first one is to assess risk as functions of hazard and vulnerability and additionally take into consideration the climatic changes affecting hazard. Under step 2, risk options and their costs are identified. In the next step, the benefits of those interventions are gauged in terms of reducing and transferring risk; finally, the last step consists in bring costs and benefits together and calculating the economic efficiency of the options studied.

CBAs can be done at different level of complexity. In a more rigorous and resource-intensive forward-looking, risk-based framework data on hazard and vulnerability are combined and lead to estimates of risk and risk reduced. Ideally in a *forward-looking* risk assessment, risk can be estimated by combining information on hazard and vulnerability. Such detailed analyses are helpful for project or pre-project appraisals. Often full-blown risk assessments are not feasible due to data, time and money constraints, particularly when the area at risk is large, is exposed to more than one hazard, or there are a large number of exposed assets with differential vulnerabilities. In a more pragmatic *backward-looking*, impacts-based framework past damages are often used for reaching an understanding of current vulnerability, hazard and potential damages. This leads to a rougher understanding of risk and potential impacts, and the type of study may be of more informational nature.

Direct risks and need to consider climate change



Loss-frequency curve for crop yield losses for baseline and future climate scenarios

Mr. Daniel Kull already presented the backward-looking approach, and we focussed now on the more complex forward looking methodology for assessing risk management options for drought exposed farmers in Uttar Pradesh. In addition to floods, drought risk is also a serious threat to livelihoods in the highly agricultural Rohini Basin. Income losses following the 2004 drought consumed up to 40% of annual farmer incomes. The conventional approach has been to manage drought risk in this region focuses on building large scale irrigation infrastructure (albeit at limited levels) or providing relief after the fact.

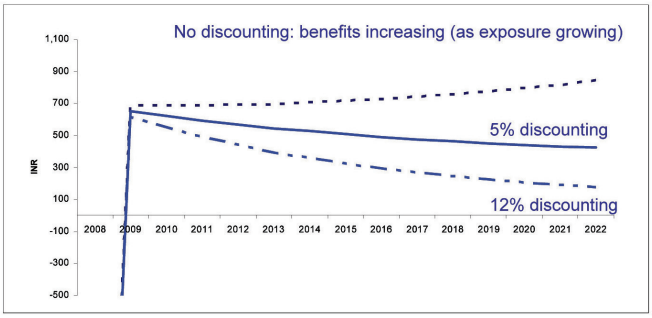
An alternative risk management option receiving growing attention particularly in India is index-based crop micro-insurance. Catered to the needs of those at risk, made affordable by parametric triggers based on rainfall and/or temperature (rather than costly indemnity-based insurance settling claims on the basis of actual losses) and possibly subsidized by donors or the government, such micro-insurance may provide important income support after an event and thus help to stabilize farmers' livelihoods. At the same time, costs can be substantial with premiums to be paid on an annual basis.

We presented our CBA performed at a household-level on a theoretical index-insurance scheme for rice and wheat, the crops on which most rural livelihoods in the Ganga Basin are based. We then contrasted and combined this insurance with the now more common drought management approach of groundwater irrigation accessed through local boreholes.

Drought hazard was defined as the lack of rainfall over given time periods, vulnerability determined through a statistical model which relating total rainfall per specific time periods with average crop yields, and exposure estimated with average cropping areas of different household and dynamic crop prices. Potential climatic changes were incorporated via the same statistical downscaling model used during the flood analysis done by Dr. Opitz-Stapleton.

Changes in the variance of total rainfall over the given time periods was explicitly modeled with the help of ensemble runs. This assisted with estimating the

Net benefits of crop insurance option in the UP drought case and discounting



uncertainty of climate-related changes within the integrated modeling approach, which were substantial. Direct risk thus reflects the frequency and magnitude of sub-average crop production, in monetary terms. Indirect risk, in this case specifically economic, is income changes due to drought as amplified or mediated by the financial vulnerability of the household, informed by our survey and driven by debt-poverty dynamics. We assumed a critical subsistence level (calories-based) per household that must be achieved with income or in times of insufficient income, additional debt. Given initial debt and wealth (in terms of assets and savings), the household must decide to invest in either income generation, such as buying high yield seeds, or income stabilization, in this case irrigation or insurance.

We find that the irrigation and microinsurance interventions are considered economically efficient given the assumptions taken. Insurance was less dependent on discount rate assumptions because it offered a secure, guaranteed payout over the full time horizon, while irrigation and its benefits are dependent on the ex-post ability of the household to pay for pumping water. As low-income households generally have limited financial resources, multiple events over the study period led to an accumulation of debt and the inability to pay for pumping in later periods, leading to income shortfalls. When climate change projections where small events become more frequent were considered, irrigation benefits and thus economic efficiency increased, while insurance performance decreased. The highest benefits were achieved with an integrated strategy combining both irrigation and insurance. In such an adaptive strategy, a more efficient insurance layer structure can be implemented: as irrigation reduces the higher–frequency events (irrigation in effect cuts off the initial portion of the loss-frequency curve), insurance can be used to cover lower frequency events.

The example below shows the CBA calculations for the case of micro crop insurance and underlines the importance of using certain parameters and assumptions, such as on the discount rate to be used. In the first year of the project, the fixed technical assistance costs (for modelling the risks, training staff etc.) for setting up the scheme would dwarf the benefits, and thus lead to negative net benefits. Over time, benefits would arise as income losses are partially offset by insurance payments. Total,

undiscounted net benefits would amount to ca. 6,000 INR over the 15 year time period considered. Yet, when discounting with a discount rate of 12%, the (discounted) net benefits would amount to only 440 INR. The discount rate has a key influence on the economic efficiency calculations and the figure shows the net benefits for 0, 5, and 12% discount rates. Not surprisingly, when a small or zero discount rate is used, benefits increase and the project appears more viable.

Generalizing from the example presented, Dr. Mechler concluded that CBA can be a useful tool in DRM if certain issues are properly considered and reported, including: complexities in estimating risk and benefits, data dependency of results, potential negative impacts of interventions and distributional issues of who pays verses who benefits. The design and process of CBA must take into consideration the objectives, available information, resources and needs of all stakeholders, and must be performed transparently, particularly with regards to driving assumptions and inherent uncertainties. Intervention design and uncertainties should be qualified through dialogue. In many circumstances the role of CBA in DRM may be more pertinent to process rather than outcome. Generally, it is often advisable to use CBA in conjunction with other decision support methods, such as cost-efficiency analysis or multi-criteria analysis.

Role of India Meteorology Department in Managing Hydro-meteorological Disasters

N.Y. Apte
India Meteorology Department
New Delhi

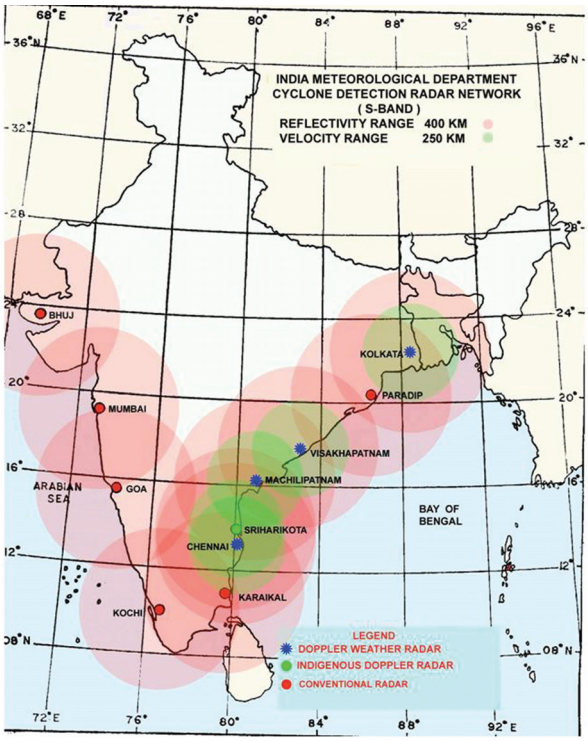
In the year 1875, the Government of India established the India Meteorological Department, bringing all meteorological work in the country under a central authority. The mandate of IMD: (i) to take meteorological observations and to provide current and forecast meteorological information for optimum operation of weather-sensitive activities Agriculture, Climatology, Weather Forecasting, Civil Aviation, Seismology, Environment ,Hydrometeorology including flood forecasting. (ii) to warn against severe weather phenomena like tropical cyclones, norwesters, dust storms, heavy rains and snow, cold and heat waves, etc., which cause destruction of life and property. (iii) to provide meteorological statistics required for agriculture, water resource management, industries, oil exploration and other nation-building activities (iv) to conduct and promote research in meteorology and allied disciplines (v) to detect and locate earthquakes and to evaluate seismicity in different parts of the country for development projects. IMD gives inputs for hazard assessment, early warning and not outputs.

IMD has a effective system of not only of collecting and processing quality meteorological data, but is competent to develop value added products required for understanding the natural disasters.
With mutual interaction IMD is and can effectively help decision makers / planners to tackle the natural disasters.

Hydrological and Meteorological Data Collection Network of India Meteorological Department includes Surface Observatories 559; Aviation Current Weather Observatories 71; High Wind Speed Recording Stations 4; INSAT-based Data Collection Platforms 100; Hydro meteorological Observatories 701; Non-Departmental Raingauge Stations; 3540 Reporting to IMD and 5039 not reporting to IMD. IMD has good network of RADAR (11) for detecting cyclones out of that 4 are modern weather doppler radars for short term forecasting. On an average, 40 years of rainfall data is available.

Wide range of meteorological information is available in the website of IMD, which includes All India Daily Weather Report, Current Weather Observations, Main Features of Today's Weather, All India Weekly Weather Report Latest Press Release, Weather Charts, Doppler RADAR Products, Cyclone Page, Climate Normals, Doppler Radar Products Satellite Imaginaries and derived products etc. For the purpose of aquiring realtime data a modernization plan has been proposed by IMD under which

3500 Satellite linked ARGs, 1000 Satellite linked AWS, 5 GPS, 55 Doppler Weather Radars, 5 Wind Profilers and this will be put in place in 5 years.



Hydrometeorological disasters that affect India are— drought, floods, hailstorm, heavy rains, snowfall, avalanches etc. However droughts and floods have potential of causing relatively large scale damage whereas others are localised in terms of their impacts.

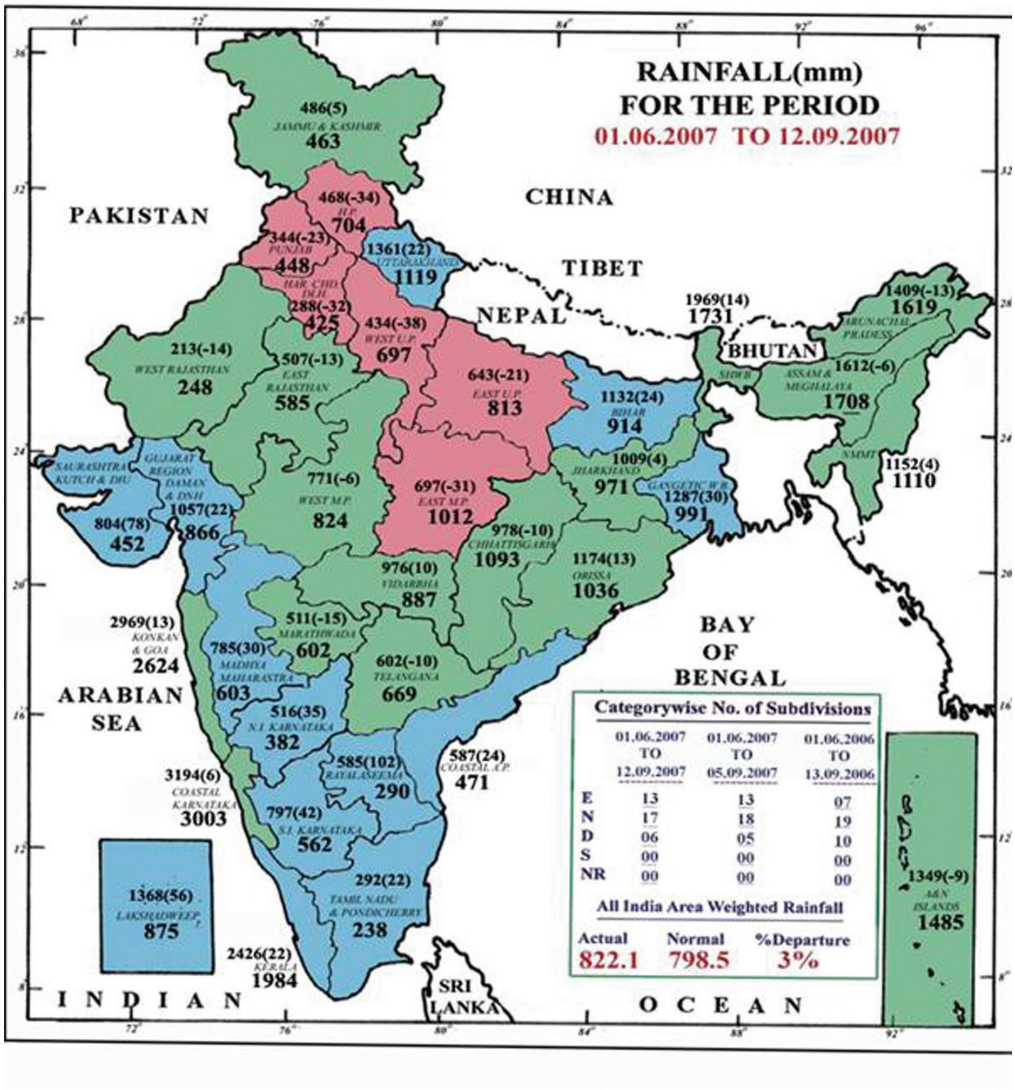
Drought and floods are related to rainfall but have different characteristics. Drought is a situation of significant water shortage while floods are mainly due to excess rainfall. Droughts lasts for seasons or years whereas floods may last for few days. Flood warnings can be effectively issued but effective prediction / warnings for drought are difficult. In the case of floods areas / population near river banks will be affected but drought affect larger areas / population. There is direct cause of loss to life and property due to floods but drought can lead to starvation deaths (are now a days rare) but cause immense hardships. Floods are annual features but drought is less frequent as compared to droughts.

Drought is due to insufficiant rainfall or increase in water demand. Drought affects population spread over larger areas for longer period of time. Drought affects water resources, agricilture, enviorement, hydro power generation and ultimately economy. Drought may result into exceptional starvation deaths but large scale migration is common resulting into economical loss to individual, malnutrition, epidemics and socio-economical stress due to migration problem. Droughts are mainly of four types i.e. Meteorological Drought, Agricultural Drought, Hydrological Drought and Socio Economical drought. All thease droughts are inter dependent and mainly cause due to inadequate rain. However all these droughts need not occure simultaneously. The commencement and conclusion time of drought is unknown. droughts are inferred from consequences.

Criteria of meteorological drought in india is when rainfall of south west monsoon season is less than 75% of normal rainfall for district/met sub division ,that area is

भारत मौसम विज्ञान विभाग

INDIA METEOROLOGY DEPARTMENT



LEGEND : EXCESS (E) + 20% OR MORE; NORMAL (N) +19% TO -19%; DEFICIENT (D) -20% TO -59%; SCANTY (S) -60% TO -99%; NO RAIN (NR) -100%; NO DATA

NOTES:
1. Rainfall figures are based on operational data.
2. Small figures indicate actual rainfall (mm), while bold figures indicate normal rainfall (mm).
3. Percentage departures of rainfall are shown in brackets.

taken to be under drought condition. when rainfall is in between 50 to 74% of normal seasonal rainfall the area is under mild drought condition.when same rainfall is below 50% of normal, area is under severe drought condition. The drought years that is when 20% or more area of the country suffered from drought(rainfall < 75% of normal) since 1801 ad are 1801, 1804, 1806, 1812, 1819, 1825, 1832, 1833, 1837, 1853, 1860, 1862, 1866, 1868, 1873, 1877, 1883, 1891, 1897, 1899, 1901, 1904, 1905, 1907, 1911, 1918, 1920, 1939, 1941, 1951, 1965, 1966, 1971, 1972, 1974, 1979, 1982, 1987 and 2002.There are 39 drought years since 1801 indicating reccurance interval of every 5 years. There are 4 occassions when drought continued for 2 years and 9 instances when drought recurred in alternate years. The area of about 5,113,00 sq. kms is drought prone. In short, even the sw monsoon is good one can expect about 8% area reeling under drought while even in bad monsoon one can expect 1% area under excess rains. We should not expect country as as whole totally free from Drought or excess Rain in any single occassion. Major challenge is that IMD produced figures for the whole of the meteorological sub division hense a part of the division may be under drought and part may be receiving excess rainfall but the mean vuales may appear normal. So always statistics will not give the correct picture.

India Meteorological department brings out rainfall summary every week for Districts, Met sub Divisions and country as a whole comprising of Actual rainfall and its departure from normal both for week and period commencing from start of season up to end of that week. Impact of droughts on river discharge/reservoir storage include the meteorological and hydrological drought results into increase in water demand. The reservoir storages get depleted at much faster rate and replenishment of same is practically negligible. Hydrological drought exerts stress on ground water resource resulting into decline in ground water table. IMD's action plan is for developing long range and medium range rainfall forecast models for country and downscaling of same to met subdivision and then further down. As demand of water is continuously increasing and expected to overtake the maximum potential of utilizable water by 2050, as India is heading towards water scarcity which is a serious concern.

The term flood to exprss something that is abundant in quantity, uncontrollable and dynamic . When it is related to rivers flood means overtoppling of banks of river by relatively high discharge that inundates adjoining areas which are otherwise dry. It is estimated that in past 50 years India had lost assets of Rs. 75000 crores and human lives in tune of 65000.

Strategies of flood management are broadly classified into structural and non-structural broadly. Non structural measures are flood forecasting and warning, flood plain zoning, relief and rehabilitation etc. Flood forecasting is a domain of hydrologists & meteorologists. In india flood warning activity is 2 tier amongst india meteorological department and central water commission. IMD is providing quantitative precipitation forecast through 10 flood meteorological offices to central

water commission, Central Water Commission is framing flood warnings using QPF as input and issues the warnings. The flood warning is provided for 157 flood prone cities. Key challenges are (i) QPF need to be time and location specific (ii) the underestimation QPF and consequently of stage / discharge results into unexpected inundation while overestimation results into unnecessary displacement which is not taken kindly by the society.

Thus advanced techniques of quantitative precipitation forecast based on hydro dynamical models (sure it is the right word?) , statistical techniques downsized to catchment area of few hundred to thousands sq. km with enhanced lead time are being developed in imd and in course will be made operational. IMD is using doppler weather radar for flash flood forecasting the doppler weather radar has a range of 500 km for cloud observation. The products like max_z (maximum reflectivity) is very useful in providing the intensity of precipitation and the total rainfall associated with the clouds. High reflectivity cloud approaching the locality can be tracked well in advance and warning of thunderstorm and heavy rains can be issued so as to take precautionary measures. National climate centre of IMD has studied the rainfall data of 100 stations having more than 90 years. The extreme rainfall indices have shown significant + ve trends over the west coast stations which results into increase in seasonal rainfall over the area. + ve trends were observed over the region 20ºN - 30ºN and 75ºE - 80ºE. IMD has a effective system of not only of collecting and processing quality meteorological data, but is competent to develop value added products required for understanding the natural disasters. with mutual interaction imd is and can effectively help decision makers / planners to tackle the natural disasters.

Hydrological Modelling for Forecasting of Flood Risks

Dr. A.K. Lohani
Sr. Assistant Director
National Institute of Hydrology
Roorkee

National Institute of Hydrology is a premier institute in the area of hydrology and water resources in India. The Institute has its headquarters at Roorkee (Uttaranchal), four regional centres at Belgaum, Jammu, Kakinada and Sagar and two centres at Guwahati and Patna. The Institute was established in 1978 as a research organization at Roorkee. Since inception, the Institute has carried out research studies covering almost all areas of hydrology, and has established contacts with national and international organisations of repute. The Institute is now well equipped to carry out computer, laboratory & field oriented studies with a team of 80 well qualified & trained scientists with excellent academic background and well equipped laboratories and facilities. The Institute has has actively participated in technology transfer activities. NIH activities are mainly in the non structural flood mitigation.

Causes and condition of flooding in India include Very heavy local rainfall, heavy rainfall synchronizing with river spill; cyclones; spilling of water from streams due to low carrying capacity, back water effect in tributaries when the main river carries heavy discharge, landslides blocking in stream courses and ice jams, resulting in the back water overflowing river banks, flooding in coastal area due to high tides; and inadequate drainage/ drainage congestion to carry away surface water with the desired quickness, flooding due to the failure of flood control structures. etc.

While modelling floods it is important to know about types of flood. There are different type of floods i.e. Flash floods, Single event floods, Multiple event flooding, Seasonal floods, Dam break floods, Floods due to drainage congestion etc. Different kind of floods different type of models are being used. About 41 million hectares, or nearly one eighth is considered flood prone to floods and 8.6 M ha of land area is annually affected. Average annual damages of the order of Rs.2,500 Crores.

Real Time Flood Forecasting can be done by Conventional Methods, Deterministic Models, Statistical & Stochastic Models, ANN Models, Fuzzy Logic based Models. Last three models are data driven models where as first two are deterministic or conventional models. CWC is mainly uses conventional or deterministic models.

NIH uses various Hydrological Models which include (i) Statistical Models like Univariate Models, Multivariate Models and Regression based Models (ii) stochastic models i.e.Time Series Models and (iii) Autoregressive Model and Armax model.

NIH working mainly on non structural measures of flood mitigation.
Real Time Flood Forecasting, Flood Plain Zoning, Flood Insurance Scheme and Dam Break Flood Simulation are some of the activities.
GIS based models can be combined with the soft computing methods like ANN and fuzzy logic for better results and NIH is working towards the intergration of various methods for better forecasting of floods.

The institute has also carried out various studies using statistical models and recently NIC has carried out a study for the Ajay River Basin in Jharkhand and compared the results with Armax model. It is found that various kinds of models can be used and an adaptive kind of model can be used for better forcasting of floods.

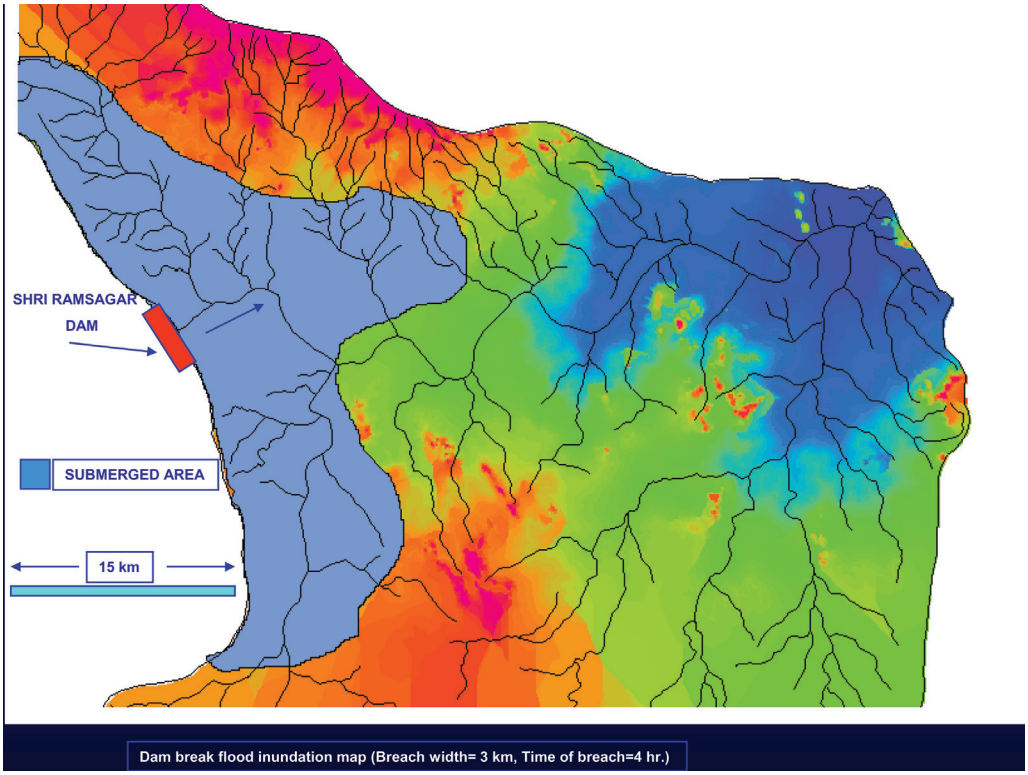
Various kind of deterministic models are used by NIH examples are event based models i.e. Nash model, Clark model, HEC1 RAS, continuous models are conceptual Sacramento models (Sacramento, TANK) and physically based distributed models (MIKESHE,TOP) etc

Another technique is soft computing methods like ANN and Fuzzy logic methods. Researchers who are working on deterministic models may not appreciate soft computing. But those who are working on softcomputing are having own justifications for using the method. In the case of flood forecasting the lead time factor is important and if more time is there better decisions can be made by the administration. Soft computing data requirement is less and very accurate results can be achived in short time.

An ANN is a computing system made up of a highly interconnected set of simple information processing elements, analogous to a neuron, called units.The collects inputs from a andneuron both single multiple sources and produces output in accordance with a predetermined non-linear function. An ANN model is created by interconnection of many of the neurons in a known configuration. ANN works similar to human brain and is an adaptive model. Fuzzy logic model is basically a multi-valued logic that allows intermediate values to be defined between conventional boolean logic like true/false, yes/no, black/white. The model has been tested for Narmada basin and it was found that fuzzy logic model was giving better result than ANN model.

Besides the institute has carried out various Dam Break Flood Wave to Predict Flood Characteristics: Peak Stage,Discharge, volume, flood wave, TravelTime. Results of these analysis is required for planning purpose. Estimation of floods situations for different breach conditions can be performed and this can be used for preparation of emergency evacuation plan. Such studies were carried out for Machhu, Mitti, Bargi, Barna,

Pulichintala, Vaigai, Myntdu, Laska, Shri Ramsagar, and Lower Maner dam in Andrapradesh.



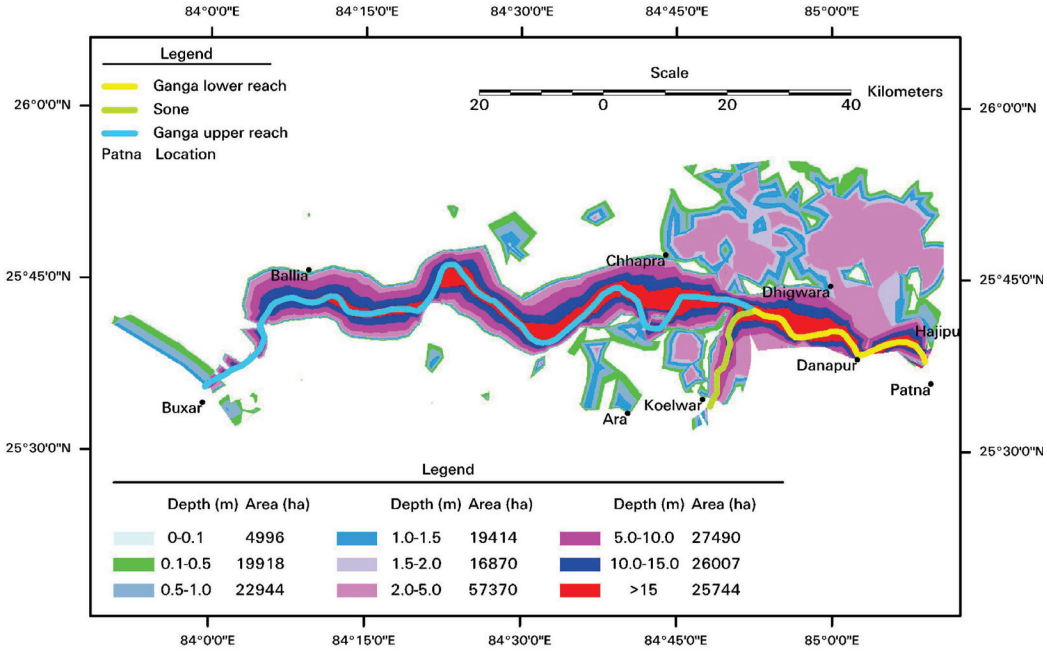
Dam break flood inundation map (Breach width= 3 km, Time of breach=4 hr.)

Flood Inundation mapping is mainly carried out using Remote Sensing & GIS Techniques Remote sensing gives timely information, covers large area and gives a reasonable good estimate. This is useful for planning purposes.

These provide information about the areas to be inundated by floods for different return periods of the floods and depth of flooding over the flood affected areas and the risk associated with the flooding. Flood plain zoning studies were carried out for main Ganga riven in Baxar to Patna in Bihar for various return periods. Flood Risk maps were gererated using flood inundation maps, event map, administrative data and RS and GIS.

Insurance is the most effective method to regulate the land uses in the flood plain. Insurance premium is charged depending upon the nature nature and location of establishment. In India Scheme is not yet implemented because good quality Flood Risk Maps are not available for different river basins.

Computer based models together with based models together with their interactive interfaces are typically calld decision support systems (DSSs). DSS does not take decisions but provides timely information and easy comprehension of abstract information which facilitates decision making.



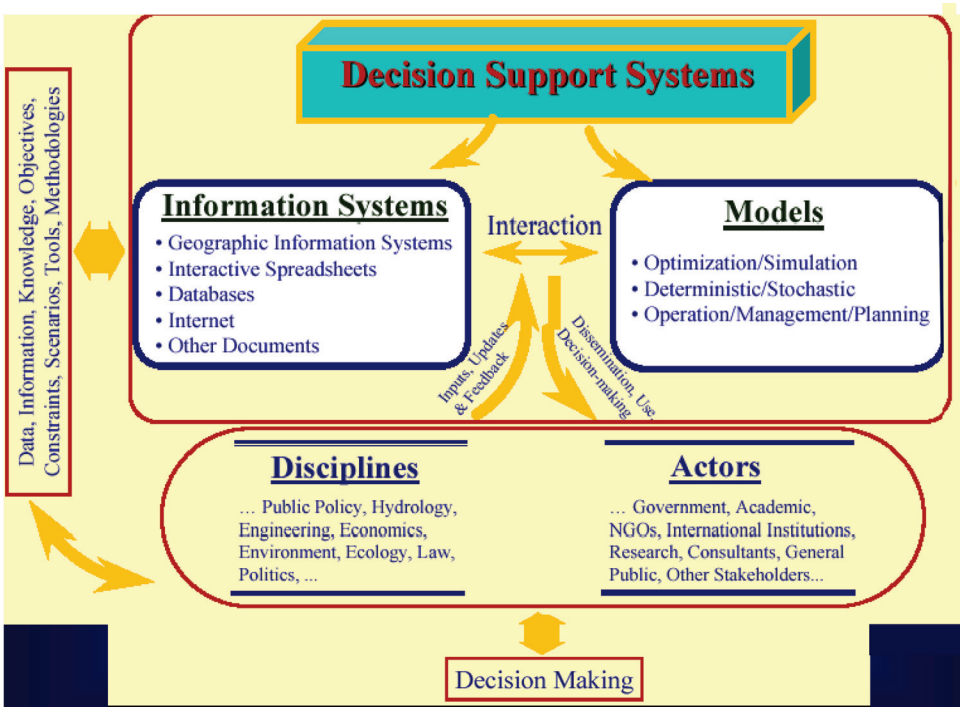
Depth and Areal Extent of flooding for T = 50 years

Recently NIH started working on development of DSS under the hydrology project for 9 peninsular states . DSS shall be developed for planning, drought management, water quality, conjenctive use and reservior operations. Activity has already been started and DSS will be developed and implement for all the 9 states in 4 years. Six central agencies IMD, CWC, CGWB are the partners. Various technologies like GPS / Modern Survey Tools , Remote Sensing, advanced Hardware, Modern Software and web based platforms will be used for developing DSS.

NIH is using DHI softwares like MYKE 11, MYKE 21, MIKE FLOOD WATCH for real time flow forecasting and HEC Geo RAS and HEC HMS software.

For the Study of flood phenomenon a combined approach considering structural and non and non-structural measures .

There is a need to develop a GIS & RS based DSS and also to improve cooperation & coordination between different organisations. GIS based models can be combined with the soft computing methods like ANN and fuzzy logic for better results and NIH is working towards the intergration of various methods for better forecasting of floods.



Key Issues and Recommendations

(a) Availability and accessibility of data on rainfall, cyclonic storms and Extreme Weather Events**:** IMD network does not cover the remote areas and average values of the meterological divisions are being taken and hence the potential for doing finer analysis at local level is not much. State government has installed rain gauges for revenue collection. NIH has carried out studies on the optimal raingauge network and the study has been carried out for nine peninsular states under the hydrology project.

Since IMD is using the data from the state governments now these stations are limited to plains. With IMDs modernisation there will be 5000 automatic telemetric weather stations covering every agroclimatic zone and every district. IMD has data on rainfall (1950-2000) and cyclonic storms and is available in both digital format as well as printed form. IMD publication Mausam gives average monthly data. Similarly disasterous weather events report also gives details of 12 hydrometerological disasters.

(b) Resolution of Data: Central Water Commission is using lumb models where they require for average areal rain fall for the catchment or subcatchment. But now CWC started generating numerical models i.e. grid based forcast and IMD will cater to the needs of CWC. Ultimate aim of IMD is to give data for 10km X 10 km grid in the near future.

(c) Climate Change factor in Modelling: Risk modeling and dam break studies have been carried out by using models for example, Myke 11 and 21 developed by Danish Hydrologic Institute, but the climate change impact is not being taken into consideration at present. Under the prime ministers action plan impact of climate change on water resources is included and NIH will also will be working with ministry of water resourses and in future the institute will include climate change aspect for modelling.

TECHNICAL SESSION 4
Tools and Methodologies to Inform Policy, Availability & Critical Gaps

This session was focused on the existing tools and methodologies to inform Policy, availability of policies including opportunities for integrating DRR and gaps. The session also highlighted required tools including strategic tools for addressing climate change and DRR and methodologies that can inform policy and decision-making at all levels.

Moderator: Prof. Santosh Kumar

Shared Learning Dialogue and DRR in the Context of Climate Change

Marcus Moench
President ISET, Colorado

The objective of the workshop is to discuss strategic tools for DRR, in the climate change context and disaster scenario. Sets of methods and approaches that have been discussed have shown more of a fragmented approach. The process of decision making around disaster and DRR tends to draw information from sectors information from IMD, CWC, and NGOs etc. Each of these organisations has their own internal processes of chasing the course of action. CWC draws on engineering practice, IMD on river flows, NIH (Roorkee) evolving natural system and so on. They are often poorly linked into decision making processes and it is still an evolving sector of data collection under different project conditions in changing environment and changing conditions of basin characteristics. It is really a challenge to integrate diverse approaches whether it is community based knowledge or information/ knowledge produced by IMD, CWC etc to inform people at multiple levels. There is an urgent need for shared learning bringing together all the efforts at one level of global scientific knowledge to move towards a qualitative process, identifying points of leverage to make something tangible and not just talking about DRR. Here is something where science comes together with community perspectives. There are costs and benefits to everything. Poverty is not the only determinant of vulnerability. While going for protective structures for flood e.g. different sets of dynamics are involved have very different types of tradeoffs. Some people gain and some are losers. People inside the embankment tend to see their vulnerability increased and

outside people tend to see reduced. Costs and benefit analysis is complex issue since there are different groups with highly uncertain conditions. Hydrology is based on historical conditions, meteorological system and what future climate might be in different conditions. Studies on these parameters are at a nascent stage. For some parts of world they are beginning to project seasonal and decadal patterns as the correlation declines difficulties in projecting. This is again where the SLD can feed into identification of strategies that much less dependence on knowledge of future. Structural approaches depend heavily on future conditions but on the other hand there are types of distributed strategies generate benefit every year and less dependent on future conditions. It is the high time to sort out those processes and what is likely to generate long returns at a higher risk and how do we evaluate those strategies. It is also important to identify the strategies to begin to put trade offs in the framework of DRR. The core thing is the question of understanding the process of give and take cross-scales; begin to understand what those tradeoffs are, the costs and benefits and to see the outcomes. It is important to identify the sets of strategies that would float to the surface, which is the value of SLD process and CBA process. CBA is generally seen as project planning tool, justifying in different forms, more of an internal benefit to the organisation or a project. Whether if the world is going to invest it is important to do a CBA based on cost and benefits of a larger community and we need to come up with tangible strategies and outputs.

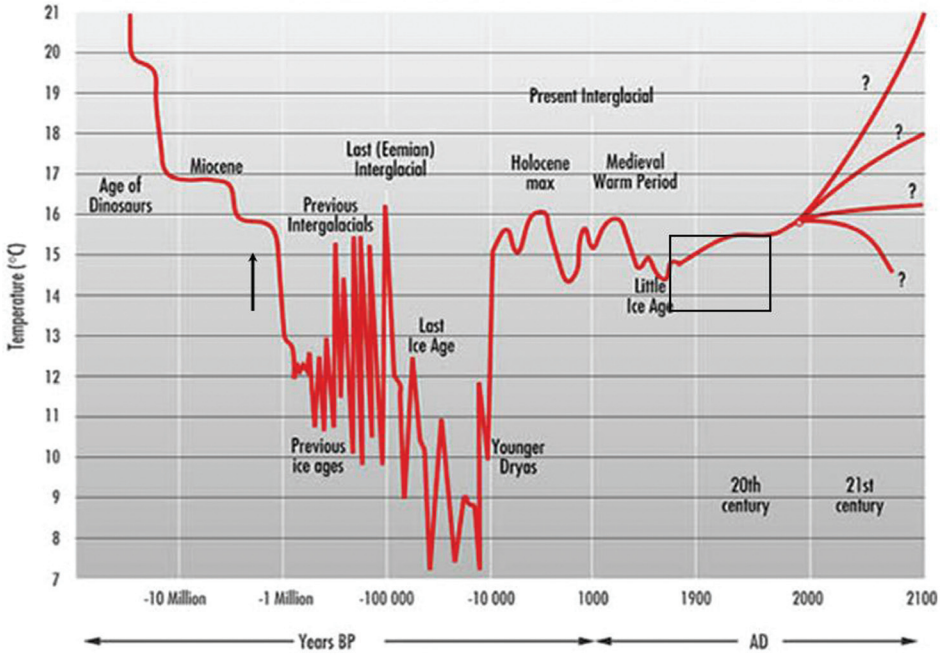
Climate Change and Disasters in India

Dr. Akhilesh Gupta

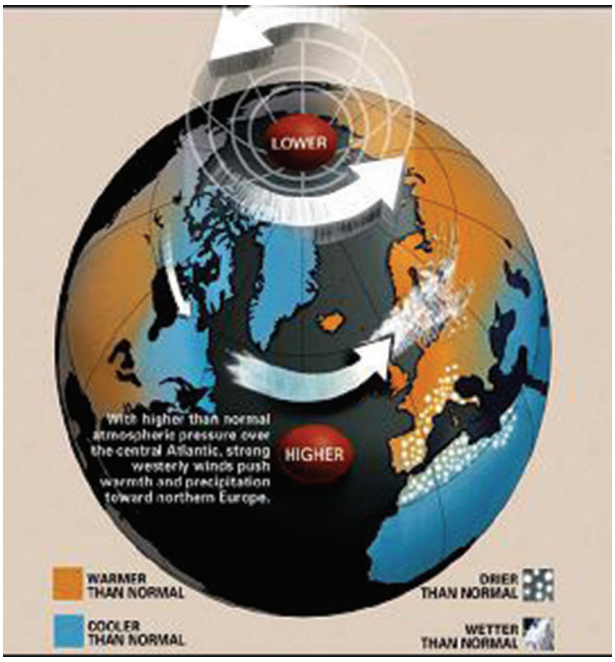
Adviser to Union Minister for Science & Technology and Minister for Earth Sciences, Government of India

Government is soon going to come up with a new Meteorological Policy for bringing out Government, Academia and Private Sector. By 2014 India Metrological Department also will be in par with any other meteorological departments in the other parts of the developing world.

Relation of climate change with the natural disasters is loud and from the message of the IPCC report. Since 1850 temperature rise of + 0.74°C and Sea level rise in 20th century 17 cm is going to have significance on the impacts of cyclones and coastal flooding. There is an increase in frequency and severity of extreme weather events. Despite several uncertainties, Climate change is a reality as a result of unprecedented increase in CO2 levels through anthropogenic emissions. Historic data clearly shows that there is a steady rise in temperature since 1900. Carbon dioxide levels are highest in last 6,50,000 years. Global average sea level has risen since 1961 at an average rate of 1.8mm/yr and since 1993 at 3.1mm/yr. There are observed changes in the sea level temperature as well.



Great Natural Disasters 1950 – 2005 (as given in CRED EMDAT) shows that there is an increase in the intensity of the natural hazards particularly the hydrometeorological disasters. There is 2-3 times increase of hydrometeorological disasters especially during the last 2-3 decades in terms of frequency and severety.



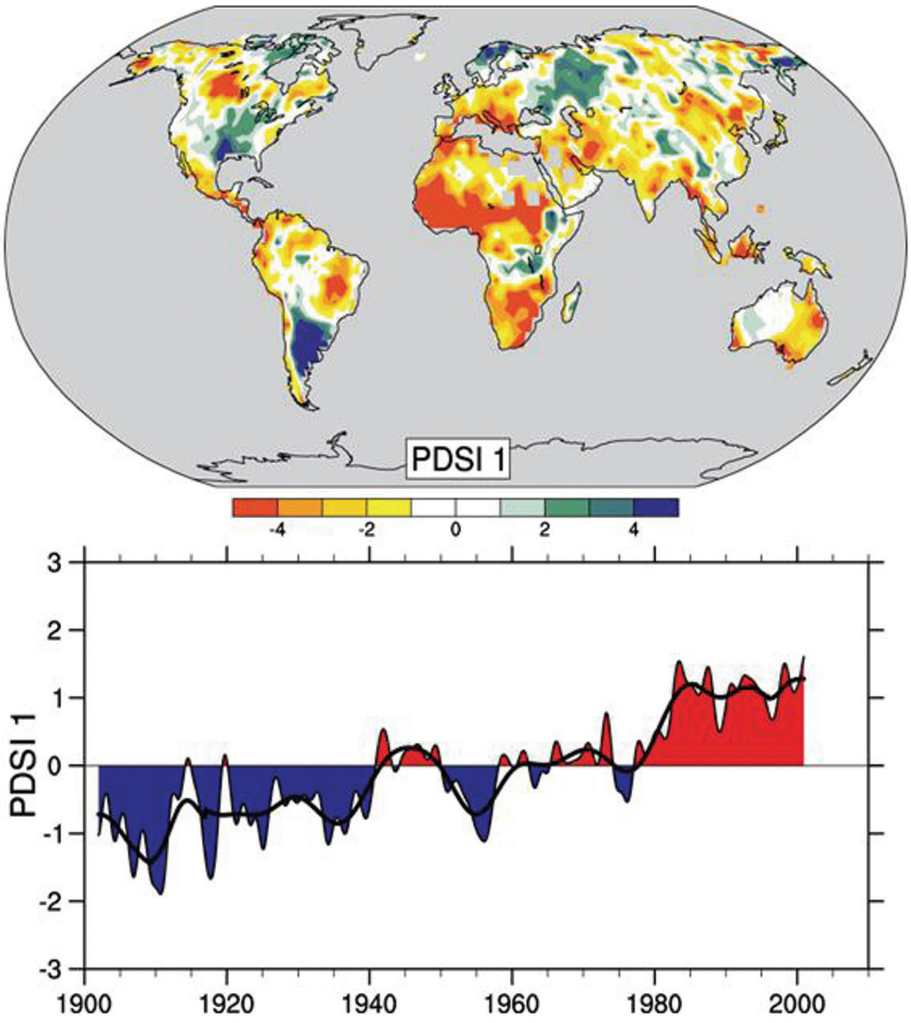
As per a report of World Water Council, there were 26 major flood disasters worldwide in the 1990s, compared to 18 in the 1980s, 8 in the 1970s, 7 in the 1960s and 6 in the 1950s. The largest number of severe floods occurred in Asia.

As per a recent studies by US scientists, worldwide, the proportion of hurricanes reaching categories 4 or 5 has risen from 20% in the 1970s to 35% in the 1990s, more impact observed in Atlantic and Pacific region although such increase for Indian region has not been that significant.

During last 50 years, cold days, cold nights and frost have become less frequent, while hot days, hot nights, and heat waves have become more frequent. While most land areas have witnessed increase in frequency of heavy precipitation events, regions like Sahel and Mediterranean have recorded long term decreasing trend in the total precipitation. India is one region where the heavy rainfall event has increased in certain pockets.

Number of windstorms were increased drastically in last three decades. Number of events increased for 150 – 350 per year during the period . Climate change is affecting storm tracks, winds and temperature patterns. Anthropogenic forcing has likely contributed. The Global Frequency of most Destructive Tropical Storms during 1980 – 2006 shows that there is an increase since the 1970s. The integrated intensity of tropical cyclones has increased.

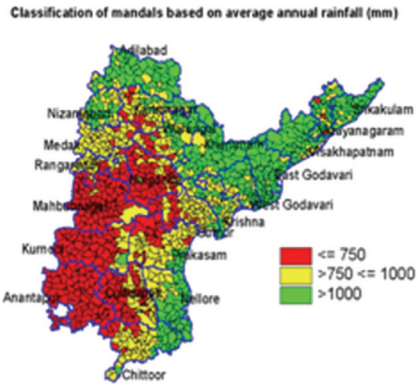
Flood Catastrophes and Droughts Globally (1980 – 2006) had shown a notable increase in terms of the frequency and severity. 1975 onwards drought events were increased drastically. The most important spatial pattern (top) of the monthly Palmer Drought Severity Index (PDSI) for 1900 to 2002 shows that droughts are also increasing . The time series (below) accounts for most of the trend in PDSI. Caused by (a) decrease in

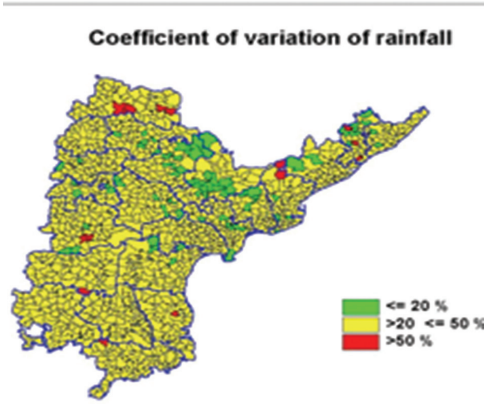


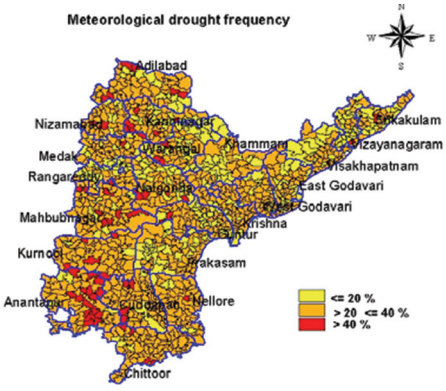
rain over land in tropics and subtropics, (b) increased atmospheric demand with warming.

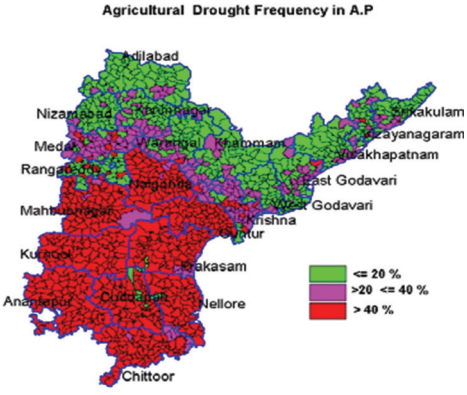
Events of Extreme Heat and Drought Globally 1980 – 2006, Heat waves are increasing: an example 2003 heat wave in Europe. Insured losses were incresed several times and 90% of the insured losses were due to wind storms.

Trends in occurrence of extreme temperature events over India in 100 years shows that until 1990 there were up and downs in temperature. Since 1990 the temperature was always above normal. There is an increase of about 0.5 degrees C as compared to global increase of 0.7 degrees C. Reasons of this is monsoons rainfall increase and NW part the temperature has decresed and hence compensated increase in other past.









The monsoon rainfall at all India level does not show any trend but there are some regional patterns of change. Areas of increasing trend in monsoon rainfall are found along the west coast, north Andhra Pradesh and north-west India, and those of decreasing trend over east Madhya Pradesh and adjoining areas, north-east India and parts of Gujarat and Kerala (-6 to -8% of normal over 100 years).

Surface air temperature for the period 1901-2000 indicates a significant warming of 0.4 degree Celcius for 100 years. The spatial distribution of temperature changes indicated a significant warming trend has been observed along the west coast, central India, and interior Peninsula and over northeast India. However, cooling trend has been observed in northwest and some parts in southern India.

Glacier melting in the Himalayas Rock Avalanches shows that Glacier Lake Outburst Flows and increasing and less water downstream in the dry season, more flooding downstream in the wet season and long-term overall reduction of water supply. Retreat of the Gangotri Glacier terminus between 1780 and 2001 shows that the glacier is receding of 7,3 m per year between 1842 and 1935; 23 m per year between 1985 and 2001. Instrumental records over the past 130 years do not show any

significant long-term trend in the frequencies of large-scale droughts or floods in the summer monsoon season.

The total frequency of cyclonic storms that form over Bay Bengal has remained almost constant over the period 1887-1997. Vulnerability mapping of areas with present and projected scenarios of climate change in relation to extreme events and developing capacities to adapt climate change in highly vulnerable regions. It is also important to increase the capability to detect and predict extreme events with greater accuracy and longer lead time. Improved communication of climate changes and options to adapt to them is the need of the time.

Drought Vulnerability at *'Mandal'* Level for Andhra Pradesh

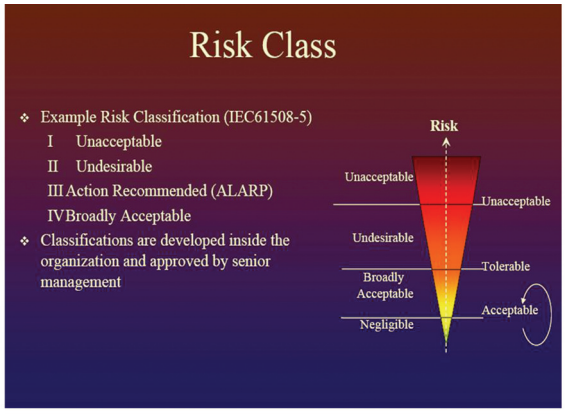
A massive programme has been launched by Ministry of Earth Sciences and all the steps towards enhancing capability to detect and predict Extreme Events. IMD's modernization plan, with an ultimate goal of detecting and predicting every single weather event in the country has already been initiated. Launching a Seamless system of Weather Observations and Prediction and District-level agro-advisory system, Outreach- launch of a 24x7 Dedicated Weather Channel and a PPP wing for addressing sectoral needs of weather and climate products/services are some of the activities. Government is soon going to come up with a new Meteorological Policy for bringing together the Government, Academia and Private Sector towards integrated efforts. By 2014 India Meteorogical Department (IMD) also will be in par with any other meteorolgial departments in the other parts of the developing world.

Despite uncertainties, climate change is more or less evident in terms of increasing extreme weather events and other eco-logical changes. Future warming and consequent climate changes are quite alarming and pose threat, especially to developing countries in terms of further increase in Extreme Events. Adaptation strategies can help minimize negative impacts. There is a need capacity building for to integrate projected Climate Change for scenario on extreme weather events into Disaster Management Plan of the country.

Policies, Strategies and Options for Disaster Risk Reduction Interventions in India

Dr. Anil K. Gupta
Associate Professor
and
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New Delhi

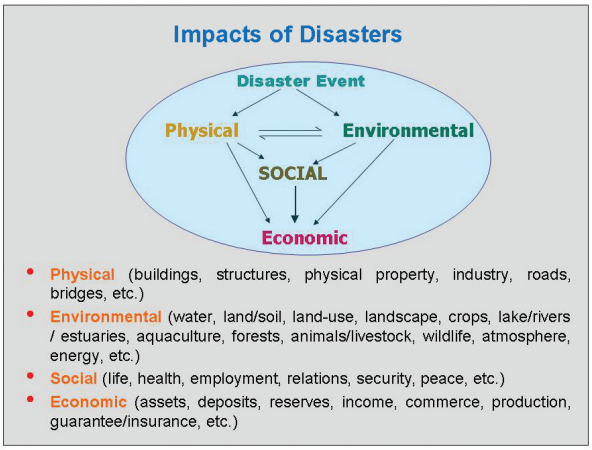
It is critically important to probe the prevailing or ongoing provisions, policies or the options for the possible ways the tools like cost-benefit analysis, planning, evaluation, etc. may be mainstreamed. Any natural event for example, rainfall – may be a heavy rainfall, may be a hazard or a resource or help at the same time given different environmental and developmental background.



Thus, the way a natural event like rainfall- heavy rainfall, floods may be a hazard or a resource as well, and it is the condition of realization by the land-use, material, community or property makes the particular scenario of hazard or disaster. If there are no floods, there wouldn't be any floodplains which are one of the most productive systems.

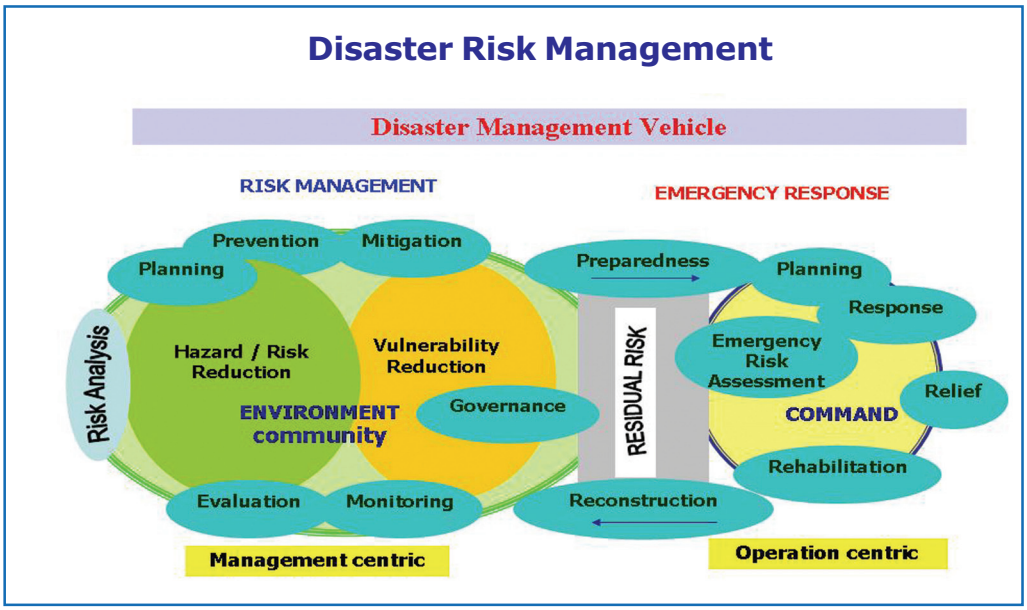
The concept of risk includes the likelihood of hazard and extent of damageability of the particular event. Combining the risk and vulnerability indicates the level of disaster risk. It is important to have a notion of risk acceptance criteria, initially been in practice for technological risks but now the concept equally in application for environmental disasters – related to water, land, earth systems, forests, etc. Interventions may be designed according to the level of risk acceptance. For example, direct interventions are needed to address the range of unacceptable risk to bring it down to acceptable range where the resilience can work. Best available technique not entailing excessive cost (BATNEEC) is an approach 'best fit' towards developing resilience. The approach of 'As Low as Reasonably Practicable (ALARP)' principles

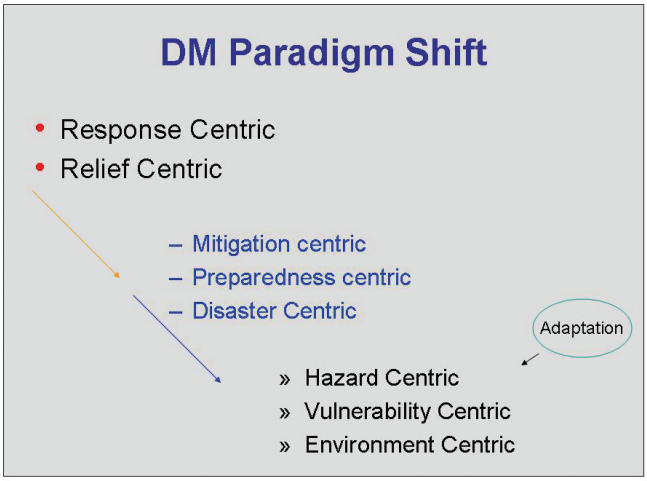
provide an understanding for the need of tools like cost-benefit analysis in screening of the alternative interventions for a set of risk. For example, the Interlinking or the Indian Rivers project was discussed and CBA can provide a decision support solution to assess its feasibility as a BATNEEC. In the disaster management cycle – the DRR zone can be identified that that has a direct bearing for the local environmental basis and community based resources.



An evolution of the disaster management cycle towards a disaster management vehicle where two wheels – disaster risk management (DRM) and emergency response (ERM) provides clarity of objectives and interventions about addressing the risk.

Distinction between the 'two' is important to understand and identify the zone of DRR interventions, as the approaches for the two are entirely different on time-scale, scope for brain-work, research, participation and command-chain-response functions. The emergency response management focuses broadly on understanding





the risks or arising an emergency, preparing with resources and written protocols with a command-chain system with very less time for response thus with little or no scope of much of brain-work. Contrarily, the DRR stage is totally the pre-disaster strategy focusing on visualizing the hazards, reducing the threats and its realization in the form of a disaster by various means-planning, mitigation, remediation, etc.

Resilience towards disaster risks incorporates interventions of – harmful event minimization and loss minimization. The approach involves projections and visualizing the hazards for knowing the hazards for which the vulnerability may be analyzed. A common understanding of the concept of vulnerability is necessary for developing a central notion. The coping capacity against the disasters also form input to the vulnerability assessment.

DRR Interventions - Routes

- **Direct : DM Act, Rules, Policy…**
  - DM Programmes – NCRM, Capacity building programme of Engineers/Architects
- **Environmental Resources:**
  - Land/soil/land-use
  - Water/water bodies, watersheds
  - Wetlands, Rivers
  - Air/atmosphere
  - Habitat/vegetation-forests, plantation, orchards, agriculture - agroforestry, aquaculture
  - Livestock, wild animals
  - Environmental supplies – water, PHE, sanitation, waste mgmt,
  - Chemicals / minerals
- **Welfare programmes**
  - Family, child, youth, sports, NREGS, RTI, ….
- **Service programmes**
  - Transport, health, communication, housing, aviation, navigation, fire, industry

The paradigm shift from 'post-disaster response and relief cenric' approach to 'pre-disaster proactive preparedness and mitigation centric' approach still focus on 'disasters' as direct concern. However, the forthcoming 2nd ***paradigm shift*** is being visualized to address the disaster risk reduction through environmental and adaptation centric approach. The environment centric approach shall address the regime where nature meets the community, and it will focus the vulnerability reduction as a major component of risk reduction. Impact assessments usually take account primarily the damages and losses to infrastructure, property and life but not the environmental resources of the people.



The indicators or vulnerability assessment like livelihood, quality of life, human development indicators, etc. and these indicators are supported by resources. These resources are supported by natural or human environmental systems like for example, soil, cropland, grazing or fodder system, bio-productivity system, aquaculture, plantation, forests, minerals, non-conventional energy, etc. that makes the first layer of vulnerability to disaster risks that further affect the socio-economic and administrative systems.

Our present disaster risk management approach is focused on 'resistance' and not exactly on 'resilience' trying to either 'avoiding' or 'developing tolerance'. However, preventive disaster management or remediation of 'hazards' and 'vulnerability' together form the 'resilience' against the risks.

Designing the DRR strategy involves the identification of the suitable and feasible measures and Cost-benefit Analysis is a key tool for decisions. Tools have been already available for project appraisal and decision making Environmental Impact Assessment (EIA) is a well known process. There are the guidelines under European Union, EPA regulations, MoEF regulations, etc. for screening of projects for site clearance, environmental clearance, feasibility, risk analysis, etc. The standard procedures have been in practice for projects funded by World Bank, Asian Development Bank, OECD, and NABARD in India for evaluating the positive and negative impacts as Decision Support System (DSS). A crucial concern of infusion of the DRR strategies in the policies and programmes of the government at various levels is the invisible mode for indirect intervention. Programmes like 'cyclone risk mitigation project', 'earthquake risk mitigation', 'drought prone area programme' are the examples of direct interventions, whereas there are numerous environmental / natural resources programmes related to water, land-use, watershed, crop diversification, agro-forestry, coastal zone, wetlands, river conservation, climate-change mitigation and adaptation, etc. that address the disaster risk and vulnerability. There are certain welfare programmes where the DRR component may be propelled in an indirect mode, for example Family, Child and Youth welfare programme, Indira Awas Yojna, Sports, Rural employment guarantee scheme, Right to Information Act, etc. Transparencies about the objectives and the type of data used shall make the tools like CBA to be more acceptable and useful.

Application of Environmental Risk Assessments (Environmental, Health Risk Analysis, Ecosystem-health modeling, Eco-audit etc.) in DRR at policy level is being talked wold-wide.

Service programmes like transportation, health, communication, education, research, housing, etc. also offer provisions for DRR interventions. Disaster communication has to be redesigned to begin with 'risk communication'. Lot of meteorological and modeled hydrological data is generated but the 'data products' including weather data is of little direct use by the stakeholders. Data products have to be presented in the form directly useful by the users and linked with the communication system. For example, the initiative of U.P. Council of Agriculture Research to provide weather related agriculture forecasts to the farmers using radio network, is an example. There is a national, state, district and local level provisions for disaster management framework as per the law. The Disaster Management Policy (draft) envisages that every Ministry or Department has to draw a disaster management plan and allocate budget. The working plan document of the Planning Commission of India (2009-2012) for "Environment and Forests" shows the budgetary allocations for various programmes related to natural resources and environment which are potential DRR interventions opportunities.

There are policies related to DRR – Environment Policy and National Statement on Conservation, Land-use policy, Agriculture policy, Climate-change statement, Map and data policy, Voluntary sector policy, Forest policy, Water policy, and programmes like NNRMS, ENVIS, JNURM, Coastal zone management, River action plans, NRCD, Wasteland Development Board, Afforestation and Ecodevelopment Board, Rainfed Area Authority, Desertification control programme, Lake conservation, etc. offer the opportunities for exploring DRR potentials and also for infusing the objective issues of disaster management.

In order to ensure the policy level screening of disaster risks, the potential application of "Strategic Environmental Assessment (SEA)" which is a well established procedure in EU, US and other developed nations for assessing the likely impacts of a policy, plan or programme. NDMA has floated an idea of Disaster Risk Assessment as a component in the EIA and appraisal process of developmental projects. Concept of "Environmental Auditing" is also being re-worked as Risk Auditing to facilitate the documented and objective assessment of DRR measures to meet the standards and goals set at various levels. There will be a critical question on the basis on budgetary allocation for disaster relief. In practice, relief has becomes a disincentive in furthering DRR functions and a driving force for increased focus on response and relief. It is therefore, suggested that the performance in DRR intervention areas to be taken into account as a plus factor in the Gadgil formula for budgetary allocations in the Planning Commission framework.

The Technical Sessions of the International Workshop ended with a formal vote of thanks by Ms. Sreeja S. Nair, Assistant Professor, NIDM to all the luminary speakers, chairpersons, partner organization and all the delegates who made the workshop a success.

KEY ISSUES AND RECOMMENDATIONS

(i) Science to Practice: Conversion of science and technology potentials to practice at various sectoral areas for example community based actions, actions of NGOs, government agencies like NIH, CWC, corporate roles, etc. so the data of historical records, real time or concurrent environmental observations and modeling based projections may be put into some kind of decision making on implementable framework of plans and projects. Central coordination of capacity development programmes by "experts" possessing interdisciplinary knowledge of 'sciences, natural resoruce management, socio-economy, prediction and forecasting tools, environmental systems and legal-political system' will help address the existing gaps. Education has to be linked directly to practice and implementaton.

(ii) Regional and local emphasis: Global and regional projections of climate related changes in delineating the risk patterns but the regional environmental changes local hydrological, vegetation and other ecological regimes are equally important for developing the risk perceptions for the region. It shall be more helpful in identifying suitable DRR interventions, mitigation alternatives and also in knowing various direct and indirect costs and the benefits of the interventions. It is also important to categorise the risks where hazard prevention or control is possible and the risk events where only vulnerability reduction and preparedness as DRR measures.

(iii) Risk Forecasting and Communication: Early warning and forecasting has to focus on risk predictions and risk communication rather than only disaster communication. Integration of the academia with the government and corporate is crucial need for better data integration and data organization. At present the academia is working in isolation, data if available is fragmented, sometimes in the non-compatible or non-usable formats. Tools like CBA may be integrated with the decisions and risk communication at early stage of disaster management that focuses on reducting hazards and vulnerability. There are many organizations working on DRR at various levels and integration of the various activities and changing the mindset is a key issue.

(iv) Policy Analysis: Various policies, plans and programmes of the government at various levels which are related to (a) economic development, (b) environment/ natural resources and social welfare, (c) need to be analysed for the potential opportunities for DRR and climate resilience related interventions. Tools of various types of impact and risk assessments, audits, evaluations, etc. may be looked for their application on disaster and climate risk issues. It is suggested that the planning guidelines for allocation of budget for developmetnal programmes may include some yardstick incentives for reducting disaster risks. Issues of special needs like gender mainstreaming, social re-structuring and livelihood have to be kept in central concern.

(v) Vulnerability framework: Vulnerability influences the level of risks and likeliness of disasters. Society and economy may get affected by direct or indirect damages and losses to life, property and environment. Services, resources and production systems of nature e.g. agriculture, water bodies, soil, horticulture, forest, animals if affected will affect the livelihood, food/nutrition and shelter/housing security of the communities. It will hamper social structure and functions finally leading to economic disruption and long-term recovery challenges. Therefore, hidden costs and benefits and the target stakeholder for such assessments have to be considered carefully.

(vi) Financial provisions: Although the DM act has passed in the year 2005 the mitigation fund has not been implemented yet. Financial provisions for DRR interventions have to be worked out with the modalities for their implementation and disbursement.

HIGH-LEVEL POLICY ROUNDTABLE SESSION

A policy round-table session was organised to conclude the workshop on "Risk to Resilience", to discuss the key messages from the deliberations and discussions during various sessions and critical implication issues for current policy and programmes that involve government, international agencies, academia, NGOs and community. Specific studies taken up by ISET and partners and working papers under the title "Risk to Resilience" were presented and discussed, besides case-experiences from various nodal Ministries/agenices involved in climatic risk management, adaptation and disaster management at different levels. The core agenda for discussion pointed on "How the tools and methodologies for evaluating DRR can be mainstreamed in the policies and programmesof Government"? The session was moderated by Mr. P.G. Dhar Chakrabarti, Executive Director, NIDM.

Following were the participants of the policy-level session:

- Mr. P. G. Dhar Chakrabarti, Executive Director, NIDM (Moderator)
- Dr. Marcus Moench, President, ISET
- Ms. Nina Minka, USAID, National coordinator, DRM
- Mr. C. Balaji Singh, Director, CARE India
- Dr. Shiraz A. Wajih, President, Gorakhpur Environmental Action Group.
- Dr. Sara Ahmed, ISET
- Dr. Janakarajan, Professor and Director, Madras Institute of Developmental Studies
- Prof. M.S. Rathore, Director, Centre for Environment & Development Studies, Jaipur
- Prof. Binayak Rath, Vice Chancellor, Utkal University, Bhubaneshwar
- Dr. Gurdeep Singh, Professor, Department of Environment Science and Engineering, Indian School of Mines, Dhanbad
- Dr. Santosh Kumar, Professor, NIDM
- Prof J.K. Garg, Dean, Environnemental Management, Indraprastha University
- Dr. Anil K. Gupta, Associate Professor, NIDM
- Ms. Sreeja S. Nair, Assistant Professor, NIDM
- Mr. Shashikant Chopde, Research Associate, ISET

Dr. Anil K. Gupta, on behalf of the organising team, provided brief background on the workshop at the beginning of the policy level round-table session aimed to

discuss the outcomes of international workshop organised by NIDM, ISET and WII India. There were certain case studies taken up by ISET and partner organisations in India, Pakistan, and Nepal. Certain other case studies as departmental or project level experiences were also presented during thematic and technical sessions. The inaugural session was addressed by Dr. S. P Sharma, Statistical Advisor, Ministry of Environment & Forests; Mr. P. G. Dhar Chakrabarti, Executive Director, NIDM; Dr. Marcus Moench, President, ISET; Dr. Anand Bose, Additional Secretary, Ministry of Agriculture. Hon'ble Member, NDMA Prof. N. Vinod Chandra Menon presided over the session and delivered the inaugural address. There were four technical sessions -

Session 1: Core concepts and challenges
Session 2: Case Studies on CBA and DRR
Session 3: Techniques for evaluating costs and benefits
Session 4: Policy and Programmes

The workshop was attended by more than 80 invited delegates including speakers from India and other countries including Pakistan and Nepal covering officials from the Central and State Governments, academia, NGOs, research and professional organisations, multi-lateral and international agencies, donors, etc.

Mr. P. G. Dhar Chakrabarti (Session Moderator): Many case studies, conceptual issues and challenges have been discussed in various sessions. The ultimate issue for policy interventions is about translating these tools and methodologies for practice at grassroot level, and decision-making or planning at various levels. Thepoint of discussion is to look for the ways for the methodologies to be incorporated in systematic ways so as to mainstream DRR into various programmes of the government.

Dr. Marcus Moench (Summary of the workshop deliberations): This session is aimed to discuss the end results of the two-day deliberations in the workshop. There are a number of sectors involved in the studies carried out and presented in the workshop. A range of actors are significant in the analysis of vulnerability and cost benefit analysis exercises. Integration of disaster risk and climate risk management and mitigation options into the policies and programmes through cost benefit analysis as a decision support tool is core issue. Discussion pointed out the ways to make the tools more useful in identifying and meeting the expectations of sectoral objectives and programmes with sets of stakeholders including communities in the region. The analysis also takes into account the impacts on livelihood, environmental resources, economy and long-term effectiveness of mitigation or risk reduction options. Institutional mechanism plays a critical role in providing a framework wherein the methodologies proposedmay support better and effective decision-making using costs & benefits as a basis of evaluating the interventions. There are methodologies required to support differentpolicy interventions, like, Share Learning Dialogues, vulnerability, quantitative and/or qualitative tools, technical

assessments, in climate risk context – climate downscaling modeling, information on environmental aspects like water resources, land and crops, input parameters for stochastic modelling, and factors in community strategies, etc. These need to fed into decision making for ensuing DRR and climate sensitivity in various projects. Common strategies for decision making involves analysis of different risk reduction measures in different contexts. For example, various contexts are based on scientific analysis, environmental analysis, technical analysis, economic analysis, social analysis, etc. There are systematic processes for identification of space of intervention where the risk may be reduced. Education is a critical area that benefits people. Thus, the integration of procedures, policy options and methodologies is an important agenda for critical intervention especially in case of climate risk management actions.

Mr. P. G. Dhar Chakrabarti: The ciritical issue is to look for resolving the challenges of 'fragmentation' at different levels. Whole lot of research and issues are directed to address the integration of various aspects into a framework that is understandable to the policy makers. There are many issues like climate risk management, adaptation, community based disaster risk reduction, etc. and the strategies of policy framework and integration of DRR can reduce the level of confusions in making decision or planning.. Lessons learnt from various kinds of case studies and documentation in the context of different geo-climatic conditions have to be analysedin relation with the present governnace framework. It needs a process for validation of such approaches and methods at micro levels. There are various kinds of climate change mitigation and adaptation schemes. The core issue is to integrate these approaches into various schemes so as to mainstream various tools like cost benefit analysis, etc. In Disaster and Climate Risk Management, there are key policy making ministries in India like Ministry of Environment & Forests, Ministry of Earth Sciences, Ministry of Agriculture, Ministry of Home Affairs, Ministry of Science & Technology, Ministry of Rural Development, besides Planning Commission (E&F), etc. which can incorporate these tools in their decision making and planning processes.

Prof. J. K. Garg: Environment, climate-change and disasters are very strongly interlinked and the programmes need various information and maps which are of common types and scales. As of now the potential of space technology for the studies related natural disasters and climate change has advanced significantly. India's satellite programme is one of the best in the world and has offered images at resolutions ranging from kilometres to few meters. Disasters impact humans and the associated environment—cyclones, forest fire, flood, drought, mining, landslide, etc. Environmental degradation exacerbates the damages and frequencies of disasters. Space technology is very effective in identifying environmental hazards that can result in disasters, monitoring and observation of affected areas and resources, damages, and also the resources to mitigate the hazards for example

fodder, water storages, shelter, etc. Space technology based studies on forest fire, coal mine fire, landslides, desertification, etc., have been providing information with broad coverage which are very important for planning and decision making. Therefore, the studies related to vulnerability at various levels and risks of climate change impacts in terms of disaster related hazards may take advantage of remote sensing techniques now available in form of multi-spectral or hyperspectral data and various associate tools including geoinformatics which will also reduce the cost and time to be spent for the studies.

Mr. P. G. Dhar Chakrabarti: Role of space technology has lot potential for providing observations and environmental data in form of imageries, etc. and is increasingly in practice. However, we are trying to focus on community based interventions and initiatives at ground level where various DRR measures are to be evaluated on the basis of costs and benefits. Presentations of RMSI on risk analysis and others on climate projections and flood risk assessment through environmental modelling exercises were there, however the social and grassroot vulnerability can not be captured by these tools and therefore we need to focus on some measures of quantitative or qualitative indicators for vulnerability mapping. Social configuration and perceptions of the people, capacities and challenges of the household is equally important to be taken into account in decisions at local levels. Issues to be considered are like structured society or fragmented societies are the examples for social vulnerability objectives.

Ms. Sara Ahmed: It is good to witness lot of in-depth discussion and deliberations on community vulnerability and cost-benefit issues in this forum. The focus of community resources or livelihood issues being integrated into disaster risk reduction in the actions of many institutions and agencies at various levels. Major key concerns are various environmental resources for example, water, sanitation, crops and food security, livelihood alternatives, gender and social-security. The institutional framework in India like NDMA, NIDM, Ministry of Environment and Forests, Agriculture, Human Resource Development are working towards integrating the issues related to livelihood, social vulnerability, disasters and climate change. This is a significant contribution. There are many other institutions in India working in relevant areas. The Centre for Environment Education, Ahmedabad is working in education sector at local level on climate change vulnerability and disaster risks and adaptation. The programmes to integrate environmental, disaster, social and adaptation issues shall be important contribution to fill the gaps in existing strategies of risk management and response to disasters at various levels for reducing the vulnerability and impacts. The case studies discussed here were also a kind of learning process which can be further replicated at various scales. Water and gender issues also need a framework of networking and communication.

Prof. J. K. Garg: To add to the need of communication and data solutions, the space technologies plays important role even at local level. Now the information and field data at micro level even 50 centimetres can be available by using remote sensing. Communication systems and facilitation using satellite is the great advantage.

Prof. Santosh Kumar: When talking of integrated framework of climate risk reduction, adaptation, risk management and environment it is difficult to draw a separation line. At the level of community vulnerability and resilience issues are already so interlinked that separating the two is rather impossible. Confusion that exists while documenting the community level adaptation or community level risk management is that the solutions are interchangeable or different. An integrated framework is needed using the tools to understand the differential dimensions of vulnerability and adaptation needs. The cost benefit analysis set of tools is important but what other tools may be supplemented to make it more effective is a question. Understanding the key benefits is important in projecting the success of a project. Capacity development has an spread-out impacts related to climate change adaptation, environmental resources, health or overall disaster risk management. The capacity building interventions may involve education, training, knowledge imparting, resources, etc. involving children, women and wide range of stakeholders. It is again a question that whether capacity building will be different for environment, climate-change, disasters or shall have to be overlapping to each other at various levels. Therefore, it is important to think of developing an integrated framework for capacity building and vulnerability reduction for addressing these issues with common objectives of sustainable development.

Prof. Gurdeep Singh: The examples of natural disasters and risks may be taken for lessons into other types of disasters also. The case of Barari mine disasters in India revealed that the knowledge of the terrain and communication systems, online monitoring etc are important in disaster risk reduction. The mine disaster risks of Kusmunda, Singrauli, related to dump collapse affecting community's water resources and flooding in the downstream villages is another example. Similar, the communication and geo-environmental awareness of the communities can help them take risk reduction measures. Thus, level of communication skills, facilities and environmental knowledge about the regional geography, etc. also influences vulnerability.

Mr. P. G. Dhar Chakrabarti: Cost-benefit analysis is a powerful tool. Let us look into the possibility of further simplifying the tool at the local level. It is a concern here that in case of natural disasters like flood, drought etc. the communities have to be made to understand their current and future risks and take mitigation measures. Disaster management is itself a new subject came into light only in last 10-15 years, with the UN-IDNDR (you meant UN-ISDR?). Earlier these so-called 'natural disasters' have been considered as an Act of God. There was indigenous knowledge to cope with disasters. However, now the community needs to be empowered to assess

their risks, identification of risk reduction measures including indigenous knowledge, mitigation and preparedness.

Dr. Marcus Moench: It is important that we take wider issues around disasters. The strategic tools are actually much broader than only cost-benefit analysis. It has Shared Learning Dialogue (SLDs), hazard analysis, climate change modelling, impact analysis, distributional issues, etc. But, the CBA has a real advantage over others because it provides tangibility to the expressions which the policy makers may be looking for, for example the Finance Ministry, etc. Tangibility is an important aspect in evaluating the alternatives on the financial grounds, in case of evaluating the projects or alternative interventions. This tangibility may be looked in national, regional or project context and also policy level implications. It is also about translating the concept of disaster risk reduction and also the climate-change adaptation in the terms of actions that actually people can take up. These may be related to community led environmental initiatives and programmes of water and livelihoods, agriculture, forestry, fuel and fodder, etc.

Ms. Sara Ahmed: Concern for the environment, climate and vulnerability is not limited to one sector. It focusses on agriculture, water, energy or health etc. Adaptation involves a multi-sectoral and multidisciplinary approach involving a number of agencies and diverse knowledge systems– adapted and indigenous. Besides this, the issues of gender sensitive resource development, differential vulnerability and therefore adaptation to climate change related disaster risks have to be considered in policy making at local levels so that DRR benefits the communities directly.

Dr. Shiraz A. Wajih: Focussing on the indigenous practices of the communities is important to deal with the risks and responses in case of disasters like floods, drought, etc. Many times community's efforts are more effective than the structural centralised interventions. However, it is important to understand the linkages of disaster risk reduction and the development and there are opportunities available at local level, for example handling the drainage situation, raising plinth height etc. Many opportunities exists for NIDM to document and disseminate the indigenous knowledge and technologies relating to flood reduction and mitigation.

Prof. Binayak Rath: The potential of educational institutes and NGOs in developing the capacities offer opportunities not only for dissemination of knowledge and skills but also in organising the society for taking up community level risk assessment—planning and organization. Examples are there when higher educational institutes, NCC and NSS cadets have carried out intensive drive for raising the awareness in masses about disaster reduction and environmental protection, and in understanding about the selection of most suitable alternatives. Awareness must focus on community capacity building and especially of the women. But, the region specific strategies have to be drawn because the common strategy can not work for different

regions for example across coastal region, hilly terrain or the river flood plains, having inherently different characteristics. There is advantage of involving educational institutions and student groups in community mobilization and empowerment related drives because they can easily obtain the confidence of the people and even the government officers also cooperate with them.

Mr. P. G. Dhar Chakrabarti: Role of economics is important in understanding the significance of tools like CBA. Cost-benefit analysis is an alternative tool besides common econometric tools. Let us look into the possibility of integrating it into a practical framework.

Prof. Binayak Rath: As far as the cost-benefit is concerned the technological or structural measures for the management of environmental hazards like flood, landslide, etc. have to be identified based on the cost-benefit analysis. The major challenge in inducting CBA is the availability of accurate and adequate data, needed for appropriate decision-making.

Dr. Marcus Moench: Analysis of indirect costs and indirect benefits has been covered under the studies which were presented in this workshop. It is really important that the availability of accurate data is a crucial issue. Therefore the process involved not only the quantitative data but also relied on qualitative assessment, shared learning dialogue and a number of other approaches.

Prof. M.S. Rathore: The organization of data and its interpretation is important but development of ground data on various environmental, social and economic components that is location and regions specific is a basic need for carrying out exercises like cost benefit analysis and planning disaster risk reduction. A separate programme for disaster reduction is not actually required but the core requirement is integration within the sectoral plan. This type of disaster risk management and climate change adaptation involved knowledge of all the components of environment and community besides policies and plans, for example economics, hydrology, remote sensing, natural resources, geography and even social perspectives like gender and livelihood issues, social structure and indigenous knowledge. Local level plans and programmes has direct relation with the ground level knowledge rather than the model based projections only, for example, the total rainfall or average rainfall may be reported to be normal by the department concerned, but the local level knowledge is very important in visualising the risks for the communities of the region. There is need for more and more involvement of research institutes and universities for cost effective research, development of basic data on various climate related environmental and geographic factors as a precursor to social vulnerability.

While talking of the various stages of decision-making on potential disaster risk reduction interventions, the first stage will be the quantification of risks,

then the cost benefit analysis of the alternatives for reducing risk. It is necessary to identify the process through which these methods may be mainstreamed in to the conventional decision-making systems and community perception of benefits.

Mr. Shashikant Chopde: The cost and benefits of DRR interventions as discussed in the workshop captures certain case studies from some small areas of India, Pakistan, Nepal. It is important to recognise that there are hidden costs and hidden benefits of these measures or projects. There is a need for developing comprehensive portfolio of DRR interventions covering various extreme events/ natural disasters, which can be further categorised based on differential mandates of various Ministries or the departments at different levels. These may be developed as climate resilient sectoral programmes. These protocols may be readily used to assess the additional costs and benefits of the projects to be evaluated. It will also provide a guiding framework for the programme of various Ministries/ departments.

Dr. Anil K. Gupta: We need to develop a framework model for development of DRR strategy with integration of tools in policy and programmes at different levels, viz. district, region, state, national, etc.. It is, therefore, necessry for us to delineate an approach document using the lessons from this workshop. Is shall include a network or matrices method for incorporating primary, secondary and tertiary level of influences/ parameters in order to holistically cover the tangible and non-tangible benefits and costs of DRR interventions. It is also imperative to take care of indirect factors which are otherwise significant in their short-term or long-term implications on development or disaster probability. Besides, environmental costs are rarely taken into account which are actually realised in terms of reduced sustainability and socio-economic costs in later stages out of analytical scope. It is important because it may become a missing link if we fail to take account of all the tangible and intangible benefits also. Sector-wise or department wise plans may be redesigned for infusion or integration of climate change adaptation issues in their own programmes and policies and also the DRR issues shall make the decisions taking actual costs and benefits in the consideration.

Prof. Santosh Kumar: In India, there are two or three mega-projects on DRR. Besides the UNDP interventions like DRM project, the World-bank intervention in Latur, and other projects in Gujarat, Orissa, wherein large scale funds have been invested in DRR related activities. The other interventions were the community based disaster risk management or community capacity building. Now, it is time to assess on how these projects have faired on costs and benefit analysis. That will help in identifying the possible ways for integrating these tools and DRR into developmental interventions.

Mr. P. G. Dhar Chakrabarti: The lessons of the case studies and the interactive sessions of this international workshop indicates the need for integrating various tools of

risk mitigation into our developmental planning and decision making process. The case studies can be taken further in different ways both at macro and micro level. The emergent issue is of partnership to further this work and NIDM would certainly take the matter forward in joint programmes with ISET, Winrock and others. The Ministries and organizations like Planning Commission are actually looking for new ideas on how to mainstream these tools. Schemes like DRM, NREGA etc throw huge challenges and opportunities for integrating DRR interventions in local level planning. I hope that the organising team of ISET, NIDM and Winrok shall work together to come up with a strategy document for furthering this agenda.

KEY POINTS FROM POLICY ROUNDTABLE

The Key findings of the policy-level round table session were recorded and are following:

(a) DRR Strategies and Options

- Policy implementation has certain challenges but the lessons of practices and case studies may be put into policy strengthening to enhance effectiveness.
- DRR needs a multi-sectoral and multi-disciplinary approach.
- Tools applicable in natural resources and environment management and developmental planning have to be collated to integrated disaster and climate risk management so as to ensure sustainability.
- Strategic interventions must be directed at various levels of government and community to address the challenges of disaster risk reduction.
- Risk management does pay demonstrated benefits as shown by case studies (Pakistan, India and Nepal cases) and these lessons must be carried forward to the new areas or follow-up projects.
- DRR is question of generational change—helps in educational context and short-term and long-term implications on resources, livelihood and risk perception of the stakeholders

(b) Evaluation and Decision Tools

- Feasibility and suitability of different DRR interventions have to be evaluated for their costs and benefits. This may target community based, structural or externality based initiatives.
- Comprehensive portfolio of DRR interventions need to be developed that get categorised by mandates of various ministries. Qualitative analysis and shared learning dialogue process can facilitate the process.
- Sector-wise analysis is needed taking account of environment & natural resource, development/ welfare activities and projects (may be taken as case studies) to identify potentials for DRR interventions.

- Analytical and decision support tools play strategic role and provide a framework for integration into policy - in the environment of inherent uncertainty in climate change projections. Tools like EIA, SEA, Auditing, and project Life-cycle Assessments, to be integrated with holistic decision and planning framework for DRR interventions with projected climatic considerations.
- Economic, social, environmental and techno-feasibility analysis feeding into decision making on resource allocation (seems an incomplete statement have to address tangible and intangible also the indirect damages/losses that affect community and their resources.
- The findings from case studies need to be refined and validated in different contexts by taking up further pilot-scale studies to systematically integrate the lessons with existing programmes of the government.

(c) Information and Knowledge

- Information and data is crucial for decision-making and understanding perceptions of risks across communities of actors. Data/ information is key input for tools and therefore, data processing and knowledge creation is a pre-requisite for assessing effectiveness and scope for refining policy interventions.
- The set of tools provide framework for data organisation and a guiding framework for creating system for collection of additional data.
- Various information sets or systems, for example environmental information systems (ENVIS, NNRDMS, State of Environment Reports), District/state statistics, Census, Land-use data, human development data, weather and events data, research yielded data, need to be integrated to support decisions.
- Data needs to be processed to generate knowledge that is acceptable by various stakeholder by feeding it into into Shared Learning Dialogue, CBA process, impact assessment, perceptions or decision making.

(d) Mainstreaming Issues

- Developing a comprehensive portfolio of DRR options (by sectors-"Ministries" and scales cutting across hard and soft) is key to contributing in a decision making or policy process.
- There are wide range of DRR options that can be used by the Ministries for intra-ministerial allocation, but as yet, perhaps, just a subset of that big set has been explored.
- The framework needs to be integrated—adding new mechanism to existing framework or infusing the DRR and climate-risk issues in the policies and programme

- Ministries have specific mandates and the key goal is to infuse DRR dimension in programmes of various ministries so as to implment them as resilient-sectoral programmes. The sets of tools can help in intra-ministerial budgetary allocations for various programmes.

The international workshop concluded with a formal vote of thanks by Dr. Anil K. Gupta.

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