

Climate Change and Disaster Management: Perspective

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The time calls for improving the planning process and implementation with adequate awareness and effective governance and safety of people and their resources are crucial components of sustainable development. A “national mission” on environment and value education as part of National Action Plan for Climate Change may be incorporated to create social and professional environment for sustainable development

Climate change has posed a major threat to developmental pace firstly due to increased frequency and intensity of hydro-meteorological hazards such as floods, droughts, heat waves, cyclones, storm surges etc. and secondly, due to degradation or alteration of ecosystems (structure, extent and services), decreased food production, reduced availability of water and negative impacts on livelihoods, etc. and thereby increasing peoples vulnerability to the impacts of natural and human-induced disasters. The challenge is particularly more serious in the developing countries like India, where agriculture and other natural resources serve as primary resource base for livelihood and economic development. Impacts of climate change related disasters were reportedly much higher than those of geophysical disasters like earthquake, volcanic eruption, landslide, etc (Figure 1).

The history of scientific awareness on global warming dates back to 1980s or even before, which was then followed by an intense socio-political awakening. I recall the first brainstorming workshop in August 1989 organised in Central India by the Environmental Science Council

I presided then, as a voice aloud alerting on increasing risk of glacial lake and other devastating floods, desertification and drought, windstorms and disease epidemics. However, scientific recognition of the causes of this increase has been poor. The Inter-governmental Panel on Climate Change (IPCC) played a key role in bringing science based realization on climate change impact on disasters.

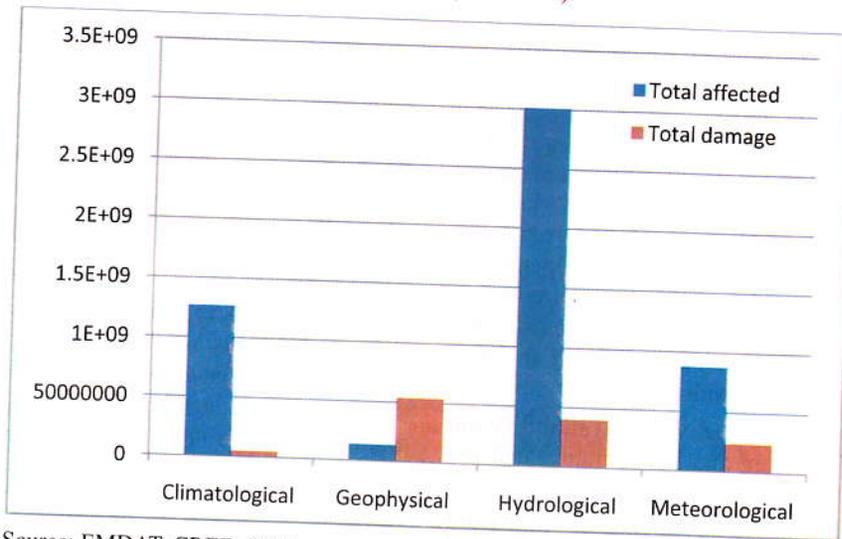
2nd Paradigm Shift in Disaster Management

IPCC's 4th Assessment Report (2007) was instrumental in bringing political recognition globally for converging climate change adaptation with disaster risk management. We termed this as 2nd paradigm shift in disaster management which focussed on three aspects: (i) addressing hazard risk, (ii) reducing vulnerability, and (iii) environmental-knowledge based approaches. The 1st shift in paradigm was from 'response and relief' to 'prevention and preparedness' centric approach in disaster management.

'Disaster management' globally is in transformation as is economics and engineering, with the realization of environmental changes. There are three aspects of environmental changes: the climate change, land use and, ecosystem alterations, known for

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Figure 1. Disasters by types (people affected, total damage '000 US\$) in Asia Pacific region (1985-2014).



Source: EMDAT, CRED, Belgium.

aggravating threats and increasing vulnerabilities. Working in field of ecology and disaster management since the period of the United Nations International Decade for Natural Disaster Reduction (IDNDR 1990-99) to the Hyogo Framework of Action (2005-15), I witnessed the initial engineering based mitigation principles moved to a broad community and socio-economic based vulnerability focused approach with emphasis on preparedness. Yokohama Strategy and Plan of Action for a Safer World adopted in the World Conference (1994) clearly “recognised the close interrelationship between disaster reduction and sustainable development”, citing the United Nations Conference on Environment and Development and the Agenda 21. However, review of the Hyogo Framework found its priority for “addressing underlying causes of disaster risk and vulnerability” as unfulfilled by nations.

Recognition of climate change impacts not only on hazards but at the same time, on vulnerabilities and risk management capacities (as explained in Table 2), brought in the subject of climate change adaptation integration with disaster risk reduction. As a clear message, we emphasized in the Bangkok Declaration and Asia-

Pacific Input Document on Post-Hyogo Framework, adopted in the 6th Asian Ministerial Conference on Disaster Risk Reduction held in Thailand in June 2014. Call for this integration clearly spells in the Sendai Framework for Disaster Risk Reduction (2015-30), an outcome of the World Conference 2015.

Vulnerability to Climatic Disasters

As shown in the Figure 1, occurrences and impacts of climate change related disasters were reportedly much higher as compared to disasters of purely geophysical origin in the Asia region. Tough talks about the implications of climate change started

with the devastating urban flooding in Mumbai followed by many Asian cities, for example, Dhaka, Islamabad, Surat, Bhopal, Bangalore, Kolkata, Delhi, Hyderabad, etc. Increasing frequency and intensity of cyclonic disasters affecting Indian coastal and sub-coastal states, other nations and islands in the region, Phailin and Hudhud for example, devastating flooding in Uttarakhand and Kashmir, intense heatwave in Maharashtra and Andhra Pradesh, spreading coverage of drought regions year by year, has made the scientific and strategic communities to come closer and work towards sustainable and safer development. Countries of Asia Pacific are mostly in different states of development or underdevelopment and therefore, suffer not only with vulnerability of the land and climate, but more intensely of their socio-economic resources. Recent floods in Thailand and Myanmar are known to have long impeding impacts on community and public infrastructure, ecosystem services and, thereby, their livelihood and economic sustenance. Ancillary effects of Nepal’s Gorakha earthquake 2015 and aftershocks triggered landslides in the hill slopes with risk aggravated by impact of climate change and ecological degradation. Shifts and spread of disease outbreaks of chikungunya, dengue, etc. are also associated with the changes in regional weather patterns and climatic regimes.

Table 1. Scenarios - A: Observed changes in temperature and precipitation extremes, including dryness in South Asia since 1950, with the period 1961-1990 used as a baseline. **B:** Projected changes in temperature and precipitation extremes, including dryness, in South Asia. The projections are for the period 2071-2100 (compared with 1961-1990) or 2080-2100 (compared with 1980-2000) and are based on GCM and RCM12 outputs run under the A2/A1B emissions scenario.

Scenario	Trends in maximum Sub-region temperature (warm and cold days)	Trends in minimum temperature (warm and cold nights)	Trends in heat waves/ warm spells and drought ¹	Trends in heavy precipitation Trends in dryness (rain, snow)	Trends in Dryness and drought
A	↑ Increase in warm days (decrease in cold days)	↑ Increase in warm nights (decrease in cold nights)	⚠ Insufficient evidence	↔ Mixed signal in India	⚠ Inconsistent signal for different studies and indices
B	↑ Likely increase in warm days (decrease in cold days)	↑ Likely increase in warm nights (decrease in cold nights)	↑ Likely more frequent and/or longer heat waves and warm spells	↔ Slight or no increase in ICPDD index ↑ More frequent and intense heavy precipitation days over parts of S. Asia	⚠ Inconsistent Change

(Source: Gupta & Nair, 2012).

An Indian reference on 'Environmental Extremes – Disaster Risk Management' for addressing climate change, released on 5th June 2012 in New Delhi, interpreted South Asia contexts from Special Report on Extreme Events and Disasters published by the Intergovernmental Panel on Climate Change (Table 1). Chapter 4 of the Report, referred that climate extremes may result in a broad range of impacts on both human and ecosystems including economic losses, impacts on different sectors such as tourism and agriculture, on urban settlements and on small island states. Extreme events have the greatest impacts on sectors that are closely linked with or dependent on the climate, for example water, agriculture and food security, forestry, health and tourism.

How Climate Change Aggravates Disasters?

Primarily, most policy interventions related to climate change were mitigation centric and based on the geophysical parameters. The focus is now shifting towards vulnerability centric approach, as was called in the "Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation,

2012" by the Inter-governmental Panel on Climate Change. The Global Assessment Report on Disaster Risk Reduction: Risk and Poverty in a Changing Climate, 2009, identified ecosystems decline as a key driver in exacerbating the natural hazards in the future. The World Bank group, through their publication entitled "Managing Climate Risk: Integrating Adaptation into World Bank Group Operations" observed in 2006, the consequences of the environmental changes in South Asia, especially affecting the poor people, include:

- decreased water availability and water quality in many arid and semiarid regions;
- an increased risk of floods and droughts in many regions;
- reduction in water regulation in mountain habitats;
- decreases in reliability of hydropower and biomass production;
- increased incidence of waterborne diseases such as malaria, dengue, and cholera;
- increased damages and deaths caused by extreme weather events;
- decreased agricultural productivity, adverse impacts on fisheries, and;

- adverse effects on many ecological systems.

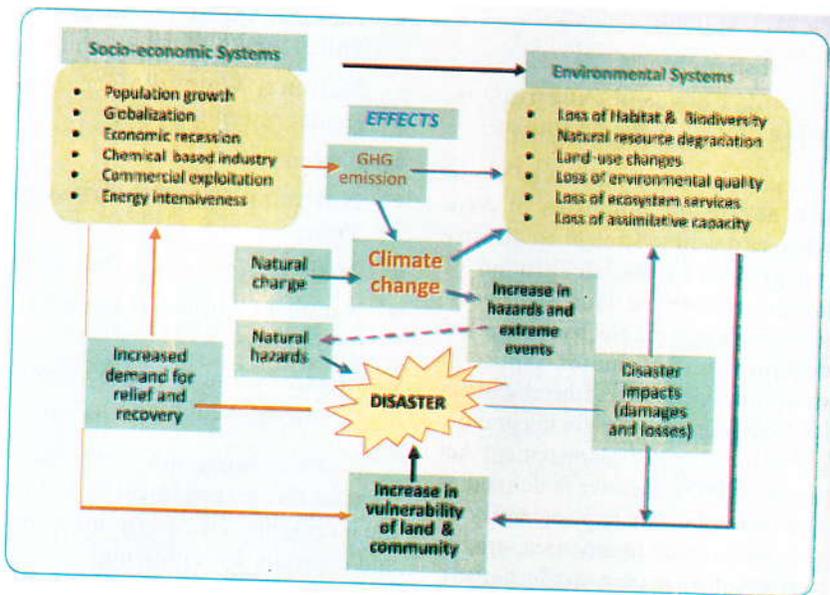
Impact of climate change on disasters need not be seen in isolation, but with other aspects of environmental changes, viz. land use changes and natural resource degradation. Increasing, unplanned or poorly planned urbanization and industrial agglomerations, and occupancies in hazardous areas like flood plains, erodible slopes, passive drainage channels in hill slopes, shift to monoculture in farming and other agriculture practices, and shift from traditionally safe housing to modern yet unsafe structures, besides lack of technology applications, make such risk being realised into disasters. A pictorial representation of this relationship is shown in Figure 2.

Climate Change Adaptation through Disaster Risk Management

Disaster risk reduction is understood to be a systematic blend of three layer objectives: addressing hazards, reducing vulnerability and increasing capacities (aimed at prevention-mitigation and effective emergency preparedness). Things may get much worse when the climate changes, as hundred-year return

Table 2: Implications of climate change effects on hazards and vulnerability for different disaster types, and their impact/relief phase					
Climate Change Impacts	Hydro-met disasters	Ecological Disasters	Chemical Disasters	Geophysical Disasters	Biological Disasters
Aggravating hazards	Flooding, Drought, Cyclone, Windstorms, Heatwave, Coldwave, etc.	Forest Fire, Mass movement/ Landslides, Coastal erosion, Invasive Species, etc.	Fire, Explosion, Toxic release, Radioactive release, etc.	Earthquakes can trigger landslides, erosion, GLOF, LLOF, etc.	Vector Borne, Water borne and allergic disease epidemics, Pandemic, etc.
Increasing vulnerability	Degraded ecosystems, Altered hydrology, Poor natural defence, Lost socio-economic resilience	Loss of moisture – increase fire weather, Green cover loss, Change in climatic niche – alien species	Shift in safety and process thresholds, Climatic stress on operability, Altered atmospheric features	Change in vegetation regime, Change in 'albedo', Glacial and ice melting, Change in drainage	Change in climatic niche – vectors / pathogens, Loss of socio-economic resilience and health resources
Disaster Impacts/ Relief Phase	Shelter, water-sanitation, waste and environmental-health issues. Effect on ecosystems and natural resources.	Soil contamination, Risk of pests and diseases, Effect on biodiversity, drainage and ecosystems	Local climatic changes, Effects on ecosystem services and community livelihoods	Landscape alterations, Effects on ecosystems, geo-systems and natural resources	Shelter, water-sanitation, waste and environmental-health issues, Loss of human capital for natural resources

Figure 2. Causative interactions of socio-economic, climate change, and disasters



- Engineering centric structural mitigation,
- Community centric preparedness based approach,
- Centralized coordination based Incident Command System (for emergency response), and
- Environment based integrated approach to disaster risk management.

Recent global emphasis of 'Ecosystem Approach to Disaster Risk Reduction (ecoDRR)' through the United Nations Partnership for Environment and Disaster Risk Reduction (PEDRR) and Ecosystem Based Adaptation (eBA) have significant overlap in their objectives and approach and, therefore, offers co-benefits in terms of livelihood resilience, food security, health resources and other ecosystem services to communities. This, in turn, strengthens their economy and reduces their vulnerability.

Legal and Institutional Framework

Climate change related disaster risk management covers all aspects including prevention, mitigation, preparedness, rehabilitation, reconstruction and recovery, and provides for:

- Establishing techno-legal and institutional framework for effective planning, implementation and finance;
- Inclusion of multi-sectoral disaster risk management concerns into process of development and disaster risk mitigation measures through schemes and projects and
- Integration of disaster risk reduction policies and planning in a holistic, participatory, inclusive and sustainable manner.

Looking at the current gaps and resultant challenges in strategic

period floods become ten-year floods; coastal storm surges are amplified by sea level rise and more frequent, powerful hurricanes; destructive tornados increase in frequency and magnitude; drought-induced wildfires become larger and more widespread; and farmers are forced to cope with unfamiliar weather regimes. Vulnerability is understood as the degree to which people, property, ecosystems, resources, and cultural, economic, and social activity is susceptible to a harmful condition or event. It refers to the inability to withstand the effects of a hostile environment. A Window of Vulnerability (WoV) is a time frame within which the defensive measures are reduced, compromised or lacking.

The term 'mitigation' refers to broad range of activities starting from prevention of a stress to tolerance, remediation and resilience of the exposed 'component' of the environment of 'socio-economy', and thereby, has a different notion in climate change remediation than in the context of disaster management.

'Adaptation' is concerned with addressing the consequences, and therefore, "Adaptation to Climate Change Impacts" as the magic theme is closest to a blend of "prevention-mitigation and preparedness" field as new paradigm in disaster management. It aims at developing a set of abilities to sustain in the given complex scenario of influences along human environment (Table 3).

"Disaster Mitigation" refers to a sum of human interventions taken for reducing the risk, minimizing impact or effects of a hazard or threatening disaster situation. Disaster mitigation may include different 'structural' and 'non-structural' interventions. While designing adaptation plans at district and local levels, therefore, a visible consideration of disaster risk mitigation concerns in all stages of planning and implementation, and in the strategic documents, is called for.

Broadly, there have been four principal approaches of dealing with disaster risk and its management, viz:

Table 3. Components of Adaptation, aimed at Disaster Risk Management:

(a) Reducing the risk of occurrence of a hazard event by:	(i) hazard prevention	(ii) mitigation or	(iii) control
(b) Reducing exposure to hazardous event:	(i) avoidance/ migration	(ii) resilience	(iii) impact control
(c) Capacity to contain:	(i) prevent damages	(ii) prevent losses	(iii) early normalcy

implementation of sustainable development objectives through climate change adaptation and disaster risks in an integrated manner, initiatives and innovations of many small countries like Myanmar, Cambodia, Philippines, Indonesia, Bangladesh, etc in the Asia Pacific region are noteworthy where disaster risk reduction issues and interventions have been integrated across sectors, governance and institutions. A suggestive national framework is drawn in Figure 3.

Regulatory provisions related to environment and its constituents natural resources; procedures and planning; and environmental services, primarily aim at environmental quality and resource management.

Sectors and their related regulatory provisions and laws related with following three segments of sustainable human development offer relevance to disaster risk management: (i) Infrastructure and industry, (ii) Environment and natural resources, and (ii) Social welfare and cultural services. Their legal provisions offer significant role in addressing hazards, reducing underlying causes of vulnerability and enhancing capacity, and thereby, relate to climate change adaptation and disaster risk

management. We have undertaken a study of different international and national environmental legislation in this regard.

Disaster Focussed Adaptation Interventions – Some Examples

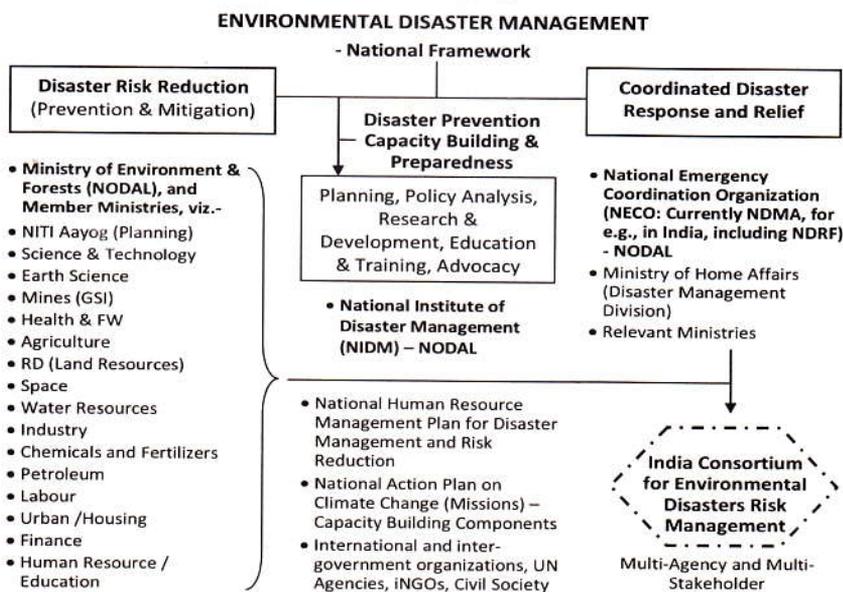
There are many initiatives world over, and in the countries of Asia Pacific as a well to strengthen disaster management in the background of changing climate and its consequences. Disaster law in India clearly recognized “environment” as major aspect in disaster management, and thereby, offers significant opportunities for integration. As per the Disaster Management Act of India (2005), disaster is defined as “a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or man-made causes, or by accident or negligence which results in substantial loss of life or human suffering or damage to, and destruction of, property or damage to, or degradation of environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected areas”. Besides the above referred legal provisions, following policy provisions in India offer significant opportunities for adaptation integration with disaster risk reduction:

- National Environment Policy 2006;
- National Disaster Management Policy 2009;
- National Water Policy 2002 (under revision 2012);
- National Forest Policy;
- National Urban Sanitation Policy;
- National Agriculture Policy;
- National Land-use Policy (draft/pending);
- Strategy on Climate change (National Action Plan);

Some specific interventions of disaster risk management to address the increasing risk of extreme events and disasters are following:

- **National Plan for Disaster Management:** It is required to be developed as per Disaster Management Act, 2005, in a holistic, consultative way with inputs from relevant Ministries/agencies and State Governments. After the Uttarakhand disaster of 2013, we undertook a rapid action to formulate the national plan under the aegis of National Executive Committee. Its components were: Hazard risk and vulnerability profile, Mitigation Plan, Response Plan and Human Resource Capacity Building Plan. We utilized this opportunity to integrate climate change issues across the entire process including into financial strategies and emergency response plan.
- **National Human Resource Plan 2012:** While drafting the plan, as a legal mandate, based on critical assessment of state of capacity building institutions and activities across sectors and different levels, resource mapping for addressing climatic risk was a key criterion. Plan envisaged roles and responsibilities to different agencies, institutions and stakeholders.

Figure 3. Suggestive National Framework for Climatic and Disaster Risk Management



- **National Guidelines for Disaster Management:** National Disaster Management Authority has developed guidelines for climate change related disasters, viz., floods, urban floods, drought, cyclone, landslides, and the provisions therein are significant adaptation options to the impact of climate change.
- **Forecasting and Early Warning:** Improving early warning is a critical requirement for effective and timely response in case of disasters. Cyclone warning has now improved and the benefits have been witnessed in managing cyclone Phailin and cyclone Hudhud. India Meteorology Department is gearing up to improve its network for monitoring and forecasting.
- **Integrating Adaptation and Disaster Resilience into District Plans:** An initiative has been undertaken to showcase the development of climate resilient and disaster risk focused departmental plans at district level, at Gorakhpur district of Uttar Pradesh. The process called as "Shared Learning" utilized climate projection downscaling and led to climate resilient disaster management plan of the district.

- **State Action Plans for Climate Change and Disaster Management:** Looking to specific challenges of coastal areas and of the local communities in dealing with impact of climate change and disaster risks, lessons of the pilot projects in Tamil Nadu and Andhra Pradesh were integrated into a framework of district disaster management plan. Process outcome was integrated in fine tuning the State Action Plan for Climate Change and the State Disaster Management Plan. Climate resilient village plans were also developed through participatory process.
- **Integration of Climate Change and Disaster Risk Reduction:** Various programmes and schemes of the government, viz. Mahatma Gandhi National Employment Guarantee Scheme, Indira Aawas Yojana, Integrated Water Development Project, Jawaharlal Nehru Urban Renewable Mission, Prime Minister Irrigation Scheme, etc. have been analyzed and their customization is delineated to integrate climate change related disaster management.

There were several field interventions of the government, community, corporate and public-

private partnership, with co-benefits of climate change adaptation and disaster risk management. Documentation of such practices is recommended to bring their lessons into policies and planning practices. A Delhi Declaration on Resilient Housing, released on 27 January 2014, called for a specific building code on flood resilient housing. The year 2015 marks special significance with new sustainable development goals and a new protocol on climate change. Implementation would require effective capacities, customised and tested tools, and policy planning mechanisms up to district and village level. An "environmental action plan" at district level has been much awaited since the enactment of Environmental Protection Act 1986. The time calls for improving the planning process and implementation with adequate awareness and effective governance and safety of people and their resources are crucial components of sustainable development. A "national mission" on environment and value education as part of National Action Plan for Climate Change may be incorporated to create social and professional environment for sustainable development. □

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India's INDC Goals-Mobilizing Finance

- To Mobilize Domestic and New & additional funds from developed countries to implement mitigation and adaptation actions in view of the resource required and the resource gap.
- USD 2.5 trillion (at 2014-15 prices) required for meeting India's climate change actions between now and 2030 as per preliminary estimates
- Ratio of emission avoided per dollar invested & economic growth attained would be relatively more favourable in case of investments made in India

India's INDC Goals - Adaptation Component

- Enhancing investments in development programmes in sectors vulnerable to climate change, particularly agriculture, water resources, Himalayan region, coastal regions, health and disaster management
- Strategies and initiatives include actions in agriculture, water, health, coastal region & islands, disaster management, protecting biodiversity and Himalayan ecosystem and securing rural livelihood.
- New missions on Health and Coastal Areas. redesigning National Water Mission & National Mission on Sustainable Agriculture
- India has set up a INR 350 Crores (USD 55.6 million) National Adaptation Fund

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