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Disaster Management & Climate Change

Indian policy frameworks and key challenges

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P. G. Dhar Chakrabarti

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Author: P.G.Dhar Chakrabarti

Editor: Malini Mehra

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Centre for Social Markets (India)
A 1 Hidden Nest,
16, Leonard Lane
Richmond Town
Bangalore 560025
Tel:+91 80 40918235
Email:info@csmworld.org

www.csmworld.org www.indiaclimateportal.org

DISASTER MANAGEMENT & CLIMATE CHANGE

India's risk management

policy frameworks and key challenges

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India's risk management policy frameworks and key challenges

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Author: P G Dhar Chakrabarti

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***Abstract**: For decades disaster management in India remained an issue of providing relief and rehabilitation assistance to people affected by natural disasters. Successive disasters and global movements for disaster reduction since the nineties have triggered a paradigm shift in disaster management leading to the creation of new legal and institutional frameworks for disaster management in India. A host of new initiatives have been taken to reduce the risks of disasters. While many of these efforts can help reduce the risks of some disasters, climate change may well enhance the risks of hydro-meteorological disasters and create new and unforeseen challenges to risk management. The Government of India has responded to these challenges by taking new policy and programme initiatives for mitigating the risks of climate change and adapting to the changing climate. This paper argues that the parallel initiatives of disaster and climate risk management are still disjointed, however, and require greater interface and integration at policy, programme and institutional levels to create synergies in approach and strategies for better risk management in India.*

1. Introduction

The hazards of nature and the vulnerabilities of social, economic and environmental conditions combine to make India one of the most disaster prone countries in the world. Close to 59 percent of India's land mass is prone to earthquakes of varying magnitudes. The average return period of potentially dangerous earthquakes with a greater than seven magnitude is once in three and half years. A sharp rise in population and unsafe building practices compound the risks of earthquakes, particularly in the urban areas. About eight percent of the geographical area of India, which is equivalent to forty million hectares, is subject to riverine and flash floods. Nearly 60 percent of the net area sown in the country is prone to droughts—half of it critically so with annual precipitation of less than 750 mm. India's long coastline, nearly eight thousand kilometers, faces regular threats of cyclones, storm surges and inundation both before and after the monsoon.

Nearly all of India's one billion-plus population is exposed to one or more forms of natural hazards. About one-third of the population is critically affected due to its location in multi-hazard prone areas.[1] Further poor economic and social conditions make these populations highly vulnerable to such hazards. According to the global database of disasters, India ranks third in the number of disaster events, second in the number of disaster victims and fifth in terms of economic damage due to natural disasters.[2]

[1] *Vulnerability Atlas of India,* Building Materials and Technology Promotion Council, 2006
[2] *Thirty Years of Natural Disasters 1974-2003: the Numbers*, Centre for Research on Epidemiology of Disasters, Leuven, Belgium, 2007

Table-1
Disasters in India: Global Comparisons 1974-2003

	Number of disaster events	Global Rank	Victims in Millions	Global Rank	Mean annual victims per 100,000	Global Rank	Damage US$ (Million)	Global Rank
India	303	3	1832.0	2	7,413.5	9	43,378	5
China	388	2	1,924.5	1	5,297.5	18	180,279	3
USA	506	1	4.6	42	58.9	124	285,923	1
Japan	128	9	6.6	32	182.1	106	187,928	2
UK	47	32	0.4	102	28.0	135	15,643	21
Brazil	112	11	49.7	8	1,195.9	68	18,443	16
South Africa	56	26	4.0	45	380.2	87	2,408	52
Bangladesh	174	6	375.1	3	12,338.5	3	17,851	17
Philippine	268	4	74.8	5	3,958.6	25	9,994	25

Source: Centre for Research on Epidemiology of Disasters, Leuven, Belgium, 2007

Average annual deaths due to natural disasters in India are around 4,500 humans and 40,000 animals. Nearly 2.5 million houses are damaged and over 1.5 million hectares of standing crops are destroyed every year. Further, damaged critical infrastructure poses serious threats to the manufacturing and marketing processes.[3] A World Bank study had pegged India's annual loss due to disasters close to 2.25 percent of GDP[4] - a colossal sum given how difficult it is to make equivalent resources available for public health or education in the country.

The plethora of natural disasters is compounded by man-made disasters of various types. Some are so regular and widely dispersed across territories -- such as road accidents, infant and maternal mortality, malnutrition, and water and air pollution -- that they do not create the sensation of sudden disruption, despite the huge loss of life entailed. Others, such as industrial accidents, fire, building collapse, stampede and serial bomb blasts, have all the ingredients of disasters and put considerable stress on normal administrative and socio-economic mechanisms. Added to these are the threats of nuclear, biological and chemical (NBC) disasters, and now the dangers of pandemics created by swine flu and threats of avian influenza.

Climate change comes on top of all this and is adding a new dimension to the risks of disasters in India. While there is evidence that the pattern, frequency or intensity of many of the known risks of disasters, such as flood, drought, cyclone, extreme temperature events etc., would change due to the impacts of climate change, many new types of disasters such as Glacial Lake Outburst Floods (GLOF) and Sea Level Rise (SLR) would further compound the risks of disasters, particularly in climate

[3] *Annual Report 2008-09,* Ministry of Home Affairs, Government of India
[4] *Financing Rapid Onset Natural Disaster Losses in India: A Risk Management Approach*, the World Bank August 2003.

sensitive zones of the deserts, mountains, islands and low lying coastal areas. The long term cumulative impacts of climate change on water, irrigation, agriculture, forests, livelihood, habitations and human and animal health etc., would be disastrous unless very serious efforts are made to mitigate the dangers of global warming beyond the threshold limits and to adapt to the climate that has already changed or would be changing in the foreseeable future.

2. Paradigm Shift in Public Policies on Disaster Management

In India, four mega disasters each claiming more than ten thousand lives - the earthquakes of Latur and Bhuj of 1993 and 2001, the super cyclone of Orissa of 1999 and the Indian Ocean Tsunami of 2004 - contributed to a gradual but consistent shift in public policy on disaster management. No longer primarily focused on relief and rehabilitation efforts, policy approaches now seek holistic management of disasters that address pre-disaster issues of prevention, mitigation and preparedness as well as post-disaster issues of response, recovery, and reconstruction.

Heralding this paradigm shift in public policy, the Tenth Five-Year Plan stated:

> The traditional perception relating to the management and mitigation of natural disasters has been limited to the idea of "calamity relief," which is seen essentially as a non-plan item of expenditure. However, the impact of major disasters cannot be mitigated by the provision of immediate relief alone, which is the primary focus of calamity relief efforts. Disasters can have devastating effects on the economy; they cause huge human and economic losses, and can significantly set back development efforts of a region or a State. With the kind of economic losses and developmental setbacks that the country has been suffering year after year, the development process needs to be sensitive towards disaster prevention and mitigation aspects. There is thus a need to look at disasters from a development perspective as well.[5]

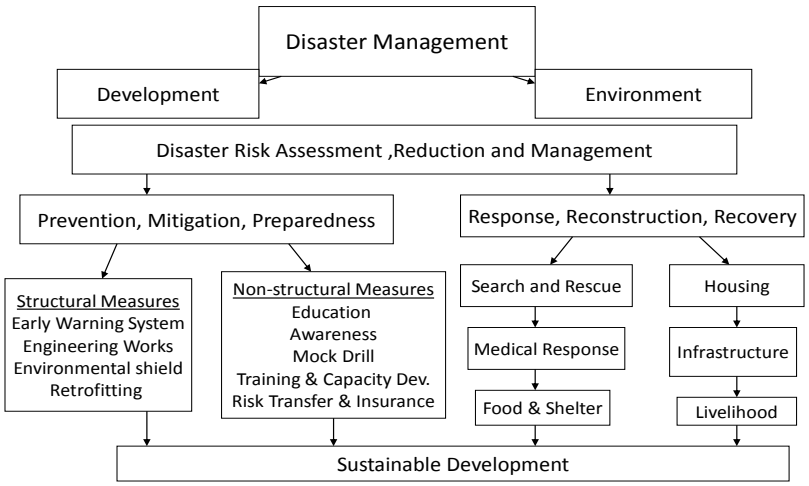
The Plan also laid down a blue-print for the future:

> The future blue-print for disaster management in India rests on the premise that in today's society while hazards, both natural or otherwise, are inevitable, the disasters that follow need not be so and the society can be prepared to cope with them effectively whenever they occur. The need of the hour is to chalk out a multi-pronged strategy for total risk management, comprising prevention, preparedness, response and recovery on the one hand, and initiate development efforts aimed towards risk reduction and mitigation, on the other. Only then can we look forward to "sustainable development."[6]

[5] Tenth Five Year Plan (2002-07) Vol -I, page –189
[6] Tenth Five Year Plan (2002-07) Vol -II, page – 202

Based on this philosophy, a holistic National Disaster Management Framework was developed highlighting the interdependence of the economy, environment and development.

National Disaster Management Framework



This framework also links the issues of poverty alleviation, capacity building, community empowerment and other structural and non-structural issues of prevention and preparedness, response and recovery for effective disaster risk mitigation and management.[7]

A National Policy on Disaster Management[8] was approved by the Union Government in November 2009. The vision of the national policy is to build a safe and disaster resilient India by developing 'a holistic, proactive, multi-disaster oriented and technology driven strategy through a culture of prevention, mitigation, preparedness and response'. The policy seeks to achieve this vision by: (i) promoting a culture of prevention, preparedness and resilience at all levels through knowledge, innovation and education; (ii) encouraging mitigation measures based on technology, traditional wisdom and environmental sustainability; (iii) mainstreaming disaster management into the developmental planning process; (iv) establishing institutional and technological frameworks to create an enabling regulatory environment and a compliance regime; (v) ensuring efficient mechanism for identification, assessment and monitoring of disaster risks; (vi) developing contemporary forecasting and early warning systems backed by responsive and fail-safe communication with information technology support; (vii) ensuring efficient response and relief with a caring approach towards the needs of the vulnerable sections of the society; (viii) undertaking reconstruction as an opportunity to build disaster resilient structures and habitat for ensuring safer living; and (ix) promoting a productive and proactive partnership with

[7] *Disaster Management in India: A Status Report,* Ministry of Home Affairs, Government of India
[8] http://ndmindia.nic.in/NPDM-101209.pdf

the media for disaster management. Various provincial governments have announced their own state-level policies on disaster management.

3. Institutional Framework for Disaster Management

After the Gujarat earthquake of 2001 the nodal responsibility of management for all natural disasters was shifted from the Ministry of Agriculture to the Ministry of Home Affairs. However the responsibility for management of drought still remains with the Ministry of Agriculture. In addition, the responsibility for management of man-made disasters vests with specialized Ministries as the following table makes clear:

Table: 2
Nodal Ministries for Various Disasters

Ministry of Home Affairs	All natural disasters except drought
Ministry of Agriculture	Drought
Ministry of Health & Family Welfare	Biological disasters
Ministry of Railways	Railway accidents
Ministry of Civil Aviation	Air accidents
Ministry of Environment & Forests	Chemical disasters
Department of Atomic Energy	Nuclear disasters

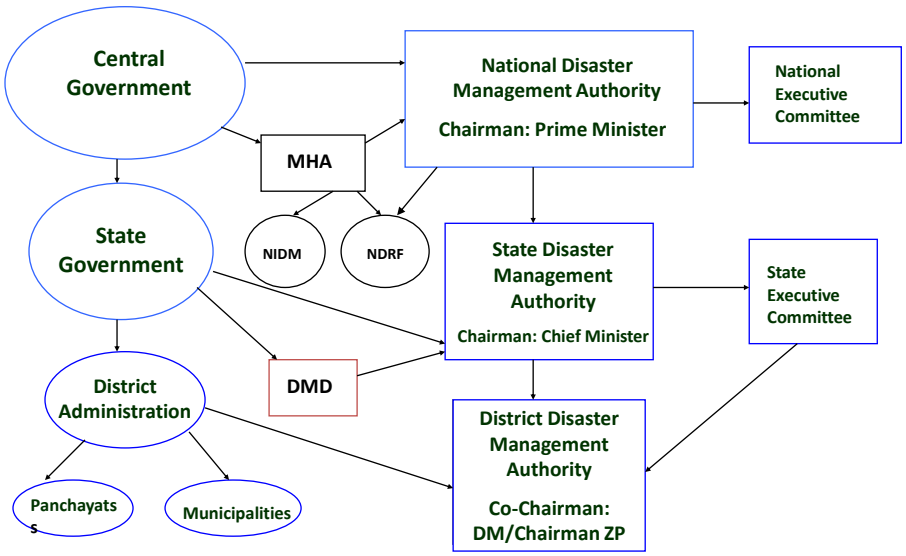
The National Crisis Management Committee (NCMC) under the Chairmanship of the Cabinet Secretary plays a coordinating role with all Central Ministries and State governments during the crucial phase of disaster response and relief, while the Central Relief Commissioner in the Ministry of Home becomes the focal point for implementation of decisions taken by the NCMC and coordinating the transition from response to early recovery.

The Disaster Management Act[9] passed by the Parliament in December 2005 has created a legal and institutional framework for disaster management in the country, supplementing the existing administrative arrangements. According to the provisions of the Act, a National Disaster Management Authority (NDMA) headed by the Prime Minister has been constituted with a Vice Chairman and eight others as Members. The NDMA is responsible for laying down policies, plans and guidelines and coordinating the enforcement and implementation for disaster management in the country.

The following diagram makes the relationships amongst the different institutions clear.

[9] *Disaster Management Act 2005,* Ministry of Law, Government of India

Institutional Framework of Disaster Management in India



Source: P.G. Dhar Chakrabarti, Emerging Framework for Disaster Management in India, 2007

A National Executive Committee (NEC), headed by the Union Home Secretary and consisting of Secretaries in charge of major departments at the national level and chief of the integrated defence staff, is to assist the NDMA in the discharge of its functions and be responsible for implementing the policies and plans of the NDMA.

At the state level, the State Disaster Management Authority (SDMA) headed by the Chief Minister of the states is responsible for laying down policies and plans for disaster management in the state and approving state plans prepared in accordance with the guidelines laid down by the NDMA. The SDMA also approves the disaster management plans prepared by state government departments and district administration, and coordinates their implementation by recommending provision of the necessary funds. The State Executive Committees (SEC) headed by the Chief Secretaries of the states is to assist the SDM and State Plan and act as the coordinating and monitoring body for disaster management in the state.

A District Disaster Management Authority (DDMA) in each district is to act as the planning, coordinating and implementing body for disaster management at the district level in accordance with the guidelines laid down by the NDMA and the SDMA. The DDMA will identify the areas vulnerable to disaster, prepare the district disaster management plan and initiate measures for the prevention of disasters and the mitigation of its effects through the state government departments at the district level and the local bodies. The DDMA will further give direction to different authorities at district level and the local bodies to take such other measures for the prevention and mitigation of disasters as may be necessary.

The Local Authorities such as the Panchayat Raj Institutions, municipalities, district board, cantonment board, town planning authority etc., are to be actively associated with disaster management closely working with the vulnerable communities. All construction projects undertaken by the local authorities are to conform to the standards and specifications laid down for disaster prevention and mitigation.

The Disaster Management Act has constituted two separate funds – the Disaster Response Fund and the Disaster Mitigation Fund – at the national, state and district levels for responding to disasters and mitigating the risks disasters.

A Standard Operating Procedure for Management of Natural Disasters has been developed by the Ministry of Home Affairs, which lays down in a comprehensive manner, the specific actions required to be taken by various Ministries, Departments and organizations of Government of India, the State Governments and the district administration for preparedness, early warning and response to natural disasters of any magnitude and dimension and for providing relief and rehabilitation assistance to the affected people[10].

4. Recent Initiatives

Considering that the paradigm shift in disaster management in India has taken place only recently, the country nevertheless managed to put in place a credible system that would provide the basis and opportunity for holistic management of disasters in the future.

The National Disaster Management Authority has issued comprehensive guidelines for the management of every major natural and man-made disaster. Based on these policies and guidelines National Plans of Action are being drafted for every sector. The focus is clearly on mitigation and preparedness. It can be expected that major public investments shall be made for mitigating the risks of disasters in different areas in the coming years. Already a National Cyclone Risk Mitigation (NCRM) project costing USD $1,600 million has been taken up with assistance from the World Bank. Similar projects for earthquake risk mitigation, school and hospital safety, and urban risk mitigation are on the anvil. Disaster risk audits have been made mandatory for each development project costing more than INR 100 million.

The utilization of advanced technology is a critical component of India's new approach to disaster management. Early-warning systems for hydro-meteorological disasters are being modernized with a network of doplar radars, automated rain gauge and weather stations to monitor rainfall and temperature and track cyclonic

[10] Standard Operating Procedure for Responding to Natural Disasters, Ministry of Home Affairs, Government of India, February 2010.

depressions. A state-of-the-art tsunami warning system has been commissioned. Flood forecasting centers have been stationed all along the major river basins to monitor the water level of rivers and reservoirs. A medium range weather forecasting system is in place for monitoring the drought situation on a weekly basis and giving advisories to farmers in the concerned regions.

The Ministry of Home Affairs has set up a National Emergency Operation Centre (EOC) that has a satellite based voice-data-communication network with triple redundancy for fail-proof communication. Similar EOCs are being set up in State capitals and district headquarters. Arrangements for emergency airlifting of mobile EOCs at disaster sites are also in place. An on-line India Disaster Resource Network (IDRN) links 565 districts to more effectively locate and coordinate public and private equipment and other material resources needed for responding to emergency situations. [11] Another on-line India Disaster Knowledge Network (IDKN) portal provides a platform for practitioners and technical institutes to share tools, formats, guidelines and other resource material necessary at various phases of the disaster management cycle.

Education and training is another important initiative for disaster management in India. The National Institute of Disaster Management (NIDM) has been established to formulate and implement a comprehensive human resource development plan on disaster management, develop training modules and undertake research and documentation work on disaster management, mainstream disaster management in education at every level, and provide assistance in national level policy formulation on disaster management. Disaster management has been included in the curriculum of middle and high schools, engineering and architectural courses and similar curricula are being developed for medicine and nursing courses.

Eight battalions of highly specialized National Disaster Management Force (NDRF) have been raised with state-of-the-art equipment to respond to any natural or man-made disasters. Four of these battalions have been trained and equipped to deal with nuclear, biological and chemical disasters while two battalions have been raised for mountain and marine search and rescue operations respectively.

A community based Disaster Risk Management Programme has been implemented in 169 multi-hazard prone districts in 17 States and Union Territories. This program trains villagers to assess their own risks in a participatory framework and develop a Village Level Disaster Management Plan (VDMP) that includes, *inter alia*, a resource map, risk and vulnerability map, shelter and evacuation map and identifies hazard specific mitigation activities. The villagers conduct mock drills to validate their plan and remain in a state of preparedness. The VDMPs are integrated horizontally with

[11] www.idrn.gov.in

block and district plans, and vertically with the sectoral plans of concerned line departments.

All these measures have reduced the loss of lives and property during and after disasters, as demonstrated during the recent devastating floods, cyclones and drought in various parts the country. The most obvious example is the Koshi flood of 2008 that affected close to three million people, but casualties were restricted to less than 300.[12]

5. Implications for Social, Political, and Security Environment

The social consequences of disasters have been fairly well documented through many case studies of post disaster situations. Disasters have been found to have disrupted the social lives of communities, but the more vulnerable sections - the poor, marginalized, women, children, disabled and the aged - have suffered the most in disasters. Various innovative schemes for mainstreaming disaster risk reduction in poverty alleviation programmes have been implemented successfully in different areas. These need to be scaled up through community-based inclusive disaster risk management programmes. The potential for micro-finance and micro-insurance in enhancing the resilience of the poor has been demonstrated in many areas. Proactive involvement of self-help groups of women in the micro credit movement have been useful in mobilizing the poor and creating awareness about the risks of disasters and their mitigation through better management of available natural resources. There are many success stories of community-based drought and flood management in high risk areas. Lessons learned from these projects should be replicated in other areas.

The political implications of catastrophic disasters are well known in many countries. The emergence of Bangladesh as an independent nation in 1971 is attributed *inter alia* to cyclone Bhola that, one year prior, had cost nearly five hundred thousand lives. In India the consecutive droughts of the mid-1960s are known to have contributed to the end of the two-decade long rule of the Congress government. The super cyclone of 1999 led to the downfall of the Giridhar Gomango government in Orissa. All of these experiences have been useful in designing systems and institutions that would ensure that disasters are managed well to neutralize disaffection among the affected population.

In this context, at a political level, post-disaster response and relief have received priority over pre-disaster prevention and mitigation - a common experience throughout the world. Again, the provinces and communities that have suffered disasters have been found to have been more proactive in preparedness. One of the

[12] www.ndmindia.nic.in

challenges of disaster management is how to transfer the experiences of suffering communities to the more complacent areas. This is a political challenge that very few leaders have been interested to take on.

Economically, disasters have been a drain on scarce national resources, not only through the damage and loss of life, livelihood and infrastructure, but also through mounting expenses on relief, rehabilitation and reconstruction. Unfortunately, there has not been adequate acknowledgement of the long-term economic consequences of disasters, leading to inadequate investments in risk reduction. As the economy grows, more and more investments, particularly in the private sector, will be exposed to the risks of disasters and, therefore, there is need to retrofit such investment by better business continuity practices. These can reduce the risk of disasters and at the same time put in place disaster contingency plans for better preparedness and response. As the BCM Survey 2009[13] indicates, there is growing awareness, but it is still not adequate to meet the need.

The implications of natural disasters for national security in the short, medium, and long term are not well documented in the context of India. Even though there is growing realization that disasters do have implications for security - not only due to the increasing involvement of the armed forces for disaster response, but also the probable role that the army has to play in catastrophic disasters in the region. Natural disasters also do not always follow national boundaries. There are many trans-border issues of disaster management that have remained unresolved and these have definite security implications. The long term security implications of climate change, on the other hand, are already on the radar of many think tanks the world over.[14]

6. Emerging Challenges

While India today is better prepared to manage disasters than ever before, the challenges of reducing the risks of and managing disasters are becoming so complex and uncertain that it is impossible to suggest that losses due to disasters will be significantly reduced in the foreseeable future. Urban growth and climate change are the two main factors that could significantly alter the disaster risk scenarios in India in the years to come. During the last census, conducted in 2001, India had 285 million people living in urban areas, almost 40 percent of whom lived in slum settlements. Every projection indicates that the urban population will rise to close to 600 million by 2021, largely due to migration of poor people from rural areas in search of employment. Never before in the history of human civilization has such a massive shift of population taken place in such a short space of time. The increased population pressure is likely to severely stress the country's already overstressed

[13] *Business Continuity Survey 2009*, NIDM and BCMI.
[14] *Security Implications of Climate Change for India,* Report of the IDSA Working Group, 2009.

urban infrastructure in terms of housing, transport, water, and sanitation, and will adversely impact the deteriorating environmental conditions of urban areas. Most of these migrants will be converging into already crowded metropolitan cities with an average density close to 16,000 people per sq. km. Compared to which one finds 1150 people per square kilometre in the USA, 4100 in the UK, 6650 in Latin America and 8200 in Africa.[15] Further densification of the cities will add to their vulnerability.

It is sheer providence that India has not faced any major urban earthquake in the past, despite the high risk of catastrophic earthquakes occurring in many of India's cities. There are thirty-five major towns with populations of more than half a million each, including the four mega cities of Delhi, Kolkata, Mumbai and Chennai, located in seismic zones III, IV and V. The combined population of these towns is more than 100 million. Various earthquake risk scenarios developed for these cities indicate huge stocks of extremely unsafe houses that would not be able to withstand moderate to heavy shocks. A major earthquake with an epicenter close to any of these cities would surely lead to loss of lives in the thousands and millions affected. The country's search, rescue, and emergency medical infrastructure are not at all equipped to deal with incidents of such magnitude.

The pressure of urban growth on city drainage systems and solid waste management are clearly visibly in every urban center of India. The recent spate of urban floods in Mumbai, Kolkata, Chennai, Hyderabad, Bangalore, Delhi and Surat have demonstrated the extreme fragility of drainage systems that are unable to withstand heavy rainfall or discharge from upstream reservoirs. Rapid urban growth will further accelerate this crisis.[16]

The urban risks are well known but there are no quick fix solutions. Such risks can only be reduced through sustained campaigns for safe houses and habitats. These require years of effort, awareness and capacity building, most particularly economic capacity of people to invest in risk reduction through safer buildings and insurance. This is going to be a long process but there are many risks that can be reduced by public investment in critical areas such as better governance and enforcement. These should remain the focus areas of government at all levels for quite some time.

7. Climate Risks and Disasters

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)[17] has collected good evidence to caution that extreme weather events and climate variability will increase the risks of natural disasters such as floods, flash floods and GLOFs, cyclones, drought, sea level rise, coastal erosion, landslides etc.,

[15] This is based on a study of urban thresholds across continents. www.demographia.com
[16] *Urban Floods in India,* Forthcoming publication of National Institute of Disaster Management
[17] Intergovernmental Panel on Climate Change, Climate Change 2007 (www.ipcc.ch)

and their impacts would be felt more severely in South Asia. A new global ranking, calculating the vulnerability of 170 countries to the impacts of climate change over the next 30 years, identifies Bangladesh and India as the two countries facing the greatest risks to their populations, ecosystems and business environments, whilst Nepal, Afghanistan and Pakistan also feature in the highest risk category.[18]

IPCC Projections of Climate Risks in South Asia

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) 2007 indicates that climate change is likely to alter risk patterns in several ways:

- Increase the frequency and intensity, reduce the predictability and change the spatial distribution of extreme climatic hazards, such as temperature extremes, storms, floods and droughts. As the water cycle becomes more intense, many climate-related hazards will become more severe, including floods, droughts, heat waves, wild land fires and storms with a range of effects in different regions. Some impacts will occur in regions with no history of a given hazard.
- Increase the vulnerability of particular social groups and economic sectors, as existing vulnerabilities are compounded by climate change-related processes, such as sea level rise, glacier melt and ecosystem stress. The increase in vulnerability in regions dependent on subsistence agriculture may be particularly drastic, due to food and water shortages, in Small Island developing states and coastal zones due to sea level rise and in regions depending on water from glacier melt for agriculture and human consumption.
- Climate change will alter patterns of climatic hazard as well as increase physical, social and economic vulnerability in many regions. At the same time, other processes that drive disaster risk, such as urbanization and environmental degradation, will contribute to an increased exposure and vulnerability to climate hazard. The increasing concentration of population and economic activities in flood and cyclone-prone coastal areas is such an example, which, when combined with stronger and more frequent floods and cyclones, will magnify the risk associated with climate change.

Source: IPCC, UNFCCC 2007

[18] Maplecroft: 'South Asia most at risk from climate change, Scandinavia safest', October 2010, http://www.maplecroft.com/about/news/ccvi.html

Flood

Erratic rainfall behaviour characterized by fewer number of rainy days but heavy precipitation events is projected to become more frequent. Heavily populated urban areas, river basins and mega-deltas will be at increased risk of flooding. Increased flooding events, exceeding historical parameters, are likely to affect areas without developed early warning, preparedness and response systems, resulting in displacement and deaths of large populations, damage to housing and infrastructure, dislocation of communication systems and loss of economic production in and outside farming systems.

The 2005 floods in Mumbai demonstrated how in a single day rain could exceed the collective rainfall of the season and offset every projection. More recently, Pakistan, Nepal, India, and Bangladesh have been hit by the worst flooding in living memory, affecting more than 70 million people. The incidence of floods in newer areas such as the arid region of western India and North Western Pakistan, and droughts in flood-prone basins of eastern India, reflect the changing face of disaster risks expanding their areas of influences to regions not known as vulnerable before.

GLOFs

The Himalayan mountain range contains the world's largest glacial reserves outside of the Polar Regions. There is now conclusive evidence that many of the glaciers in the Himalayas are melting fast, resulting in increased incidences of flash floods and landslides in mountainous settlements. A significant increase in the size and volume of glacial lakes and the formation of new lakes have also made many regions in the Himalayas more prone to Glacier Lake Outburst Flooding (GLOF). The Hindu Kush-Himalayan region has suffered several GLOF events some of which have trans-national impacts[19]. This phenomenon is likely to increase the risks of flooding in many river systems of the mountains, including rock avalanches from destabilized slopes, overflow floods and natural dam rupture.

[19] Impact of Climate Change on Himalayan Glaciers and Glacial Lakes, ICIMOD-UNEP Report 2007

Himalayan Glaciers Retreat Documented in various Scientific Publications

- Siachan and Pindari Glaciers retreated at the rate of 31.5 and 23.5m per year respectively.
- Gangotri retreated 23 m per year between 1985 to 2001. The total of 2 km retreat of Gangotri Glacier is shown.
- Retreat of Chhota Shigri glacier in India is 800 m between 1988 and 2003. Areal extent of 466 glaciers in Himachal Pradesh, covering three highly glaciarized basins of Chenab, Parbati and Baspa from 2077 sq. km in 1962 and 1628 sq. km in 2001-04, gives rapid glacial retreat of about 21% deglaciation.
- Amount of retreat varies from glacier to glacier and from basin to basin, depending on parameters such as maximum thickness, mass balance and rate of melting at

Cyclone

In the past 270 years, 20 out of the 23 major cyclone disasters, resulting in a loss of life of 10,000 or more people, have occurred in India and Bangladesh. Warmer seas, measured as temperatures in excess of 26^{o}–27^{o}C to a depth of 60 metres with abundant water vapour in the overlying air (through evaporation), are likely to increase the frequency and intensity of tropical and extra-tropical cyclones. As depicted in Table 3 below, during the past three decades the number of tropical cyclones of Category 4 and above has increased sharply from 8% to 25% in the North Indian Ocean and 18% to 34% in South Indian Ocean basins – the largest among the ocean basins of the world. This is likely to intensify hazard exposure in existing cyclone hotspots which are already densely populated with a range of economic activities that would face the risk of damage.

Table 3
Change in Number and Percentage of Hurricane/Cyclone

Category 4 (wind speed – 210 to 250 km/hr) to 5 (wind speed 250 km/hr and above)

	1975-1989		**1990-2004**	
Basin	Number	Percentage	Number	Percentage
East Pacific Ocean	36	25%	49	36%
West Pacific Ocean	85	25%	118	41%
North Atlantic	16	20%	25	25%
South West Pacific	10	12%	22	28%
North Indian	1	8%	7	25%
South Indian	23	18%	50	34%

Source: PJ Webster et al (2005), Science, 16 Septembre 2005, Vol 309.

At the same time, higher sea temperatures may alter cyclone tracks, exposing new areas and population to risks and creating newer hotspots of tropical storms[20]. Storm surges are a catastrophic feature of cyclones. The degree of disaster potential depends on the storm surge amplitude at the time of landfall, characteristics of coast, phases of tides and the vulnerability of the area and community. The tropical cyclones of specified intensity in the Bay of Bengal (striking the east coast of India and Bangladesh), usually produce higher storm surges compared to elsewhere in the world because of the special nature of the coastline, shallow coastal ocean bottom topography and characteristics of tide. Their coastal impact is very large in the region because of low and flat coastal terrain, high population density, low awareness of the community, inadequate response and preparedness and absence of hedging mechanisms. With an expected increase in intensity as well as frequency of tropical cyclones in the Indian Ocean, the devastating potential of storm surges is likely be on the rise.

Drought

The IPCC Fourth Assessment Report suggests that the average temperature would continue rising resulting in ever drier conditions in our region. Total rainfall amounts may increase in some parts of the region, but variability is likely to increase further. As a result, droughts will become more frequent and intense, while rainfall will be concentrated in shorter and more intense duration. In arid, dry semi-arid and moist semi-arid regions, delayed and reduced precipitation owing to the El Nino and South Oscillation (ENSO) phenomenon, climate change and other local conditions are expected to exacerbate the growing water shortage faced by poor inhabitants of the region. Further, with climate change, the areas suitable for agriculture, the length of growing seasons and yield potential, particularly along the margins of semi-arid and arid areas, are expected to decrease, leading to drought like conditions in larger areas particularly in Afghanistan and parts of Pakistan and India.

The impacts of climate change will not remain limited to disasters which would be the extreme flash points. These will be felt much more widespread both in space and time, which would adversely affect the natural resource base and ecosystems, creating serious problems of water and food scarcity, livelihood, sea level rise and displacement of population with consequential social inequity and unrest.

Water Scarcity

The overall impact of climate change is expected to be a depletion of surface and ground water resources, creating conditions of water famine in many parts of India. Glacial melt in the Himalayas will in the long run reduce the net flow of water through the perennial rivers which will stress the multi-purpose hydel projects and irrigation

[20] Disaster Risk Reduction – Global Overview 2007, United Nations www.unisdr.org

systems and also disturb the natural recharge of ground water. Fewer rainy days combined with extreme Summer and Winter would also drastically reduce the surface runoff, especially in arid and semi-arid areas, increasing the expanse of drought-like conditions in many parts of the region.

Due to the higher contribution of snowmelt runoff in the western Himalayas as compared to the east, any intensification of monsoon is likely to contribute to more flooding in the western Himalayan catchments, as compared to the east, reversing trends of the past. Further, an increase in surface runoff during the Autumn and a decrease during Spring are projected in the highland regions of South Asia creating water scarcity in the sowing season. In addition, an increase in surface temperature will contribute to a rise in the snowline, which in effect would reduce the capacity of the natural reservoir. This situation will increase the risk of flood in north India during the wet season[21].

Food Scarcity

Over the past few decades, the production of major cereals, rice, corn and wheat has declined in many parts of the region due to increasing water stress arising partly from increasing temperature during the critical stages of crop growth, a reduction in the number of rainy days, etc.[22]. In a study by the International Rice Research Institute, the yield of rice was observed to decrease by 10% for every 1°C rise in the growing-season minimum temperature[23]. Further, crop simulation modeling studies based on future climate change scenarios indicate that substantial losses are likely in rainfed wheat and the drop in yields in non-irrigated wheat and rice will be significant for a temperature increase greater than 2.5 ^{o}C, incurring a loss in farm level net revenue of between 9% and 25%. The net cereal production in South Asian countries is projected to decline at least between 4 to 10% by the end of this century under the most conservative climate change scenario[24]. Rainfed crops could face water-related challenges in coming decades due to increases in water demands and soil-moisture deficit associated with projected decline in precipitation. Climate change could make it more difficult to enhance agricultural production to meet growing food demands in the region.

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[21] P Singh 1998: Effect of global warming on the streamflow of high-altitude Spiti River. In: Ecohydrology of High Mountain Areas [Chalise, S.R., A. Herrmann, N.R. Khanal, H. Lang, L. Molnar, and A.P. Pokhrel (ed.)]. International Centre for Integrated Mountain Development, Kathmandu, Nepal, pp. 103–114.

22 Agarwal, P. K., S.K. Bandyopadhyay, H. Pathak, N. Kalra, S. Chander and S. Kumar, 2000: Analysis of yield trends of the rice-wheat system in north-western India, Outlook on Agriculture, 29(4), 259-268 [Asia, agriculture]

23 8 Peng, S., J. Huang, J.E.Sheehy, R.E. Laza, R.M. Visperas, X.Zhong, G.S. Centeno, G.S. Khush and K.G. Cassman, 2004: Rice yields decline with higher night temperature from global warming, Proc. Nat'l Acad. Sci. (PNAS), Vol. 101, No. 27, 9971-9975

24 Kumar, K.S. and J. Parikh, 1998: Climate Change Impacts on Indian Agriculture: Results from a Crop Modeling Approach, In Dinar and others, eds. Measuring the Impacts of Climate Change on Indian agriculture, World Bank Technical Paper No. 402. Washington, DC: World Bank.

Further, the impact of climate change on marine fisheries depends on the complex food chains in the surrounding oceans which are likely to be disturbed by climate change. Future changes in ocean currents, sea level, sea water temperature, salinity, wind speed and direction, strength of upwelling, mixing layer thickness and predator response to climate change have the potential to substantially alter fish breeding habitats and food supply for fish and ultimately the abundance of fish populations in the coastal regions of South Asia[25]. Potential decline as well as uncertainty in climate sensitive agricultural and fishery production will have a profound impact on the region, already home to the world's largest number of poor, under-insured and malnourished people.

Sea Level Rise

India with a long coastline of 8,000 km and high population density along most of the coast is highly prone to oceanogenic hazards. Climate change may make many of these coastal areas extremely vulnerable to disasters. Over the past 100 years or so, the rise in sea level has been around 2 mm per year. Over the next 100 years, the IPCC estimates that the sea level rise rate could increase significantly up to around 10 mm per year. The deltaic regions of West Bengal and low lying coasts of Krishna-Godavari basins, besides the islands of Andaman & Nicobar and Lakshadweep islands are going to be the most vulnerable to sea-level rise, affecting the lives of millions of people who are already affected by storm surges, tsunami, water logging etc. Sea level rise would further enhance the risk of flooding and storm damage, precipitate salination of surface and ground waters and affect coastal tourism among other effects.

Migration

The socio-economic impacts of water and food scarcity and sea level rise would be far-reaching as people from the low lying coastal areas, and areas affected by acute water scarcity, would be forced to migrate in large numbers in search of new habitats and livelihoods which would create new social tensions in already dense settlements of the region. It is feared that more than 100 million people from India may become ecological refugees, which would upset established social, ethnic and political balances among affected groups and states and create new grounds for social tensions and conflict in the region and sub-region.

Health

Climate change is likely to have wide-ranging but mostly adverse effects on human

25 FAO (Food and Agriculture Organization), 2003: "World agriculture: towards 2015/2030 – An FAO Perspective", Bruinsma (ed.), FAO, Rome and Earthscan, London

health. Increases in mortality from heat waves compounded by more severe urban air pollution are indicated in the IPCC's Fourth Assessment Report. Increases in infectious diseases, such as malaria and schistosomiasis, are expected to be driven by the geographical spread of conducive climactic conditions and changes in the lifecycle of disease vectors and infectious organisms. Vector-borne diseases are a major cause of illness and death in South Asian countries. Climate is an important determinant of the spread of vector-borne diseases, affecting the distribution of the disease-carrying insects as well as the infectiousness of the disease itself. The IPCC concludes that increased warmth and moisture is likely to enhance transmission of these diseases. The increased prevalence of disease vectors will also contribute to greater human vulnerability, compounding the above causes. All of these increases in vulnerability may result in a reversal of the trend towards reducing mortality risks for climatic hazards.

Biodiversity

With the climate impact, the present distribution of species in high-elevation ecosystems is projected to shift to higher elevations. There is growing concern that climate change may accelerate the damage to freshwater ecosystems such as lakes, marshes, and rivers, besides altering the boundaries of forest types and areas, primary productivity, species populations and migration, the occurrence of pests and diseases, and forest regeneration.

Further, there are complex inter-relationships and feedbacks between human driving forces and impacts on the one hand, and climate- and sea level-induced changes and effects on the other. At the interface between ocean and terrestrial resources, coastal ecosystems undergo stress from competing multi-usage demands, while having to retain their functional diversity and resilience in the face of global environmental change. Temperature increases could also adversely affect local flora and fauna of coastal areas, coral reefs, mangroves, as well as the biological equilibrium of marine life[26].

8. Policy Framework for Climate Risk Management

Recognising the likely adverse impacts of climate change on India's precipitation patterns as well as ecosystems, agricultural potential, forests, water resources, coastal and marine resources, in addition to an increase in the range of several disease vectors, the National Environment Policy (2006) acknowledges that large-scale investment would be required for adaptation measures if catastrophic human

[26] Church, J., J. M. Gregory, P. Huybrechts, M. Kuhn, K. Lambeck, M. T. Nhuan, D. Qin, and P. L. Woodworth, 2001, Changes in sea level, in Climate Change 2001: The Scientific Basis, Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change, edited by J. T. Houghton et al., pp. 639–693, Cambridge Univ. Press, New York

misery is to be avoided. The Policy outlined the 'essential elements of India's response to climate change' as:

a) Adherence to the principle of common but differentiated responsibilities and respective capabilities of different countries in respect of both mitigation of GHGs, and adaptation measures.
b) Reliance on multilateral approaches, as opposed to bilateral or plurilateral or unilateral measures.
c) Equal per-capita entitlements of global environmental resources to all countries.
d) Over-riding priority of the right to development.
e) Identify key vulnerabilities of India to climate change, in particular impacts on water resources, forests, coastal areas, agriculture, and health.
f) Assess the need for adaptation to future climate change, and the scope for incorporating these in relevant programmes, including watershed management, coastal zone planning and regulation, forestry management, agricultural technologies and practices, and health programmes.
g) Encourage Indian Industry to participate in the Clean Development Mechanism (CDM) through capacity building for identifying and preparing CDM projects, including in the financial sector.
h) Participate in voluntary partnerships with other countries both developed and developing, to address the challenges of sustainable development and climate change, consistent with the provisions of the UN Framework Convention on Climate Change.

The focus of the Policy was therefore on the global climate change negotiations and on mitigation of climate change. The Policy had very little to offer at the country level in terms of climate risk management, except to highlight the need to identify the vulnerabilities of India to climate change and assessing the needs for adaptation to future climate change.

Such an academic exercise had been done in India's Initial National Communications to the United Nations which devoted one chapter on climate projections at the national and regional levels. It also analysed the impacts of projected climate change on water resources, agriculture, forestry, natural ecosystems, coastal zones, health, energy and infrastructure and analysed adaptation options and strategies available for the country[27].

Recognizing that India's disaster vulnerability is closely linked to climate change, there are several on-going centrally funded schemes under implementation for mitigation of weather-related risks viz., flood control and drought proofing, cyclone

[27] India's Initial National Communications to the United Nations Framework Convention on Climate Change, Ministry of Environment and Forests, 2004

warning and shelters, malaria eradiation, developing crop varieties resistant to weather related risks; integrated coastal zone management etc. The National Food Security Mission and National Rainfed Areas Development Authority have been taken up by two separate Ministries of the Government and have strong climate adaptation elements. Similarly, there are ongoing efforts on conservation of Himalayan glaciers taking into account the climate change issues.

India has also taken up several initiatives at the national level which are inherently supportive of sustainability and clean development. For example, increased use of CNG for public transport, metro rail in many cities, and the bio-diesel programme (including mandatory blending of ethanol in petrol) are just some of the initiatives related to mitigation as well as adaptation. Further, India has launched the Green India project, the world's largest afforestation project covering six million hectares of degraded forest land. Overall, the efforts have been targeted to enhance natural endowments, ensure environment protection and ecological fragility, while addressing the fundamental issues such as food security and poverty alleviation. A study based on the expenditure incurred by the central government during 2006-07 indicated that the Government of India was spending no less than 12 percent of its annual budget or 2.63 percent of the GDP on adaptation programmes, which was more than India's annual defense expenditure[28].

With the objective of consolidating India's current initiatives on climate change mitigation and adaptation, and giving them a new direction, enhancement of scope and effectiveness and accelerated implementation with time-bound plans, a National Action Plan on Climate Change (NAPCC) was launched on 30 Jun 2008, laying down the priorities and future actions on addressing climate change. The NAPCC set out eight national missions focusing on both GHG mitigation as well as adaptation:n the solar mission, enhanced energy efficiency, water, sustainable habitat, Himalayan eco-system, agriculture, green-India and strategic knowledge for climate change[29]. Each of these missions is developing a comprehensive plan of action to harmonize activities in the respective sectors.

The NAPCC did not have a separate mission on climate risk management. Its inherent approach appeared to be to mainstream risk management across all sectors. But this approach is not very clearly evident from the mission action plans that have been approved so far. The technical document attached with the NAPCC identified two main planks of mainstreaming - infra-structural project design and strengthening communication networks and disaster management facilities at all levels. It was felt that as a planned adaptation strategy, reducing risks from natural disasters needs to be a part of all infrastructure project design, especially in areas vulnerable to extreme events, as it is generally much cheaper to

[28] Prodipto Ghosh, Climate Change: Is India a Solution to the Problem or a Problem to the Solution? In *Climate Change: Perspectives from India*, UNDP India, November 2009
[29] Prime Minister's Council on Climate Change, National Action Plan on Climate Change, 2008

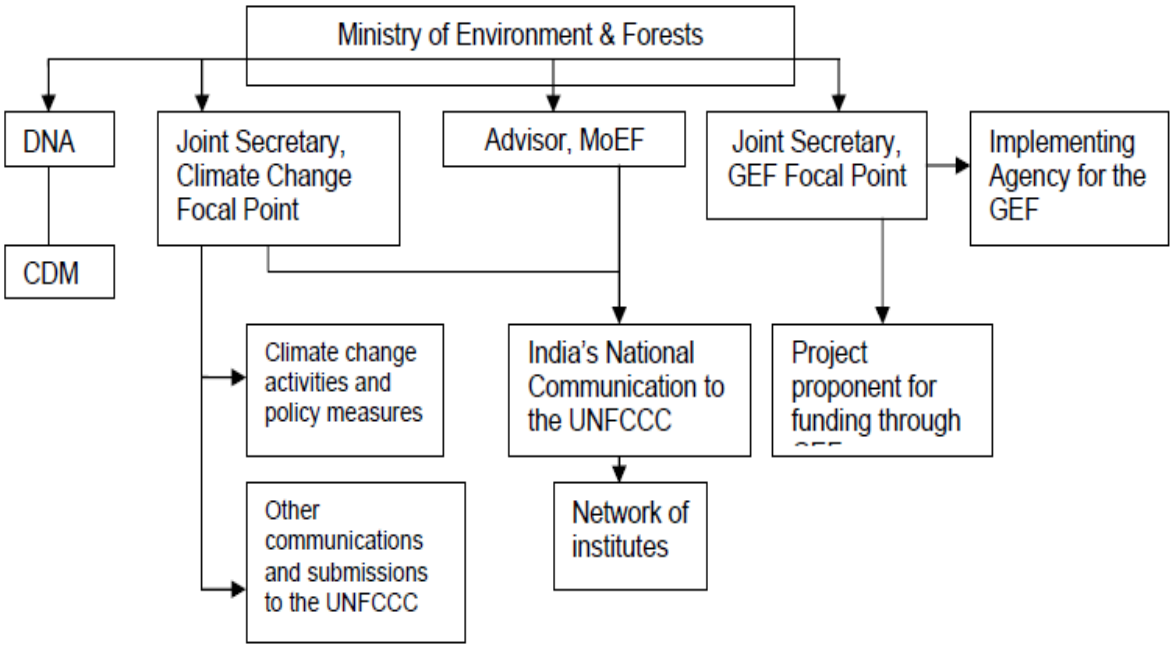
incorporate appropriate features in the initial design and construction of infrastructure projects, including siting, than to undertake retrofits later. Other elements of climate risk management recommended in the action plan include: disaster-specific vulnerability assessments and sectoral impacts assessments at the state and district level for preparing contingency plans, maintenance of critical facilities such as health care services and water supplies, collaboration with insurance providers to insure infrastructure, mainstreaming disaster risk reduction into Sarva Shiksha Abhiyan, Jawaharlal Nehru National Urban Renewal Mission and Indira Awas Yojana, capacity building among design engineers, project planners and financial institutions on incorporating elements of disaster management, development of prefabricated structures instead of cast-in-place construction in vulnerable areas and enforcement of building codes; better urban planning and zoning of vulnerable areas.

The NAPCC further highlights that it is essential to provide early warning of imminent disasters to facilitate a planned response, including evacuation from vulnerable areas to minimize the impact of disasters. Specific action areas recommended include: upgrading forecasting, tracking and early warning system for cyclones, floods, storms and tsunami, monitoring river flows and mapping flood zones, generation of regional scenarios based on single or multi-hazard mapping, disaster response training at the community level and developing infrastructure and human resources for medical preparedness and emergency medical response to manage mass casualties during extreme events. Many of these measures figure prominently in the National Policy on Disaster Management and in the series of guidelines issued by the National Disaster Management Authority for management of disasters.

9. Institutional Set-up for Climate Change Action

The Ministry of Environment & Forests (MoEF) is the nodal Ministry for all climate change related activities in the country. The institutional set up within the MoEF has evolved[30] according to the requirements of various processes that have emerged from ongoing international initiatives on climate change mitigation and adaptation. Four major activities that drive climate change action in the MoEF are: (a) international negotiations on climate change and guiding national policies of these issues, (b) submission of national communications to the United Nations Framework Convention on Climate Change (UNFCC), (c) implementation of Clean Development Mechanism (CDM) and (d) monitoring and implementation of Global Environment Facility (GEF) funded projects.

[30] Anand Patwardhan and Mita Ajit, Disaster Prevention, Preparedness and Management and Linkages with Climate Change Adaptation, Technology Information, Forecasting and Assessment Council, 2007



The CDM is operated through a Designated National Authority (DNA), which receives project proposals for approval and evaluates them according to the guidelines. The Joint Secretary, Climate Change is the focal point for climate change related policy formulations and negotiations at the international level, while the Advisors deal with issues related to India's national communication to the UNFCCC. The GEF Cell deals with GEF project activities ranging from receiving proposals, evaluating them and sending them across to the implementation agencies. Each of these units network respectively with other relevant ministries, departments, research institutions and organizations. However, it is important to note that climate risk management features nowhere in this set up with the exception of collating information for communication to the UNFCCC.

The NAPCC has widened the climate change brief beyond MoEF to a number of other Ministries and Departments who have nodal responsibilities for spearheading the eight different national missions on climate change. The task of coordination has shifted from the MoEF to the Prime Minister's Office, which now has a Prime Minister's Council on Climate Change to oversee the implementation and monitoring of the missions.

Table-4
Nodal Responsibilities for National Missions on Climate Change

National Solar Mission	Ministry of New & Renewable Energy
National Mission for Enhanced Energy Efficiency	Ministry of Power
National Mission on Sustainable Habitat	Ministry of Urban Development
National Water Mission	Ministry of Water Resources

National Mission for Sustaining the Himalayan Ecosystem	Ministry of Science & Technology
National Mission for a Green India	Ministry of Environment & Forests
National Mission for Sustainable Agriculture	Ministry of Agriculture
National Mission on Strategic Knowledge for Climate Change	Ministry of Science & Technology

Many of the mission documents have been finalized with inputs from various scientific, technical, academic and research organizations, focusing on the issues highlighted in the Technical Document of the NAPCC. The ministries are largely tasked with implementing programmes within the existing institutional setting while issues of inter-ministerial coordination have largely not addressed. This is a key and abiding challenge. It is clear that MoEF is unlikely to play such a co-ordinating role – it lacks a mandate - while the Prime Minister's Council on Climate Change can at best play an oversight role of periodic monitoring. It remains to be seen, therefore, how issues of co-ordination are addressed during the course of implementation of the missions. Further, the missions have projected requirement of funds which are not always provided in the budget of their respective Ministries. Consequently, it is expected that the Planning Commission will have to allocate resources in the annual plan budget of the Ministries or in the Twelfth Five Year Plan for implementation of the mission projects.

Anticipating the issues of coordination the MoEF, had identified 24 action points under NAPCC which are to be addressed by the various Ministries of Government of India and State Governments, out of which only 3 issues were related to climate risk management. Table 5 lays these out below:

Table-5
Action Points on Climate Risk Management arising from the NAPCC[31]

No.	Para	Action Point	Objective	Ministries/Agencies/Groups
21.	4.3	Disaster management response to extreme climatic events	Enhance measures for prevention, mitigation and preparedness, besides relief measures, to respond to extreme climate events	Ministry of Home Affairs
22.	4.3.1	-	Reducing risk to infrastructure through better design	Ministry of Urban Development
23.	4.3.2	-	Strengthening communication network and disaster management facilities	Ministry of Home Affairs

[3131] Ministry of Environment and Forests, Action Points Arising from the National Action Plan on Climate Change, 2008

It appears that the action points arising out of the NAPCC have been compartmentalized according to the Rules of Business of the government and no serious effort has been made to understand the issues of convergence that would involve a number of ministries and organizations. Climate Change Adaptation (CCA), for example, has large degrees of similarities with Disaster Risk Reduction (DRR), which need to be integrated for better synergies in approach, strategies and programming, which is still missing.

10. Integrating CCA with DRR

So far, the climate change and disaster management communities in India have been working in relative isolation, as in other regions, with the former focusing more on long-term modeling and projections of climate scenarios and their possible impacts, and the later concentrating on short-term preparedness and response to disaster events. Recognising this shortcoming and conscious of the urgency of improved policy coordination and a more strategic and integrated approach to risk management, the Indian think tank, Centre for Social Markets and the global re-insurance firm, Swiss Re, have come together to provide a platform for dialogue and action. It is clear that the time has come when the implications of future climate projections for the current risks and vulnerabilities are understood and accordingly factored into the policies and programmes developed for reducing the risks of disasters. An initial Roundtable for policymakers convened by CSM and Swiss Re in November 2010 led to a call for a Consortium on Disaster Management & Climate Change endorsed by all experts present. Improved dialogue and interaction between the two communities will help ensure that climate change analysis and adaptation and disaster risk reduction can be integrated to the extent possible and new innovative tools and methodologies are developed for such integration in development projects and practices. With such efforts to bring together stakeholders in climate change and disaster management, the task of integration has begun, but challenges will remain not only in harmonizing diverse institutional structures and distinct sectoral planning and policy frameworks, but also in translating them into concrete projects on the ground.

Indeed, one can find support for such integration in the National Policy on Disaster Management:

> Climate change is impacting on our glacial reserves, water balance, agriculture, forestry, coastal ecology, bio- diversity and human and animal health. There are definite indications that climate change would increase the frequency and intensity of natural disasters like cyclone, flood and drought in the coming years. In order to meet these challenges in a sustained and effective manner, synergies in our approach and strategies for climate change adaptation and disaster risk reduction shall be encouraged and promoted.[32]

[32] National Policy on Disaster Management, Government of India, November 2009.

What is needed is follow-up action to implement these policy guidelines to synergize our approach, strategies and programmes for effective integration of climate risk management with disaster risk management at all levels. The National Action Plan on Climate Change (NAPCC) provides opportunities for such integration across key sectors and must be seized. Efforts such as the CSM-Swiss Re initiative, bringing together climate change and disaster management professionals, policymakers and decision-takers, can be an important step towards precisely the kind of synergy that India's National Policy on Disaster Management (NPDM) calls for, leading to greatly improved outcomes and more resilient societies .

P. G. Dhar Chakrabarti is Executive Director, National Institute of Disaster Management, New Delhi and Director, SAARC Disaster Management Centre, New Delhi, India.

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Climate Challenge India

Climate Challenge India is an award-winning independent, non-partisan, non-political national mobilisation effort on climate change. The first of its kind in India, it was initiated by the Centre for Social Markets in 2007 to raise awareness of climate impact and opportunities and to build a strong, pro-active, leadership agenda for the country.

If you would like to find out more, or join the CCI Platform, please go to the India Climate Portal

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Alternatively, please contact the CCI Secretariat directly:

CCI secretariat
Centre for Social Markets
1A Hidden Nest, 16 Leonard Lane
Bangalore 560025, India
ph :+91 80 409 18235

CCI email: cci@csmworld.org

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Bangalore Delhi London

Website: www. csmworld.org , Email :info@csmworld.org