



Disaster Management And Risk Reduction Strategies To Climate Change :An Indian Perspective

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Abstract

This article examines disaster management and risk reduction strategies in the context of climate change with a specific focus on India and the wider South Asian region. It highlights the growing frequency and intensity of climate-related disasters and the resulting socio-economic vulnerabilities, particularly in densely populated and resource-dependent societies. The study explains the conceptual and operational linkages between Climate Change Adaptation (CCA) and Disaster Risk Reduction (DRR), emphasizing the need for their institutional and policy-level integration. It traces the evolution of India's disaster management framework from a relief-centric model to a proactive, prevention-oriented, and legally institutionalized system under the Disaster Management Act, 2005, supported by national and state-level authorities and specialized response forces. The paper reviews India's disaster profile, covering major hazards such as earthquakes, floods, droughts, cyclones, tsunamis, and landslides, and discusses mitigation, preparedness, response, and capacity-building measures aligned with global frameworks such as the Sendai Framework for Disaster Risk Reduction. It argues that effective risk governance requires inter-agency coordination, knowledge-sharing platforms, regional cooperation, and continuous monitoring mechanisms. The article concludes by recommending stronger institutional convergence of DRR and CCA policies, enhanced resilience-building, and regional collaboration across South Asia to address emerging climate risks and ensure sustainable development.

Keywords: Disaster Risk Reduction (DRR); Climate Change Adaptation (CCA); Disaster Management in India; Climate-related Disasters; Risk Governance; Institutional Framework; Sendai Framework; Resilience Building; Mitigation and Preparedness; South Asia.

The rising awareness of the dangers of climate change in urban areas has resulted in enhanced engagement collaboration between climate change adaptation (CCA) and disaster risk reduction (DRR) disciplines. Climate-related disasters in South Asia are becoming frequent, damaging, and economically and socially burdensome (UNISDR 2011; Bhatt et.al 2015). Between 1900 and 2015, the frequency of climate-related disasters has consistently risen, reaching its zenith from 2000 to 2015 (EM-DAT 2016). The fatality rate linked to such calamities has significantly decreased in the present era, despite a substantial increase in the number of individuals apparently impacted.

South Asia is consistently subjected to severe climate-related disasters, a predicament exacerbated by extraordinary population growth, which reached 1.8 billion in 2018 and is projected to rise by an additional 800 million by 2050. The entire population is susceptible to climate change and catastrophic concurrences because to inadequate institutional capacity, economic fragility, and significant reliance on climate-sensitive resources. Natural catastrophes impact household welfare in three specific manners: Loss of bodily integrity, assets, and income, together with injuries, fatalities, and health epidemics, undermine the quality of life.

Climate-related vulnerabilities are exacerbated by low population resilience; most people survive on less than USD 1 a day (UNDP 2013). The extent of this stress is, however, highly uncertain because the magnitude of climate-related disasters is so variable. In addition, the rural population across South Asia still survives on agriculture, which is regarded as the principal employment opportunity of more than 60% of its population. More than half of the South Asian countries, particularly Afghanistan, Bangladesh, Bhutan and Nepal, are classified as least.

Developed countries as of March 2018 United Nations are grappling with various socioeconomic issues such as poverty, health, and education. Therefore, climate related environmental hazards and their impacts potentially have serious consequences over the entire region and should be addressed with specific consideration of unique regional Geo-morphology, culture, and socio-economic structures.”

However, scientists often use the term for any change in the climate, whether arising naturally or from human causes. In particular, The Intergovernmental Panel on Climate Change (IPCC) defines Climate change as a change in the state of the climate that can be identified by changes in the mean and or the variability of its properties, and that persists for an extended period, typically decades or longer.² Disaster risk reduction means reducing disaster-related risks through a systematic effort. Improved preparedness, reduction in individual exposure, reduced damage to property, proper management of land, and enhanced population resilience are the core objectives of DRR (UNISDR 2011).

Climate change adaptation only refers to the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, including regulating damages and exploiting possible beneficial opportunities (UNFCCC 2008; IPCC 2013). Both DRR and CCA have several similarities and represent similar policy goals, DRR is concerned with a widely known problem in the field of all environmental hazards and CCA with only emerging issues related to climate change-instigated environmental hazards.

While these concerns have different origins, DRR deals with all environmental hazards including CCA, which by definition is about change in climate and largely through the common factors of weather and climate and through tools used to monitor, analyze, and address adverse consequences (Kelman et al, 2017). In addition to CCA, many states have been making efforts to institutionalize several practices relating to DRR to reduce regional vulnerability. In tune with this paradigm shift in disaster management, the focus has shifted to other components of DRR, such as preparedness, prevention, and mitigation. Some slowly changing climatic phenomena can last for whole seasons or even years; the best known of these is the El-nino Phenomenon.

However, many DRR measures, particularly those related to hydro meteorological events such as drought-proofing, flood protection, cyclone warning and shelters, malaria eradication, resistant agriculture, mangrove conservation, saline embankment, and alternative livelihood development, have similarities to CCA measures in terms of their application. Various researchers, practitioners, policymakers, and organizations focused on the similarities and differences between CCA and DRR, and on the process for integration (Kelman and Gaillard 2008; Alexander et al 2013). Suggestions of increases in the frequency, intensity, and severity of climate-related disasters call for better integration of DRR and CCA in order to reduce vulnerability and increase population resilience, especially over the South Asian region (Seidelr et al, 2018). While it is recognized that South Asia is frequently associated with disasters, information regarding the roper governmental framework for implementation of CCA and DRR is extremely scarce.

This article specifically discusses institutional developments among the Indian perspective their policies and programmes for DRR and CCA in terms of analogous geological and hydro meteorological conditions. In conclusion, the suggestions and recommendations have been included especially for Indian states, to improve institutional mechanisms for different facets of preparedness, response, improving resilience, and mitigation. Efforts have therefore been made to understand the process of such evolution and recognize and attempts at possible DRR including CCA within the South Asian context.

Disaster management in India:

Disaster management in India has evolved from a relief based approach to a multidimensional proactive institutionalized setup with multiple stakeholders (Minister of External and Frost 2012). Initially, activities to address natural hazards were kept within the purview of provincial and state agencies. During the 1990s the Natural Disaster Management (NDM) division was created within the Ministry of Agriculture. However, following a series of disaster such as the Latur (1993), Malpa (1994), and Bhuj earthquakes (2001) and the Orissa super cyclone (1999), a systematic and comprehensive approach for disaster management was initiated, and the NDM was transferred in 2002 to the Ministry of Home Affairs, Further, a legal framework was created through the Disaster Management Act of 2005, which provided a mechanism for coordinated actions of response, preparedness, and mitigation at the national, state, and district levels. "National Plan" means the plan for disaster management for the whole of the country prepared under section 11.*4

The "National Disaster Response Force was created for emergency response, in conjunction with the National Institute of Disaster Management for capacity enhancement. Focused initiatives on Climate Change Adaptation (CCA) commenced with the ratification of multiple international treaties and conventions, including the Vienna Convention in 1993, the Montreal Protocol in 1992, the UNFCCC in 1993, the Kyoto Protocol in 1997, and the Paris Climate Change Agreement in 2015. Moreover, several legislative and policy measures have been implemented to regulate and include environmental and climate-related issues."

The "Ministry of Environment, Forest and Climate Change (MoEFCC) serves as the principal ministry for all climate change-related initiatives in the nation. The Prime Minister's Council on Climate Change was established in 2008 to coordinate national efforts for the assessment, adaptation, and investigation of climate change. The National Action Plan on Climate Change (NAPCC) was initiated in 2008 to tackle essential issues related to sustainable energy, energy efficiency, habitat, water resources, the Himalayan ecosystem, green initiatives, agriculture, and strategic knowledge."

Losses due to disasters have shown growing trend in terms of lives and property throughout the world due to urbanization, increasing population and huge degradation of environment. The global efforts to manage disasters are not matched with the frequency and magnitude of disasters. However, for the last 15 years or so some new thinking on disaster management has emerged at global level which pleads for a proactive and preventive approach and integrates disaster management with ongoing development activities that is sustainable development.

Disaster-related losses in lives and property have exhibited an increasing trend globally, attributed to urbanization, population growth, and significant environmental deterioration. The international initiatives for disaster management are insufficient relative to the frequency and severity of disasters. In the past 15 years, a novel perspective on disaster management has arisen globally, advocating for a proactive and preventive approach that blends disaster management with sustainable development initiatives.

India's Disaster Profile:

The "Indian subcontinent is one of the most disaster-prone regions in the world. Approximately 85% of India's territory is susceptible to one or more hazards. Among the 29 states and 6 union territories, 22 are susceptible to disasters. It is susceptible to wind storms originating from the Bay of Bengal and the Arabian Sea, earthquakes resulting from active tectonic activity in the Himalayan region, floods induced by monsoons, and droughts in the nation's dry and semi-arid zones. The Indian Ocean tsunami in December 2004 resulted in the deaths of over 250,000 individuals, followed by the Kashmir earthquake, which claimed tens of thousands of lives and rendered over 3 million people homeless."⁶

Earthquakes:

Among the earthquake-prone regions, "12% is susceptible to very severe earthquakes, 18% to severe earthquakes, and 25% to damaging earthquakes. The most significant earthquakes transpire in the Andaman and Nicobar Islands, Kutch, Himachal Pradesh, and the North-East region. The Himalayan regions are especially susceptible to seismic activity. The most recent significant earthquakes occurred in Gujarat in January 2001 and in Jammu and Kashmir in October 2005. Numerous minor earthquakes transpired in various regions of India in 2006. All seven states of North East India are situated under Seismic Zone V."

Floods:

Approximately "30 million individuals are impacted each year. Annual flooding occurs in the Indo-Gangetic Brahmaputra lowlands. Annually, several hundred lives are lost, millions are displaced, and numerous hectares of crops are destroyed. Approximately 75% of the annual precipitation transpires during a brief monsoon season (June-September). Floods are a recurrent occurrence in at least five states: Assam, Bihar, Odisha, Uttar Pradesh, and West Bengal. Due to climate change, flooding has recently transpired in regions typically not susceptible to such events. In 2006, drought-affected regions of Rajasthan encountered flooding."

Droughts:

Approximately 50 million individuals are impacted by drought each year. Out of over 90 million hectares of rain-fed regions, approximately 40 million hectares are susceptible to insufficient or absent precipitation. Nine out of thirty-six meteorological subdivisions have inadequate rainfall, with each subdivision encompassing a geographic area exceeding 10 revenue districts in India. The majority of drought-prone areas are located in the country's arid and semi-arid regions, characterized by low average precipitation. The drought-affected regions in India can be categorized into two distinct tracts.⁷

Tsunami:

Tsunamis, derived from the Japanese term meaning "harbour wave" are a succession of substantial waves characterized by exceptionally long wavelengths; in the deep ocean, the distance from crest to crest can exceed 100 kilometers. It is typically produced by abrupt displacements of the sea floor resulting from earthquakes, landslides, or volcanic activity. The majority of tsunamis, particularly the most catastrophic, are produced by significant and shallow earthquakes that typically transpire along geological plate borders or fault lines, where tectonic plates converge.

Cyclones:

Approximately "8% of the land is susceptible to cyclones, with coastal regions encountering two to three tropical cyclones of varied strength year. Cyclonic activities on the east coast are more intense than those on the west coast. The Indian subcontinent is regarded as the most cyclone-prone region globally due to its shallow oceanic topography and coastal structure. The primary hazards posed by a cyclone include gales and intense winds, heavy rainfall, and elevated tidal waves or storm surges. Most fatalities result from coastal inundation caused by tidal waves and storm surges. Cyclones predominantly affect the East Coast of India, including the Bay of Bengal states of West Bengal, Odisha, Andhra Pradesh, and Tamil Nadu, as well as portions of Maharashtra and Gujarat along the Arabian Sea West Coast. An comparison of cyclone frequency on the east and west coastlines of India from 1877 to 2005 reveals that around 283 storms occurred (106) inside a 50 km wide strip on the East Coast; in contrast, the West Coast saw significantly less cyclonic activity, with only 35 cyclones recorded during the same timeframe."9

Landslides:

Landslides transpire in mountainous areas, including the Himalayas, North-East India, the Nilgiris, and the Eastern and Western Ghats. Landslides in India are a frequent occurrence. Landslide-prone regions predominantly align with earthquake-prone zones, namely the NorthWest and North-East, where the frequency of landslides is greatest.

Classification of Disasters:

The categorization of disasters varies according to the classification criteria employed. They are classified as natural and artificial based on their origin. Considering their severity, they can be categorized as major and small disasters. In August 1999, the Government of India established a high-powered committee, chaired by J.C. Pant, which adopted origin as the criterion for disaster classification.

The primary objective of the committee was to develop extensive model plans for disaster management at the district, state, and national levels. The committee has recognized 30 disasters and categorized them into five distinct groups.

1. Hydrological and Climatic Catastrophes: Including floods, cyclones, hailstorms, cloudbursts, heatwaves, cold waves, snow avalanches, droughts, coastal erosion, and thunderstorms.
2. Geological Disasters: Including landslides, mudflows, earthquakes, mine fires, dam failures, and general conflagrations.
3. Biological Disaster: Includes epidemics, insect infestations, livestock outbreaks, and Égodborne illnesses.
4. Nuclear and Industrial Disasters: Including chemical and industrial catastrophes as well as nuclear incidents.
5. Accidental Catastrophes: Incidents including urban and forest fires, oil spills, mine flooding, structural collapses of large buildings, bomb detonations, aviation, vehicular, and railway accidents, maritime capsizing, and stampedes during gatherings.

National Disaster Management Act 2005:

National Disaster Management Act, 2005 defines events that cause substantial less of life, prosperity and environment. It read, Disaster means catastrophe, mishap, calamity or grave occurrence in any area, arising from nature or man- made causes, or by accident or negligence which result in substantial loss of life, of human suffering or damage to and destruction of property, or damage to, or degradation of environment and is of such nature of magnitude as to beyond the coping capacity of the community of affected areas.

The "Disaster Management Act of 2005 describes Disaster Management as a continuous cycle and integrated process of planning, organizing, coordinating, and implementing measures necessary for the prevention of risk or threats posed by any disaster."

- (i) Mitigation or reduction of disaster risk, severity, or consequences;
- (ii) Capacity-building;
- (iii) Preparedness for disaster response;
- (iv) Prompt response to imminent disaster situations;
- (v) Assessment of disaster effects' severity or magnitude;
- (vi) Evacuation, rescue, and relief operations;
- (vii) Rehabilitation and reconstruction efforts.

Reducing Risk; Enhancing Resilience (Mitigation):

Countries are actively discussing and negotiating ways to deal with the climate change problem, within the UNFCCC. The first task is to address the root cause by reducing greenhouse gas emissions from human activity. The means to achieve this are very contentious, as it will require radical changes in the way many societies are organized, especially in respect to fossil use, industry operations, urban development and land use. Within the climate change arena, the reduction of greenhouse gas emissions is called Mitigation.¹⁰

The Disaster Management Act, 2005 and the National Policy, 2009 marks the institutionalization of paradigm shift in disaster management in India, from a relief - centric approach to one of proactive prevention, mitigation and preparedness. The policy notes that while it is not possible to avoid natural hazards, adequate mitigation and disaster risk reduction measures can prevent the hazards becoming major disasters. Disaster risk arises when hazards interact with physical, social, economic and environmental vulnerabilities. In the terminology adopted by the UNSIDR, the concept and practice of reducing disaster risks involve systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment and improved preparedness for adverse events. Mitigation consists of various measure required for lessening or limiting the adverse impacts of hazards and related disasters.

The causes of past changes are not always clear but are generally known to be related to changes in ocean currents, solar activity, volcanic eruptions and other natural factors.

The effectiveness in disaster risk reduction will depend on coordination mechanisms within and across sectors and with relevant stakeholders at all levels. For each hazard, the approach used in this national plan incorporates the four priorities enunciated in the Sendai Framework into the planning framework for Disaster Risk Reduction under the five thematic areas for action:

1. Understregning Risk
2. Inter-Agency Coordination
3. Investering in DRR- Structural Measures
4. Investing in DRR- Non- Structural Measures
5. Capacity Development."

Mitigation Measures for People:

The state Governments must maintain close coordination with India Meteorological Department (IMD) and closely monitor the situation. Warnings should be disseminated to the public through appropriate forums (including local newspapers and radio stations) on a regular basis. Some of the mitigation measures to be followed are:

1. Listen to local radio stations for weather updates.
2. Maintain proper ventilation when using kerosene, heater or coal oven to avoid toxic fumes.
3. Stock up on food, water and other necessities.
4. Follow the advice of the Government to avoid huge property loss.
5. In case of Floods, Cyclones and heavy rain the people residing in the low lying area should vacate their places and go to the cyclone shelters in the Mandal.
6. Cooperation and coordination among the members of the villages, town, tandems etc., should be maintained.
7. Fishermen should avoid fishing during the cyclone conditions.
8. People living near the hilly areas should move into safer areas to avoid damage during landslides.

Response:

Response measures are those taken immediately after receiving early warning, anticipating an impending disaster, or post-disaster in cases where an event occurs without warning. The primary goal of response to a disaster is saving lives, protecting property, environment, and meeting basic needs of human and other living beings after the disaster. The immediate focus will be on search and rescue of those affected and to evacuate those likely to be affected by the disaster or secondary disaster that is likely to happen."

In the section on response, roles function and responsibilities of ministries and agencies that have a key role to play are described. Since contexts, knowledge base, and technologies change, DM plans must be updated periodically to reflect any changes in the key roles envisaged to particular ministries or agencies. At the national level, the central government has assigned nodal responsibilities to specific ministries for coordinating disaster-specific responses. The NDMA will be coordinating with relevant nodal ministry. The disaster-specific nodal ministry will ensure liaison with the state government where the disaster has occurred and coordination among various relevant ministries and departments to provide quick and efficient response.

The state government will activate the Incident Response Teams (IRT) at state, district, or the block level as required. The IRTs will coordinate with the state EOC. The SDMA1 (or its equivalent, CoR, or Dept. of Revenue) will provide technical support to the response. Different central ministries and departments will provide emergency support to the response effort as per request from the State Government. It may be noted that the NDMA, Department of Revenue or Commissioner of Relief (as applicable) is the nodal agency for coordination of disaster response. The various agencies whose responsibilities are defined in detailed DM plans for the state and district will be responsible specific response measures.

The DDMA serves as the principal agency for coordinating responses at the district level, with help from other district-level entities. The specific functions of departments within central ministries and state governments are presented in a matrix, elucidating the duties and responsibilities of various authorities. The Sendai Framework for Disaster Risk Reduction 2015-2030 delineates seven explicit targets and four priorities for action aimed at preventing new and mitigating current disaster risks. (i) Comprehending disaster risk; (ii) Fortifying disaster risk governance to mitigate disaster risk; (iii) Allocating resources for disaster reduction to enhance resilience; and (iv) Improving disaster preparedness for efficient response, and to "Build Back Better" in recovery, rehabilitation, and reconstruction.¹²

Capacity Development:

Capacity building encompasses the enhancement of institutions, methods, and capabilities of all stakeholders across all levels. The strategy acknowledges the necessity for a strategic methodology in capacity development and the imperative for active engagement from diverse stakeholders to ensure its efficacy. The plan tackles the task of establishing a suitable institutional structure, management systems, and resource allocation for the effective prevention and management of disasters. The capacity development planning requirements are delineated for all four facets of disaster management:

- a) Prevention or mitigation to reduce risk from hazards
- b) Preparedness for response
- c) Effective response when disaster occurs
- d) Ability to recover and build back better

Conclusion:

Climate-related disasters in South Asia are becoming frequent, devastating, and costly in terms of economic and social repercussions. Concurrently, climate change amplifies awareness and apprehension regarding more severe and frequent climate-related disturbances, as well as the necessity for policies that promote adaptive response learning systems. These connections may prompt the Indian government to acknowledge the significance of disaster risk reduction beyond the immediate aftermath of a disaster and to prioritize adaptive capability in light of evolving risk and hazard levels. Considering the evidence regarding the current status and extent of integrating disaster risk reduction and climate change adaptation into various development projects, policies, and planning across South Asia, it has been determined that there are several fundamental and operational constraints that require prioritized attention.

Consequently, we identify several priorities necessitating consensus and advancement among South Asian partner states, governmental and international entities, as well as disaster and climate specialists, and propose realistic methods to attain these objectives. To tackle disaster risk reduction (DRR) and climate change adaptation (CCA) in South Asia, it is imperative to develop institutional connections at both national and regional levels by eliminating structural impediments. Priority must be placed on fostering integration among diverse institutions both horizontally and vertically. The prioritization of a system for the convergence of policies, planning, and programs is essential.

The Government of India should establish a framework to ensure the comprehensive integration of policies, plans, and programs related to Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) at both national and regional levels. It is essential to create a knowledge-sharing platform, such as a climate change knowledge management center alongside the Disaster Management Centre (or as a division within the country, to promote the exchange of information, conduct regional research, and replicate best practices among SAARC member states. A regional response facility should be established under the SDMC to optimize the capabilities of member nations, enabling the rapid mobilization and deployment of essential resources.

An accurate and effective system for monitoring and assessing executed projects is also necessary. This mechanism is essential for upholding standards throughout all implemented projects. Guidance documents regarding compliance, quality control, and evaluation criteria across several scales may be developed to aid both policymakers and practitioners. Furthermore, a non-lapsable SAARC fund should be established to facilitate the development of innovative instruments and strategies for disaster risk reduction, including climate change adaptation, by the member nations. A regional coordinating structure for diverse agencies in pertinent sectors, including agriculture, water resources, and health, is essential for member states to effectively manage shared resources. Consequently, it is imperative to embrace the principles of knowledge, innovation, and education to cultivate a culture of safety and resilience across all strata.

Therefore, it is essential to establish a roster of regional and international disaster and climate experts inside the South Asian member nations. Numerous SAARC member nations have cultivated significant knowledge in diverse domains of disaster risk reduction (DRR) and climate change adaptation (CCA), including scientific, technical, administrative, and research and rescue capacities. This skills can be employed the disseminated for the collective benefit thought the region. The The Prime Minister Secretariat ought to establish and sustain a panel of experts from the member states for utilization by individual member states as required.

References:

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