

Need for Disaster Risk Resilience: A case of India

Manish Sharma¹, Nand Kumar², Ashwani Kumar²

¹PhD Student, Dept. of Architecture and Planning, MNIT Jaipur, Rajasthan, India

²Assistant Professor, Dept. of Architecture and Planning, MNIT Jaipur, Rajasthan, India

Abstract - The increasing frequency of natural & human activity induced disasters and climate related extreme events like cloud bursts, heavy precipitation and associated floods and large scale destruction resulting into hazards in recent time has led to huge damage in life and property. Climate sensitive nation like India, with large number of vulnerable population, unplanned and haphazard physical development and poor institutional capacity and governance, are worst affected by the disaster related impacts. Though both rural and urban areas are vulnerable to disaster risk and climate change, their effects on cities are more daunting owing to the high concentration of humans, infrastructure and critical services in such areas. India accounts for 24 per cent of the deaths due to disasters in Asia, on account of its size of the vulnerable population and the developmental planning with negligence on the resilience front [12]. Disaster risks in India are further compounded by increasing vulnerabilities related to its changing topographical profile, diversified socio-economic profile of the people, ineffective planning leading to haphazard and unplanned urbanization, weak infrastructure, unchecked development along high-risk disaster prone zones, risks of climate change, epidemics.

This paper attempts to identify the need for urban disaster risk resilience in Indian cities through disaster profiling of various zones. The paper further elucidates the issues of the Indian cities with respect to the proneness to disaster risks and its management.

Key Words: Vulnerability profile, resilience, disaster management, disaster loss.

1. INTRODUCTION

Moving towards urbanization and overall development, India faces precarious challenges in form of global threat of climate change, which hinders its aim of achieving its endeavors of sustainable development. Increasing frequency of occurring disasters and hazards, extreme climate events cause widespread impact to our ecosystems, both natural and man-made. India is a country with varied climate and geographical conditions. Due to its typical topographical conditions, in context to the tectonic plate activity in the Himalyan region due to the fold and vast coastline of 7,516 km, India is susceptible to many natural disasters and hazards. India is also ranked high amongst the nations exposed to climate change risks accentuating the country's critical status as a climate sensitive nation. Due to this immense geographic diversity and varied climatic zones, vulnerabilities to climate change risks are many and multifaceted. On a global level too, the efforts to cope with

disaster events does not match with the magnitude and frequency of disasters. During the decade 1991-2000, 66, 59,598 people were killed due to natural disasters, of which nearly two-thirds were from developing countries like India, while the reported casualties from the developed nations were limited to 4 per cent.

Sectors like infrastructure, transportation, agriculture and water are disaster and climate sensitive, hence building resilience addressing specifically these and other sectors is essential for the overall development paradigm, so as to eventually build resilience to disasters and climate change risks and its impacts in the years to come. Urbanized areas constituting cities in a developing country like India are economic and production centers, contributing approximately three-fifth (60%) of the total Gross Domestic Product of the country which is expected to grow to more than 70% by 2030.

Considering the increasing frequency of natural & human activity induced disasters and climate related extreme events like cloud bursts, heavy precipitation and associated floods and large scale destruction resulting into hazard (as recently seen in Uttarakhand, India in 2013), and the ever rising climate variability being recorded across places in India in one form or another, it is opportune to develop strategies to inculcate resilience into urban development and planning decisions. There is an emerging need for a modification in the approach to address urban matters, policies and planning and shift of paradigm in the way urban areas are planned, developed and managed in India.

Since cities and urban settlement have unique issues to address in context to their vulnerabilities to disasters, climate change and other parameters, the methodological process should be unique to each of the cities corresponding to the city's context so as to assess risk and vulnerability in the cities and also, prepare city specific tailor made resilience strategies.

In Indian context, it's ripe to involve resilience considerations into urban planning, policies and governance setup since few cities have developed master plan, city development plan documents. Also, the colossal number of exposed vulnerable population in urban locations in India and their marginalized subsistence that often lacks safe and secure access to essential services and depends on fragile urban systems, makes them vulnerable to system failures in the wake of disaster and climate related stress.

In doing so, the programmer considers targeting urban systems in cities including infrastructures and ecosystems; agents including community, government, NGOs; institutions including regulations, laws [19].

2. RESILIENCE

Resilience as a term has multifaceted applications in diverse disciplines [1]. Conversely, it has been the concept pertaining to Ecology discipline which has been the most influential on natural, developmental hazards and climate change. Holing conceptualizes resilience as the ability of ecosystems to absorb changes and still persist [10]. This was further elaborated by Folke, who extended the domain of resilience to re-organizational capacity of systems and identified resilience as the ability of systems to ‘absorb disturbance and re-organize while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks [9]. United States Agency for International Development describes resilience as capacity of individuals and different groups to mitigate, adapt and recover from shocks and stresses, reducing vulnerability and facilitating growth [20]. Rather than relying on the strength of individual components, resilient systems retain functionality through flexibility and diversifying functional dependence [19].

Conceptualization of resilience involves assessment of vulnerability, hazards and coping abilities of communities (Eq. 1). Reducing vulnerability spells increasing resilience for the communities.

Equation of Disaster Risk:

$$[R= H * V -C] \dots (1)$$

Where R: Disaster Risk; H: Hazard; V: Vulnerability; C: Capacity, implying risk, hazard and vulnerability are related, but not synonymous. Vulnerability has been as “the degree to which communities or societies are susceptible to the damaging effects of a hazard” [20]. While Hazards and vulnerability reduces the resilient behavior of the communities, strong coping capacity increases the resilience of the communities thereby decreasing the disaster risk potential. Reducing vulnerability requires strengthening coping capacities to minimize the degree of loss emerging from a disaster. Different sections of communities respond to disasters and climate variability in a different way, underlying their coping abilities, with low income group as more vulnerable section with limited access to safety nets and disseminated information. Risk is characterized by impact, probability, severity, exposure, vulnerability or types of hazards [15].

3. INDIAN SCENARIO

3.1 Overview

India is witnessing an explosive growth in the population living in urban areas. It is estimated that of the nearly 30 % of India’s population or about 300 million people live in towns and cities. This population is estimated to reach 534 million by 2026. According to Emergency Events Dataset (EM-DAT) [22], India is fifth amongst the top ten countries in terms of loss of lives due to natural disasters during the past two decades (1997-2017 period) (Table 2). The loss of lives and damages to property in the country has been indicated in Table 2 for the period 1990-2000[23]. Along with rapidly urbanization, there have been a more rapid growth in the population residing in slums. It is estimated that nearly one-third of India’s urban population or nearly 100 million live in slums characterized by overcrowding, poor hygiene and sanitation and the absence of civic services. The UNHABITAT estimates that the slum population in India will double to 200 million by 2020.

India is witnessing an explosive growth in its total population and it is progressively becoming urban. Incessant urbanization has in turn led to the expansion of habitats and other developments, which have spilled into areas which are exposed to hazards related to developmental, natural and climatic events, increasing the vulnerability profile of the local populations, especially the economically weaker section of the society. Frequency of extreme events is expected to increase under the influence of altering average climatic conditions and inducing greater climate variability, hence increasing extreme weather events like droughts floods and cloud bursts though climate change. Furthermore, the poor quality and quantity of the built-infrastructure services in urban and peri-urban areas, governance and poor management has affected cities coping ability adversely.

Table -1: Countries with highest numbers of deaths due to natural disasters during the period 1997-2017

Sr. No.	Country	No. of deaths
1	Haiti	237382
2	Indonesia	185051
3	Myanmar	139715
4	China	120100
5	India	98700
6	Pakistan	85904
7	Russian Federation (the)	58571
8	Sri Lanka	37574
9	Iran (Islamic Republic of)	32248
10	Venezuela (Bolivarian Republic of)	30319

Source: Extracted from EM-DAT: The Emergency Events Database - Université catholique de Louvain (UCL) - CRED, D. Guha-Sapir - www.emdat.be, Brussels, Belgium [22]

Table -2: Countries with highest numbers of deaths due to natural disasters during the period 1997-2017

Damage Due to Natural Disasters in India				
Year	People Affected (million)	Human lives lost due flood/cyclone/hail-storm/earthquake	Houses and Buildings or Property Damaged	Amount of Damage or Loss (Rs. Crore)
1990	31.7		1,019,930	10.71
1991	342.7	2299	1,190,109	10.9
1992	190.9	2257	570,969	20.05
1993	262.4	1690	1,529,916	50.8
1994	235.3	9946	1,051,223	10.83
1995	543.5	2344	2,088,355	40.73
1996	549.9	2464	2,376,693	50.43
1997	443.8	3828	1,103,549	NA
1998	521.7	2062	1,563,405	0.72
1999	501.7	3965	3,104,064	1020.97
2000	594.34	12585	2,736,355	800
2001	788.19	>23048	846,878	12000

Source: (Singh, 2017) [23]

3.2 Disaster profile of India

Indian sub-continent is considered to be amongst the world’s most disaster prone areas due to high frequency of natural hazards, large size of exposed population with little protection of the safety nets, poor infrastructure and severely tight finances translating into weak coping capabilities. More than four-fifth of the country (85 per cent) is under risk of one or more hazards. India, in varying degrees of vulnerability, is prone to be affected adversely by natural hazards transforming into human and economic disasters.

More than half of the country’s landmass (58.6 per cent) is vulnerable to earthquakes with intensity levels of moderate to high, with large areas under high risk seismic zones. Fig. 1 shows the Earthquake hazard map for India. About 40 million (12 per cent) hectares of the land is prone to floods and erosion which affect about thirty million people annually. Approximately three-fourth of the precipitation takes place in the monsoon quarter (months from June to September). States of West Bengal, Orissa, Assam and Uttar Pradesh experience flood events every year, making it a perennial phenomenon. Fig. 2 shows the Flood hazard map for India. More than three-fourth of the country’s coastline (about 5700 kms of the total 7,516 kms) is vulnerable to coastal cyclones, with the east coast vulnerable to more severe cyclonic activity than the west coast. States along the eastern coast of India, namely, Tamil Nadu, Orissa, West Bengal and Andhra Pradesh are most vulnerable due to coastal inundation by wild storm surges and tides. Fig. 3 shows the Cyclone hazard map for India. More than two-

third (68 per cent) of the area under cultivation is prone to drought, while hilly areas are vulnerable to avalanches and land-slides, which are very evident in the North-Eastern and Himalayan region of the country. Drought, on an average, annually affects about fifty million people, prominently in the states of Rajasthan, Maharashtra, Madhya Pradesh and Orissa. More than two-fifth of the rain fed areas (40 million hectares of 90 million hectares) are prone to scanty rainfall. Rainfall is unreliable and poor in one-fourth of the total meteorological subdivisions (9 out of 36), each covering a land of more than 10 revenue districts.

Ill-effects of climate change have also emerged in form of flooding events in areas which are not flood prone like parts of Rajasthan which are conventionally vulnerable to drought. Also, the changing precipitation patterns cause heavy rainfall in unexpected months, choking the drainage systems resulting in the events of urban flooding. This erratic behavior of the monsoon is putting a huge pressure on the civic municipal bodies, which are already struggling under financial crunch. Hot and cold waves sweeping few regions, specifically in North India, claims hundreds of lives annually, affecting urban poor the most. As per the 10th Five Year Plan, natural hazards have affected 6 per cent of the country’s population, and about one-fourth (24 per cent) of the deaths in Asian region due to disaster events occurred in India [12]. India lost nearly 2 per cent of its GDP due to natural disasters, and the amount spent on the rehabilitation and relief works accounted for 12 per cent of the Government revenue during the period 1996 to 2001.

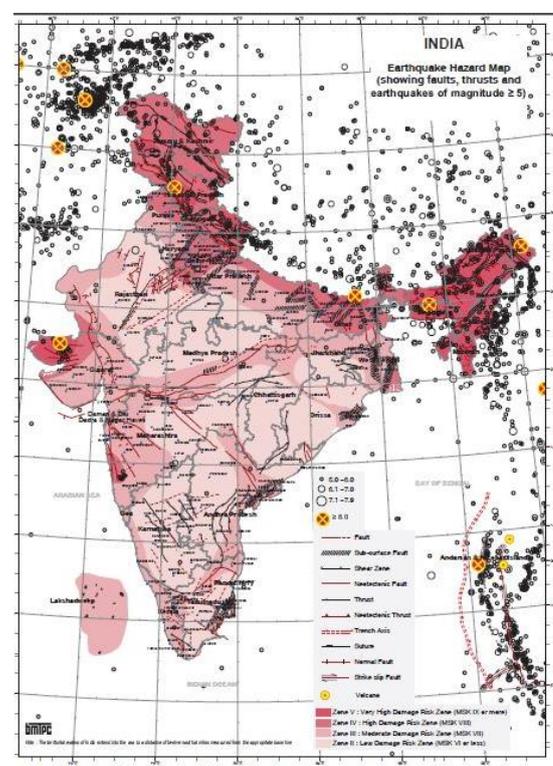


Fig -1: Earthquake hazard map of India. Source: BMTPC

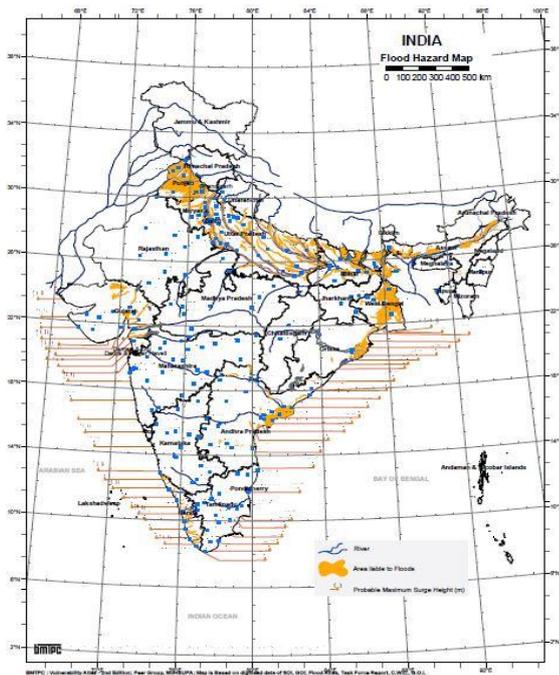


Fig -2: Flood hazard map of India. Source: BMTPC

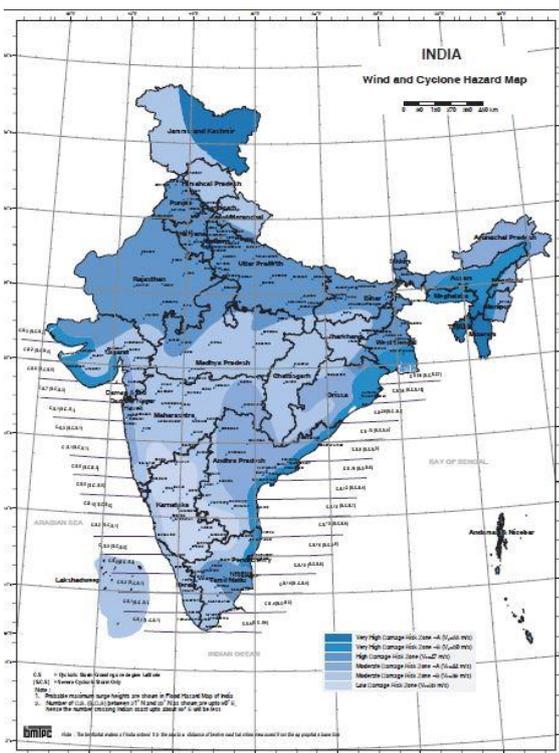


Fig -3: Wind and cyclone hazard map of India. Source: BMTPC

per cent in 2001 to 42.6 per cent in 2011 [4]. The urbanized population following the relentless urbanization trend has rose from 17.97 percent in 1961 to 31.16 percent in 2011 [18] indicating the progressive urbanization of Indian population (Table 3). Also, Indian cities have grown incessantly in size in terms of the number of the residents, with the average size of the cities and towns up from 33,624 inhabitants in 1961 to 61,159 inhabitants in the year 2011 [12]. Urban development has also induced changes in land-use, and due to weak structure of implementing agencies, peri-urban areas have witnessed violation of building laws and regulations.

Table -3: Trends in India’s urbanization: 1961-2011

Census Year	Urban Population(in million)	Percentage urban	Annual exponential growth rate (%)
1961	78.94	17.97	-
1971	109.11	19.91	3.23
1981	159.46	23.34	3.79
1991	217.18	25.72	3.09
2001	286.12	27.86	2.75
2011	377.10	31.16	2.76

Note: As the 1981 Census was not conducted in Assam, and the 1991 Census was not held in Jammu and Kashmir, the population of India includes projected figures for these states in both those periods. Source: (Tripathi, 2013)

Cities, today, face a very big challenge of providing basic necessary services to its inhabitants, with a decent quality of life with safe environment due to continuous population growth, urban sprawl characteristics and as centers for economic growth. Very limited job opportunities for half-skilled and unskilled laborers, continuous in-migration, and increasing land prices going beyond the affordability levels contribute to urban poverty thereby promoting informal settlements and slums, which generally find the space on environmentally sensitive, hazard-prone areas of a city, due to negligence, unawareness and poverty.

The pace of in-migration from rural to urban settlements, which is gradually increasing over the last few decades, is expected to increase further by virtue of the government policies, economic development in cities and lack of opportunities in the rural areas with inadequate infrastructure. Migration can also be instigated due to the adverse direct and indirect impacts of climate change. These factors combined might trigger a situation which puts the urban areas under severe stress due to more frequent hazard events turning to disasters in presence of vulnerable population and poor coping capabilities, apart from the impacts of climate change, environmental impacts, with the consequent risk of epidemics. Though India, amongst the fastest growing economies in the world, with continuous urbanization, attracts investment, Indian urban centers

4. CONCERNS

Million plus population cities have sharply risen from 35 to 53 during the decade 2001 and 2011 of which eight cities house population in excess of five million. The share of these cities in the total urban population has increased from 37.8

mostly struggle to provide even basic necessary infrastructural services to its inhabitants, with the slum dwellers and urban poor amongst the most vulnerable lot. Though prominent economic centers like Mumbai, Delhi-NCR region seek to ensure adequate and efficient infrastructure and services provision, city systems will struggle to cope up under the pressure of increasing population. This also puts the city environment, both natural and man-made under severe stress. Consequently, the resilience of the urban centers may be affected adversely, affecting the coping capabilities of the cities to disasters and climate change threats.

5. CONCLUSIONS

Indian cities and other cities in many developing countries are under risk from disasters and climate change, due to a number of reasons. Transformation of a hazard into a disaster event is accredited to the fundamental problems of development which India faces today, which also contribute towards increasing its vulnerability to disaster events. Haphazard urban growth, persistence of rural and urban poverty, deteriorating environment due to exploitation of natural resources, inefficient governance and institutional structure and shortage of investment in services and infrastructure sector. The policy and institutional structure in place focus on coping with emergency situations, rather than disaster risk mitigation and prevention. The need in today's era is to reduce the vulnerability and strengthen the resilience framework, which involves strengthening of infrastructure, economic, political and social aspects. Also, inculcating good urban governance structure, well informed local authorities and responsive residents, through support from awareness campaigns are very crucial in improving the city resilience.

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