RESILIENT CITIES IN INDIA
Case study-Chennai

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Abstract : 'Resilience', the term explains the ability of 'system' to cope with change or to attain equilibrium state after. Many cities around the globe are experiencing frequent natural disastrous shift with flooding, typhoons, earthquake, sea level rise, climate change etc. Year 2013 was characterized by water-related disasters, with extensive flooding and severe impacts on nearly all continents. Losses in human life were more severe. Swiss Re's sigma study, 2014 identified a total of 150 natural catastrophes which resulted in 26,000 fatalities worldwide, making 2013 the 20th most deadly year on sigma records.

Need of resilience city in india: an overview

Cities are estimated to support more than 40% of India's population and more than 75% of the national GDP by 2030.

This pace of urbanization and associated challenges, coupled with climate risks like flooding, heat waves, etc., are aggravating the vulnerability of cities. In 2018- 2019 alone, multiple extreme events across India severely affected urban areas including Chennai, Mumbai, Kochi, and Bhubaneswar.

the initial short-term effects, such disasters have long-lasting impact on the socio-economic-physical conditions of cities and communities in terms of impacts on urban infrastructure, socio-cultural systems, and the overall quality of life.

Given this scenario, building urban resilience is imperative for safeguarding urban investments and paving the way for a forward-looking, risk-aware, inclusive and integrated approach to sustainable urban development.

Major Drivers of Resilience City:

Economy

- A diverse number of industries
- A dynamic economy to generate growth
- Conditions allow innovation to take place
- People have access to employment, education, services, skills training

Governance

- Clear leadership and management
- Strategic and integrated approaches are taken by leaders
- Public sector has the right skills
- Government is open and transparent

Society

- Society is inclusive and cohesive
- Citizens' networks in communities are active
- Neighbourhood is safe
- Citizens enjoy healthy lives

Environment

- Ecosystem is sound and diverse
- Infrastructure can meet basic needs
- Adequate natural resources are available
- Coherent policy towards land use

How is resilience measured?

Indicators	Description
Natural Hazards	
Temperature observed trends	Maximum and minimum monthly temperature (1950–2000).
Rainfall observed trends	Maximum and minimum monthly rainfall (1950–2000).
Extreme events	Floods, flash floods, droughts, heat waves, cold waves.
Exposure to other hazards	Cyclones, sea-level rise, landslides, storm surges.
Infrastructure status	
Water supply	Per capita water availability, water supply coverage and water resources (surface water and ground water) and demand and supply gaps, non-revenue water.
Sewerage	Sewage collection and/or coverage of piped sewer lines, reuse and recycle and treatment capacity.
Solid waste management	Per capita - kg/day, collection of waste. It can also involve collection, segregation, handling, transport and treatment.
Stormwater drainage	Coverage, period of its installation, design capacity, number of cases of water logging reported.
Transportation	Road coverage, connectivity, efficiency of transportation, congestion.
Power (Electricity)	Energy consumption in the cities by different sectors.
Housing	Available housing units, construction material used (*kutcha/pucca houses*).
Governance	
Administrative unit assigned to address climate change and hazards	Government institutions authorized to handle climate change and disaster.
Willingness of city leadership to address climate change	Initiatives by the government if any.
Socio-economic characteristics	
Population	Current population, sex ratio, literacy rate, population age composition.
Density	People per km^2.
Income	Population below poverty line.
Percentage of urban areas susceptible to hazards	Affected areas.
Per capita GDP	City Gross Domestic Product (GDP) (per capita).

Study area: Chennai

Chennai, a fast-growing city on the South-Eastern coast of India, has about 6.5 Million inhabitants (Census of India, 2011). It is located in the Low Elevation Coastal Zone which is threatened by rising sea-level, coastal flooding, groundwater depletion and salinity intrusion and cyclones. The frequency and intensity of these extreme meteorological events is expected to increase because of climate change. Urban growth is a major challenge for the City of Chennai, especially for infrastructure systems such as water drainage. Drainage system is inadequate and badly maintained. Wastewater is diverted directly into rivers and canals. This magnifies the frequent inland flooding. Electricity services are good in Chennai whereas Water services are disrupted in most of the areas and they get 3-5 hours of regular water supply.

Chennai disaster time line (1985-2017)
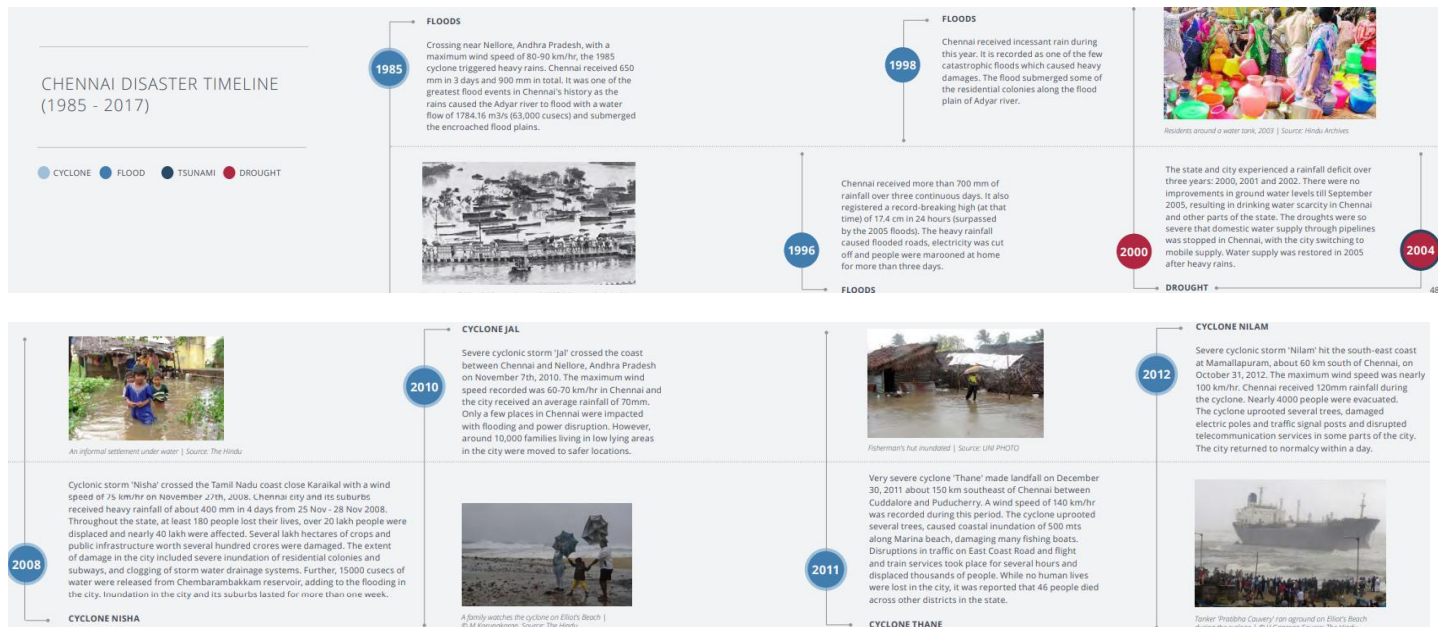
Strategy:

Urbanising Responsibly:

1. Fostering resilience thinking within the urban planning paradigm so that an integrated approach is used to address environmental concerns through policy and design;
2. Addressing solid waste related challenges more effectively;
3. Encouraging a more multi-stakeholder driven urban planning process;
4. Promoting transit-oriented development to make Chennai a well-connected, people and environment-friendly city.

Carving a resilient future around our water resources:

1. Fostering responsible water usage.
2. Giving primacy to water related challenges in urban design efforts.
3. Ensuring better coordinated efforts between public, private and civic agencies to restore and protect our water bodies.

Early warning systems for forecasting extreme events:

1. Leveraging data and technology to cope with disasters more efficiently.
2. Specifically address challenges faced by vulnerable groups living in disaster prone areas.
3. Support small and medium scale businesses through a combination of economic and non-economic measures to help them cope better with disasters.
4. Build capacity across government and community to ensure everyone is better prepared in the event of disasters.

Governance Ecosystem:

1. Improving efficiency to handle resilience challenges by enabling knowledge transfer across government agencies;
2. Strengthening current practices of enforcement and monitoring;
3. Fostering an environment where government, citizens and market interests co-build the city's resilience;

Chennai's vulnerable communities:

1. Bringing diverse vulnerable communities into mainstream policy making by identifying the different groups and their needs.
2. Ensuring the integration of vulnerable groups into the urban fabric, while meeting basic needs for adequate housing.
3. Ensuring a more humane process of proximate resettlement of informal settlers when no other option exists.

Strategies to make cities more resilient

Literature study gives an understanding of various risks, cities are exposed to. These risks are partly related to climate change and partly due to crumbling urban system. Awareness against climate change is missing at local

level due to lack of information. Infrastructure, Socioeconomic developments are interrelated with natural climate change and human induced climate change.

Such cities experience extreme impacts even in case of non-extreme weather event due to poor urban infrastructure.

a) Existing building byelaws & codes, development control regulation and land use planning guidelines needs to be updated considering the future climate impacts and associated urban risk.

b) Set back lines and buffer zones should be created based on projected sea level rise and storm surge and should be incorporated in the City development plans. Provision of open spaces for evacuation purpose in case of natural disaster should be provided.

c) Sustainable ecosystem management plan needs to be implemented to restore water bodies and flood plains, existing green areas, parks etc. to support natural habitat and reduce human induced stress to eco-system.

d) Concept of Reduce, Recycle & Reuse of resources should be practiced at local level.

e) Technology based, climate conscious development and spatial planning should be practiced. (Use of Geographic Information System)

f) IT enabled service systems (in traffic), metering for water supply etc. should be implemented in all areas of city.

g) Prioritize a climate resilient agenda for each city to be prepared against sudden future climate impacts. Evacuation Plans, drills should be practiced regularly.

h) Enhance Institutional & Policy coordination at local and national level. Coordination amongst various services, Transport, water supply, sewer system, electricity etc. should also be enhanced.

i) Improving the country's meteorological services, provision of advance alarming system should be in place in case of natural hazard.

j) The results of technical studies conducted on climate change impacts should be disseminated to all relevant local partners.

k) Investment in Green & Blue Infrastructure should be made at the Governmental level and subsidies should be provided at local level in order to provide incentives for such implementation at household levels. E.g. installation of Rain water harvesting system, solar energy, green roof etc.

l) City requires devising a collaborative, integrated strategies, strong governance, and innovative technological and financial solutions like a model for other cities to work on.

Conclusion

This comparative analysis described the various risks, cities are exposed to, their severity and resilience against it. All of three cities are struggling with the infrastructure & urban services deficits and do not see climate change adaptation as priority. The overall performance on resilience framework is ranging from average to moderate. To strengthen resilience capacity these cities have to develop a strategy for 3 significant sectors – Urban development, disaster management and climate change adaptation at national level and at local level as well. Development authorities need to address the climate impacts, and to integrate considerations of potential future risk when implementing any urban development measures. Most of urban agglomeration in India has grown beyond their infrastructural capacity and are unable to meet the demand of still growing population. Proposed strategies need to be implemented at local level (ULBs- Urban Local Bodies). There is a need of control check for each indicators explained, and look for alternative and sustainable approaches in order to become more resilience cities. Resilience framework assesses the vulnerability profile and helps to address this by raising awareness of the vulnerabilities within a city. It will enhance the city administrations' knowledge and hence their ability to plan for climate-induced hazards.