India City Profile

Climate and Disaster Resilience

Aizawl, Amritsar, Bhubaneshwar, Delhi, Guwahati, Jaipur
Kanpur, Kolkata, Nagpur, Port Blair, Shimla and Varanasi

CONSULTATION REPORT

2010

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India City Profile

Climate and Disaster Resilience

CONSULTATION REPORT

India is passing through an unprecedented phase of urbanization when urban population is projected to almost double during the course of two decades. This has put enormous pressures on the physical infrastructure, socio-cultural fabric, natural environment and institutional systems in our cities. While planned urban development has not been able to keep pace with the rising demands, ad-hoc growth has resulted in people living in high-risk zones and increased the level of risks in cities as a whole.

Climate change has added a new dimension to the urban risks. It threatens cities directly through physical impacts of stresses and catastrophic events, and indirectly through distress migration due to impacts in the hinterland. The concept of climate resilience is very new to our developmental and management paradigms, and requires innovative approaches and interventions.

There is a definite link between urban disaster and climate risks. In the context of urban risk reduction, both of these need to be viewed through a developmental lens, and mainstreaming of risk reduction has to be one of the most prominent agendas for action. Under the approach of integrating urban risk reduction with climate change adaptation, the linkages with the challenging processes of risk assessment, risk communication and risk mitigation and preparedness at the local level needs to be relooked at.

Assessment processes need to be comprehensive and need to cover developmental parameters that govern risk and resilience in cities. Risk reduction plans, in accordance, need to follow a bottom-up approach that ensures that they are context specific and capitalize on the local resources. National policies such as those on urban development, economic growth, infrastructure planning, slum improvement and disaster management need to converge on the issue of risk reduction, and provide ways forward for the implementation of appropriate risk reduction measures. Finally, the way forward needs to be aligned with the international framework for risk reduction to which we are committed, primarily the priorities of the Hyogo Framework for Action.

This modest study initiates a discourse on urban risk reduction, inclusive of disaster and climate resilience, at the local as well as national level. With this initiative, policy directions as well as specific city climate action plans will be brought into focus. Decidedly, different city contexts will require customized planning and action, which can be derived from the principles outlined in this study. Techniques will be further developed and refined in future cycles of the process.

I express my appreciation of colleagues at Kyoto University, SEEDS, Town and Country Planning Organisation and NIDM for their contributions towards this initiative. I am confident that this study will contribute significantly towards putting urban India on a path of development wherein resilience is an engrained quality.

P.G. Dhar Chakrabarti, IAS
Executive Director
National Institute of Disaster Management
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As cities all over the world have or are being urbanized rapidly, most cities have confronted environmental problems and resulted disaster risk issues. In the context of urban areas, especially in developing nations, it can be narrowed to the quality of life of living population, where disaster risk reduction and environmental management are closely interrelated. The Climate and Disaster Resilience Initiative (CDRI) is an umbrella initiative of Kyoto University, funded by the Global Center of Excellence (GCOE) Program "Human Security Engineering for Asian Megacities," which has research, education, training, and implementation components.

The current program was developed in cooperation with NIDM and SEEDS, and data were collected through questionnaire survey. The cooperation and inputs from all the cities listed here are highly appreciated. The CDR (Climate and Disaster Resilience) index is developed based on five resilience-based dimensions: natural, physical, social, economic and institutional. The scope of this study is limited to climate-induced disasters, such as cyclone, flood, heat wave, drought and heavy rainfall induced landslide. For each individual city case, resilience information is presented as overall resilience, and separate physical, social, economic and institutional resilience. Higher values of resilience are equivalent to higher preparedness to cope with climate and disasters and inversely. Based on the results, policy points and recommendations are suggested. Not only are outputs from this study useful for city governments, but they also provide valuable knowledge and information to other local and national stakeholders having a similar target: the enhancement of community resilience.

United Nations Intenrational Strategy for Disaster Reduction (UN ISDR) has announced 2010-2011 as the 2 years campaign for Safer Cities. Under the slogan "My City is Getting Ready", the aim is to promote the concept of disaster resilient cities. A Task Force has been created on the Urban Risk Reduction for the Asian Region. As the Chair of the Task Force, I hope that this publciation will make value addition to the ISDR Safer Cities campaign, and will also be benficial to the city governments as well as related national ministries in the Government of India. Our key target is to enhance action, whatever small it may be. Hope, this publication will be a small step for creating actions.

Rajib Shaw
Associate Professor
Kyoto University

Climate change and urban disaster risk are two of the biggest challenges to India today, as it faces the consequences of unprecedented rates of population growth, urbanization, economic development, and greenhouse gas emissions. While initially there used to be concerns mainly around mega cities, the emergence of second and third tier cities as major engines of economic growth have brought in a much wider landscape of urban concerns that cuts across thousands of cities in different geo-climatic settings within the country.

This study is a first of its kind attempt to go down to the root causes of vulnerability in a city, taking a truly multi-sectoral and developmental approach. It is based on the belief that risk reduction is not a disaster management subject, but a developmental one. The focus of this approach is not on disasters, or even risks, but is on resilience. Building resilience can be achieved only through multi-sectoral and multi-stakeholder approaches, and the study presents the base information that can help build such resilience through appropriate policy and planning interventions.

The report presents findings from the first batch of twelve cities that were studied in detail. The selection of cities ensures that the report gives a representative spectrum that will be of use in taking this work forward both at research and policy levels.

We are grateful for the support and partnership that the National Institute of Disaster Management provided in seeing this study to its successful completion. Special thanks are due to Mr. P.G. Dhar Chakrabarti, Executive Director, National Institute of Disaster Management (NIDM), for his personal interest and guidance in this effort. Ms. Chandrani Bandopadhyay and Prof. Chandan Ghosh of NIDM provided invaluable support in finalizing the approach and ensuring fruitful engagement with the participating cities. The Kyoto University, has developed this methodology and we are grateful to them for having shared it, helped in its adaptation, and guiding the data collection and analysis of results. We are particularly grateful to Dr. Rajib Shaw, Assocatie Professor, Kyoto University and Mr. Joerin Jonas and other colleagues of Kyoto University's Global Centre of Excellence on Human Security Engineering for Asian Megacities. We also gratefully acknowledge the support of the Town and Country Planning Organisation of India, and the guidance and support provided by Mr. J.B. Kshirsagar, Chief Planner, and Mr. Udit Ratna towards the conduct of this study. Our special thanks also to Christian Aid for having supported the publication of this research.

Manu Gupta
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12 Introduction

14 Methodology

16 Analysis

17 Results and Key Findings

18 AIZAWL, Mizoram: Mountainous

20 AMRITSAR, Punjab: Arid

22 BHUBANESHWAR, Orissa: Mixed

24 DELHI, New Delhi: River Side

26 GUWAHATI, Assam: Mixed

28 JAIPUR, Rajasthan: Arid

30 KANPUR, Uttar Pradesh: River Side

32 KOLKATA, West Bengal: River Side

34 NAGPUR, Maharashtra: Arid

36 PORT BLAIR, Andaman & Nicobar Islands: Coastal

38 SHIMLA, Himachal Pradesh: Mountainous

40 VARANASI, Uttar Pradesh: River Side

In recent years, the focus on cities in India has grown steadily due to large population transfers (rural-urban migration) and more frequent and intense natural hazards leading to disasters. Currently, the urban population is only 30 per cent, but is likely to rise up to 40 per cent by 2030. This urbanisation pressure--in combination with more frequent and severe natural hazards that have been projected--are likely to challenge significantly the urban infrastructure and services of cities in the coming years. Especially, if natural hazards turn into disasters, the potential losses of lives, infrastructure in cities are expected to increase. Therefore, this study aims to understand how cities currently perform and whether the cities are ready to withstand climate-related disasters (for example, floods, cyclones, rainfall-induced landslides, heat waves, droughts).

SCOPE

In this study, results are shown from 12 cities from India regarding their resilience to climate-related disasters. The cities being Aizawl (Mizoram), Amritsar (Punjab), Bhubaneshwar (Orissa), Delhi (New Delhi), Guwahati (Assam), Jaipur (Rajasthan), Kanpur (Uttar Pradesh), Kolkata (West Bengal), Nagpur (Maharashtra), Post Blair (Andaman and Nicobar Islands), Shimla (Himachal Pradesh) and Varanasi (Uttar Pradesh). They were further catogorised based on population sizes and various other aspects as illustrated in Table 1 below.

Size Aspect	River-side	Coastal	Moun-tainous	Arid	Mixed
Small (up to 500,000)		• PORT BLAIR	• AIZAWL • SHIMLA		
Medium (500,000 to 3 million)	• KANPUR • VARANASI			• AMRITSAR • JAIPUR • NAGPUR	• BHUBANESHWAR • GUWAHATI
Large (more than 3 million)	• DELHI • KOLKATA				

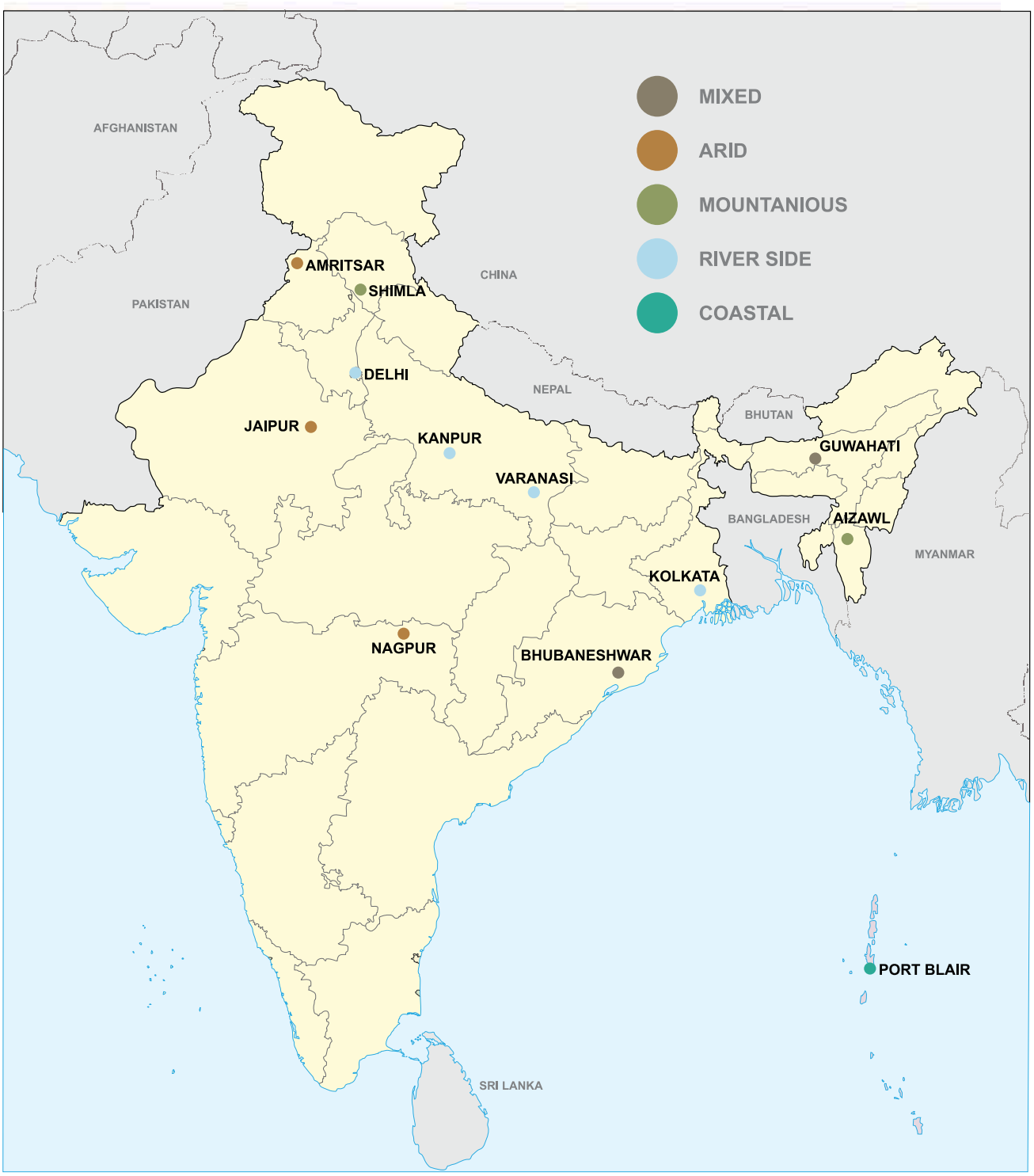
Table 1: CDRI - City selection

CONCEPT OF RESILIENCE

Resilience to climate-related disasters applied in an urban area tries to identify the capacity of a city's urban infrastructure and services to withstand disasters on one hand and how communities and institutions are expected to deal with such an event on the other. The question is basically how resilient is a particular city today? Or how is a community going to absorb, maintain, and recover from a disaster?

In order to assess this resilience, five dimensions (physical, social, economic, institutional, and natural) were identified, which may provide an appropriate picture of the current condition of a city. Thus, this concept of resilience is people-centred but also includes institutional dynamics and interactions of the environment to climate-related disasters.

Location of the selected 12 Indian cities



This study is based on a questionnaire covering five dimensions (see below) in which every dimension consists of another five indicators defining it in more detail. Each of the five indicators is then again represented by another five variables. Accordingly, 125 variables define the overall resilience of a city.

Climate Disaster Resilience Index (CDRI): Dimensions and Variables

PHYSICAL DIMENSION

Electricity: Access, availability, supply, external dependency on supply, alternative capacity
Water: Access, availability, supply, external dependency on supply, alternative capacity
Sanitation and solid waste disposal: Access to sanitation, collection of waste, treatement, recycling
Accessibility of roads: Transportation network, paved roads, accessibility during flooding, roadside covered drain
Housing and land-use: Building codes, buildings with non-permanent structures, buildings above water logging, ownership, population living in proximity to polluted industries

SOCIAL DIMENSION

Population: Population growth, population under 14, population informal settlers, population density
Health: Population suffer from waterborne/vector-borne diseases, access to health facilities, functionality, capacity of health facilities during a disaster
Education and awareness: Literacy rate, people's awareness about disasters, availability of public awareness programmes/disaster drills, access to internet, functionality of schools after disaster
Social Capital: Population participating in community activities/clubs, ability of communities to build consensus and to participate in city's decision-making process, castes interlinked with other castes
Community preparedness during a disaster: Preparedness -- logistics, materials and management; population participating in relief works, provision of shelter for affected people, support from NGOs/CBOs, population evacuating voluntarily

ECONOMIC DIMENSION

Income: Population below poverty line, number of income sources per household, income disparity, income derived in informal sector
Employment: Formal sector: percentage of labour unemployed, percentage of youth unemployed, percentage of women employed, percentage of employees coming from outside the city; percentage of labour employed in informal sector
Household assets: Households have: television, mobile phone, motorized vehicle, non-motorized vehicle, basic furniture
Finance and savings: Availability of credit facility to prevent disaster, accessibility of urban poor to credits, saving practice of households, household's properties insured, existence of catastrophe risk financing framework
Budget and subsidy: Funding of Disaster Risk Management (DRM), availability of subsidies/incentives for residents to rebuild houses, alternative livelihood, health care after a disaster

Mainstreaming of Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA): Mainstreaming in: city's land-use plans, housing plans, school education system, transport plans, environmental plans

Effectiveness of city's crisis management framework: Existence of disaster management plan, effectiveness of emergency team during a disaster (leadership, readiness, existence of alternative decision-making personnel)

Effectiveness of city's institutions to respond to a disaster: Formal/informal institutions, disaster training programmes for emergency workers, capability to learn from previous disasters

Institutional collaboration with other organisations and stakeholders: City's dependency to external institutions during disaster (national government, NGOs, private organisations), collaboration with neighbouring cities

Good governance: Integration of DRM, accountability of city government during a disaster, implementation of building codes, existence/effective operation of early warning systems, existence of disaster drills

Intensity/severity of natural hazards: Floods, cyclones, rainfall-induced landslides, heat waves, droughts, water scarcity

Frequency of natural hazards: Floods, cyclones, rainfall-induced landslides, heat waves, droughts, water scarcity

Ecosystem services: Quality of city (biodiversity, soils, air, water bodies, urban salinity)

Land-use in natural terms: Area vulnerable to climate-related hazards, urban morphology, settlements on hazardous ground, availability of Urban Green Space (UGS), loss of UGS

Environmental policies and food security: Existence/compliance rate to environment-related policies, existence of efficient waste management system (RRR), supply of food during a disaster

Accordingly, the respondents (municipalities) of the questionnaire were asked to choose a score between 1 and 5 for each question according to the city's performance in this particular matter (see Table 2 for the indicator of electricity).

In this study, 12 cities/ municipalities participated in providing answers to the extensive questionnaire to measure their resilience to climate-related disasters or the city's Climate Disaster Resilience Index (CDRI) The period of data collection was between August and September 2009.

2.1.1 % of city dwellers have legal access to electricity

1 (Up to 10%)	2 (11 – 25%)	3 (26 – 50%)	4 (51 – 75%)	5 (76 – 100%)	Choice
					2

2.1.2 2.1.1 Status of interruption

1 (Available up to 4 hours)	2 (Available 5 - 8 hours)	3 (Available 9 - 15 hours)	4 (Available 16 - 23 hours/day)	5 (No Interruption)	Choice
					3

2.1.3 City's electric supply authority capable to provide electricity

1 (Up to 10% of its demand)	2 (11 – 25% of its demand)	3 (26 - 50% of its demand)	4 (51 – 75% of its demand)	5 (76 – 100% of its demand)	Choice
					3

2.1.4 City's electric supply dependent on external provision (e.g. from other cities/areas) during most frequent disasters

1 (76 – 100%)	2 (51 – 75%)	3 (26 – 50%)	4 (11 – 25%)	5 (less than 10%)	Choice
					5

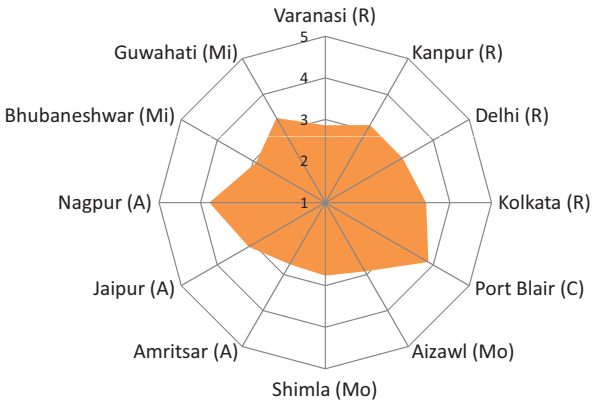
2.1.5 Extent of capacity of alternative emergency electric supply system to keep emergency services functioning (e.g. hospital, evacuation centers, etc.)

1 (No capacity)	2 (1 -25% of its demand)	3 (26 – 50% of its demand)	4 (51 – 75% of its demand)	5 (76 – 100% of its demand)	Choice
					2

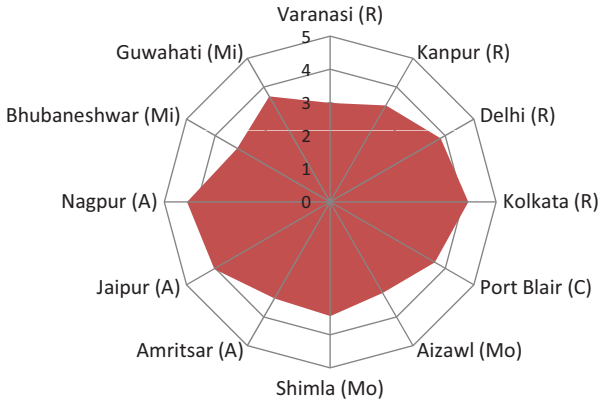
Table 2 – Electricity: filling-out

Cities Resilience Mapping based on CDRI

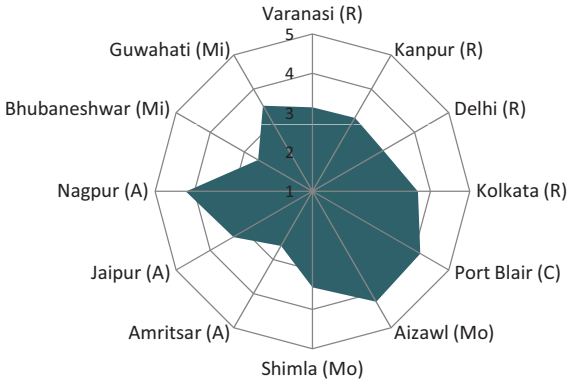
Climate Disaster Resilience Index



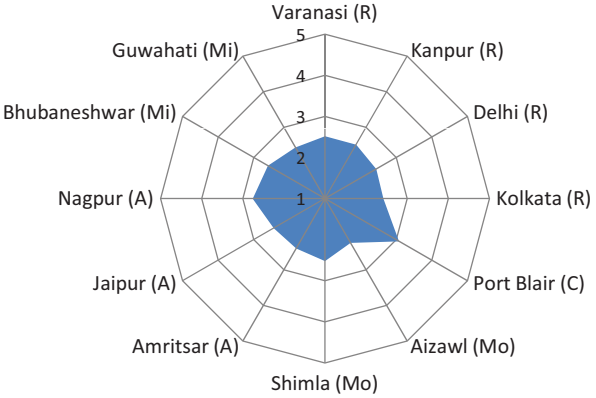
Physical



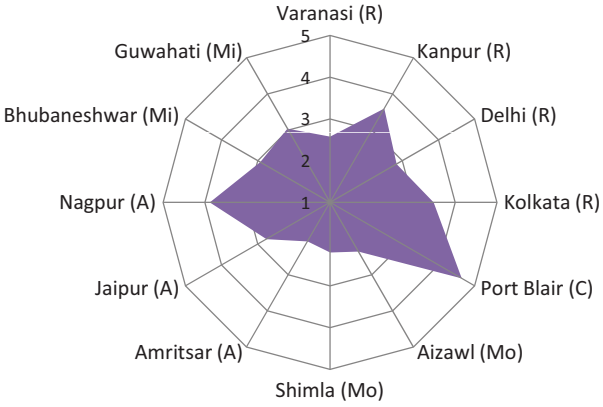
Social



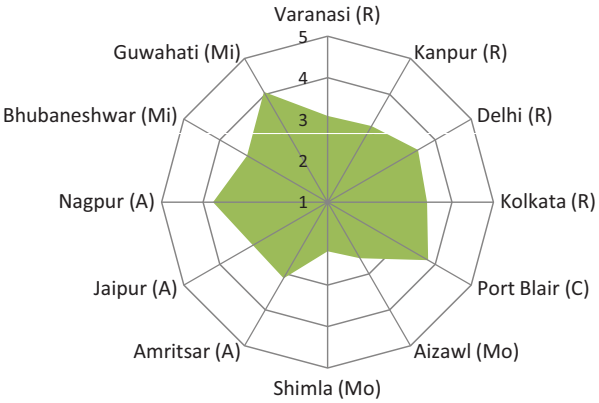
Economic



Institutional



Natural



On the overall analysis, there are six diagrams (spiders) showing comparative nature of the cities. This comparison is made to highlight the positive side of the city's preparedness. The first diagram shows the overall city's resilience, and rest five demonstrates cities resilience in terms of physical, social, economic, institutional and natural dimensions.

The following pages show the results for each of the 12 cities in the form of a detailed report, including policy implications in relation to the Hyogo Framework for Action (HFA), and diagrams (spiders) providing a visual idea about the current condition of a particular city. A graphic line crossing the line of a dimension/indicator closer to digit 1 means the city has low resilience in this aspect; accordingly, a result approaching the score of 5 represents high resilience.

Although it is not suggested to compare individual results of cities because of their contextual-based characteristics and also due to the small number of samples to allow solid conclusions, some overall findings may still be drawn:

- **The overall physical resilience indicates that in general, the cities are capable to provide the basic urban infrastructures and services.**

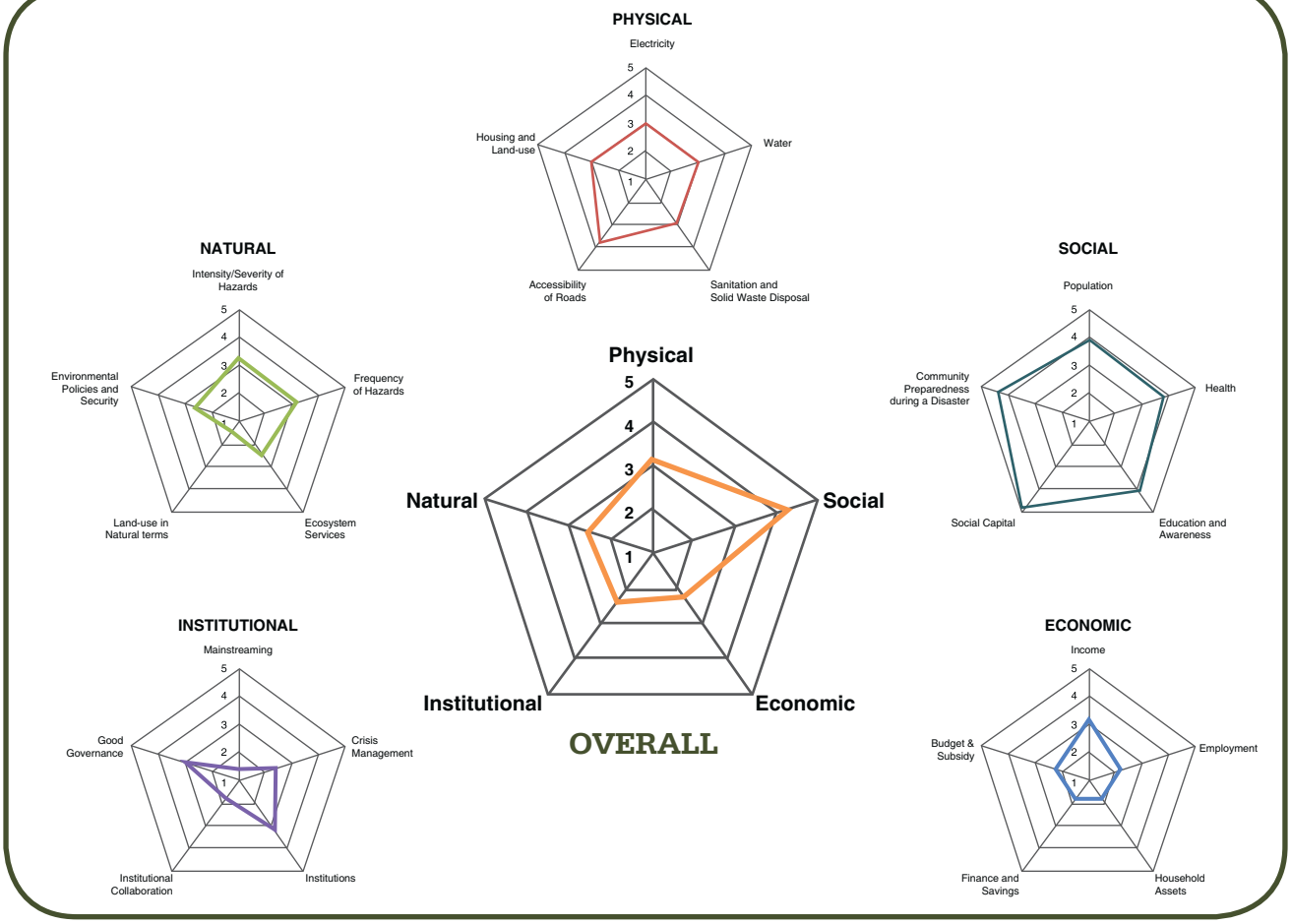
- **The overall economic resilience tends to be low in all the cities highlighting the challenges of providing sufficient employment and related incomes to their residents.**

- **The resilience of the natural dimension of cities located in mountainous areas tends to be lower than that of cities which lie in other areas, probably because natural hazards are felt stronger in hilly areas.**

AIZAWL, Mizoram: Mountainous

The city is characterised by a strong social resilience, especially with regard to social capital and cohesion. People are also quite knowledgeable about disasters and are generally in good health. During normal times, the city can provide the basic needs for its residents (electricity, water, sanitation, etc.), but these services are very fragile and liable to stop functioning considerably in case of a disaster, lowering physical resilience. The economic resilience is shaped by diversified sources of income of households as up to half of all households have at least two income sources. Another highlighting fact is that, as well up to half of all women are employed in the formal sector, and therefore, may contribute considerably to the financial stability of a family. The Municipality is quite strong in its entity and may protect the city from a disaster as collaborations exist with NGOs to receive support, but also the city's own emergency team is quite effective in case a disaster strikes. The Municipality could strengthen its role in securing the needs of its residents, for instance, by implementing DRR and CCA measures in major plans or implementing and enforcing DRM (Disaster Risk Management). The city lies in a mountainous region where natural hazards strike so the city may consider appropriate measures to reduce its vulnerability.

ANALYSIS RESULT



PHYSICAL:
The provision of electricity is available during 'normal' times, but is dependent on external suppliers during a disaster. Citizens have access to water, but the availability is limited to only a few hours a day. The majority of people have access to hygienic sanitation, but the disposal (treatment and recycling) of solid waste is a problem in the city. The accessibility of roads is good; however, most of them do not have a drainage system. Few buildings have been constructed following a building code for disaster resistance and most often the cities have infrastructure that are make-shift or of non-permanent nature.

SOCIAL:
The city's overall social resilience is high, in particular, social capital and cohesion demonstrate a population, which seems to be prepared in case of a disaster. Communities also enjoy good health and primary facilities are available and function during normal and disaster times. Nevertheless, ongoing growth of the city's population may challenge these strong social ties and conditions.

ECONOMIC DIMENSION:
In the city there are up to 24 per cent of people who live below the poverty line. However, less than half of the households depend on just one source of income. The city may suffer from a high unemployment rate (more than 25 per cent) and large numbers of people working in the informal sector. Accordingly, not all households have basic household assets such as television, mobile communication, or motorized vehicle. Citizens' and Municipal government's habits to be financially resilient (insurance system, individual savings, credit facility) in the case of a disaster are established, but the city would increase its resilience (protected) if more money (for DRM activities) or rather incentives could be developed and initiated by the Municipal government to help citizens protecting their properties against potential disasters.

INSTITUTIONAL DIMENSION:
The mainstreaming of DRR and CCA measures in city's land-use, housing, education, transport, and environmental policies and/or plans is limited. The crisis management framework of the city has a lot of potential to be improved, as the city might not be able to respond appropriately in case of a disaster due to the emergency team being short of trained workers. The other formal and informal organisations/institutions of the city are expected to be effective during a disaster. However, the city may be dependent on external institutions/support provided a severe disaster occurs. Stronger cooperation and the creation of networks with neighbouring cities would help to improve the emergency management. Furthermore, the resilience of the city could benefit from a more efficient early warning system and occasionally run disaster drills.

NATURAL DIMENSION:
The city is prone to frequently occurring (more than once a year) rainfall-induced landslides and droughts (water scarcity). The city's ecosystem (water bodies, biodiversity, soil, urban salinity) is in a reduced condition; however, the air quality is still moderate. A large proportion (more than 75 per cent) of the city's land area is vulnerable to climate-related disasters and the majority of settlements are located on hazardous ground. The amount of urban green space is less than one per cent and would benefit from strong environmental preservation policies.

POLICY IMPLICATIONS IN RELATION TO THE HYOGO FRAMEWORK FOR ACTION (HFA)

HFA-1 (Governance):
The city benefits from available financial resources targeting DRM which may help in building key capacities (institutional setting) for successful implementation of DRR measures.

HFA-2 (Risk Assessment and Early Warning System):
The availability and operation of early warning systems is limited and may be improved to reduce the risk of potential losses (infrastructure, human lives) due to a striking hazard. Improved dissemination of information during a disaster may also help to minimise additional losses after the incident.

HFA-3 (Knowledge Management):
Frequently organised disaster drills and public awareness programmes may contribute to a high awareness level about disasters among communities. However, DRR is not yet implemented into the school curricula, which may be a measure to generate an even more aware population.

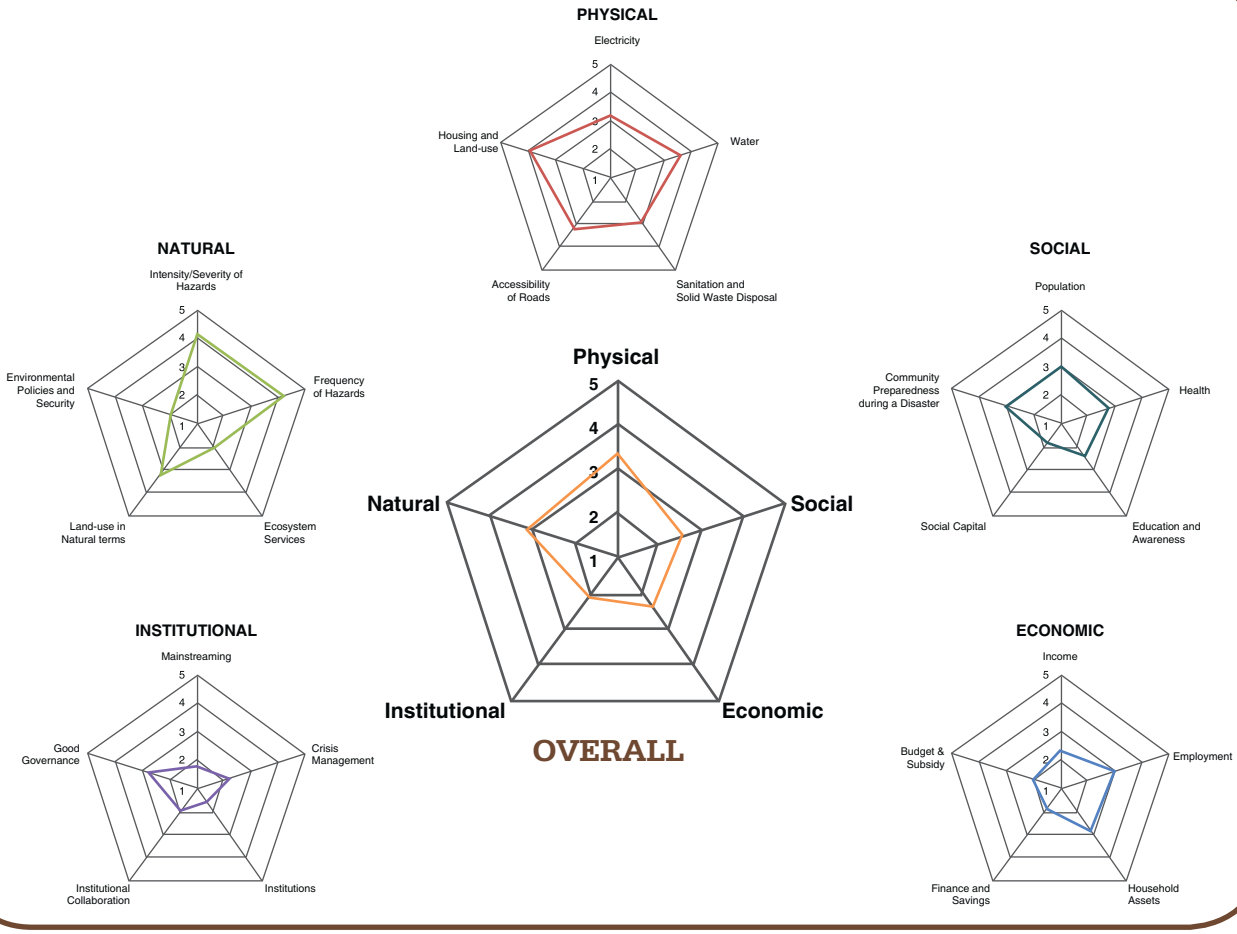
HFA-4 (Vulnerability Reduction):
The city has not yet fully mainstreamed DRR into its plans/policies (land-use, housing, transport, or environmental) although it would be beneficial to reduce the vulnerability of the city to climate-related disasters. DRR measures which would reduce the underlying risk factors could aim to safeguard the ecosystem of the city, fully implement a solid waste management system (RRR), create more employment in the formal sector, or provide households with credit facility to help them finance necessary disaster prevention measures.

HFA-5 (Disaster Preparedness):
The formal/informal institutions of the city are effective during a disaster, however, they need to be strengthened through a well implemented disaster management plan which would also define responsibilities among the various stakeholders (communities, emergency management team, national government, NGOs, etc.) involved during a disaster. Accordingly, increased collaborations with these stakeholders would make the city more prepared to climate-related disasters.

AMRITSAR, Punjab: Arid

The city is located in an arid area and experiences heat waves more than once a year. The physical resilience of the city is characterised by adequate provision of key urban services (electricity, water, sanitation) for most people during normal times. The social, economic, and institutional resilience are lower in their performance, on one hand due to not yet sufficiently established social networks/capital, institutions to provide effective disaster management, and reduced financial opportunities of the people and the Municipality, but on the other unemployment rates of labour (less than 12 per cent) are low, people are literate, and have good health condition.

ANALYSIS RESULT



PHYSICAL DIMENSION:
Most residents (up to 75 per cent) have access to electricity and potable water; however, unlike water, the provision of electricity is only available for not more than 8 hours a day. The city is not dependent on external electric supply during a disaster, but the capacity of alternative emergency electric supply to keep emergency services running is not sufficient. Similarly for water, the capacity of alternative safe water supply in the case of a disaster is limited. Access to hygienic sanitation is available for most residents. Although solid waste is collected, its disposal (no treatment or recycling) remains a problem. The accessibility of roads is moderate or good, but most roads do not have a drainage system. Buildings constructed following a building code for hydro-meteorological disasters are few; nevertheless, they are mostly of permanent structure and not located in proximity to polluted industry.

SOCIAL DIMENSION:
Although the percentage of people suffering from waterborne or vector-borne diseases is very small, the capacity and functionality of health care facilities during a disaster is limited. The literacy rate of the city is high, but citizen's awareness about disasters is minimal which could be improved by the introduction of awareness programmes, disaster drills, etc. and better access of people to internet. Social capital and cohesion of communities is not yet sufficiently established as few people are engaged in social activity groups, participate in the city's decision-making process, are being mixed up with other castes, or are capable to provide relief support (volunteering, logistics, shelter) in case of a disaster.

ECONOMIC DIMENSION:
More than a quarter of households in the city depend on income derived from the informal sector and most households depend on only one income source. Although unemployment rates in the formal sector are low (less than 12 per cent), there is also a large fraction (more than 25 per cent) of labour working in the informal sector. Most households benefit from basic household assets, like television and motorized vehicles. So far it seems that there is no effective insurance scheme in place to protect properties of residents or for residents to avail of loans/credit in case of a disaster. Accordingly, there are not yet subsidies/incentives available for residents in form of alternative livelihood and health care in the aftermath of a disaster. The Municipality's role would be beneficial to protect future losses resulting from disasters if the city's current annual budget (less than 2.5 per cent) targeting DRM could be slightly lifted.

INSTITUTIONAL DIMENSION:
The institutional capacities of the city are not yet sufficiently established. Although the city has an early warning system in place and runs disaster drills more than once a year, efficient emergency management and prepared institutions (collaboration with other stakeholders, logistics, etc.) are likely to have difficulties if a disaster takes place. For instance, mainstreaming of DRR and CCA measures in land-use, housing, transport, and environmental plans/policies or the implementation of a disaster management plan could provide basic indications on how to protect the city against potential natural hazards.

NATURAL DIMENSION:
The city is vulnerable to frequently (more than once a year) occurring heat waves. The quality of the city's ecosystem (biodiversity, soil, air, water, urban salinity) is on the decline. However, less than a quarter of the municipalities' land area is directly affected by heat waves and only few settlements are located on hazardous ground. Although the percentage of available urban green space in the city is still high, its loss over the past decades was also considerable. Environmental preservation policies (for example, mitigation of air pollution) could be a possible instrument to protect the urban ecosystem from further degradation.

POLICY IMPLICATIONS IN RELATION TO THE HYOGO FRAMEWORK FOR ACTION (HFA)

HFA-1 (Governance):
The city benefits from available financial resources targeting DRM, which may help in building key capacities (institutional setting) for successful implementation of DRR measures.

HFA-2 (Risk Assessment and Early Warning System):
The existence and operation of early warning systems led by the government is reduced. Thus, it may be improved and better operated to provide the necessary warning in case of a disaster to reduce potential losses (infrastructure, human lives). Furthermore, the dissemination of information during a disaster may be more transparent to reduce losses.

HFA-3 (Knowledge Management):
The population of the city has limited knowledge about the potential threat of disaster which may be improved by incorporating DRR into the school curricula. More frequent public awareness programmes would also be beneficial besides disaster drills organised once a year. Improved access to internet may also be helpful for communities to increase their knowledge about disasters.

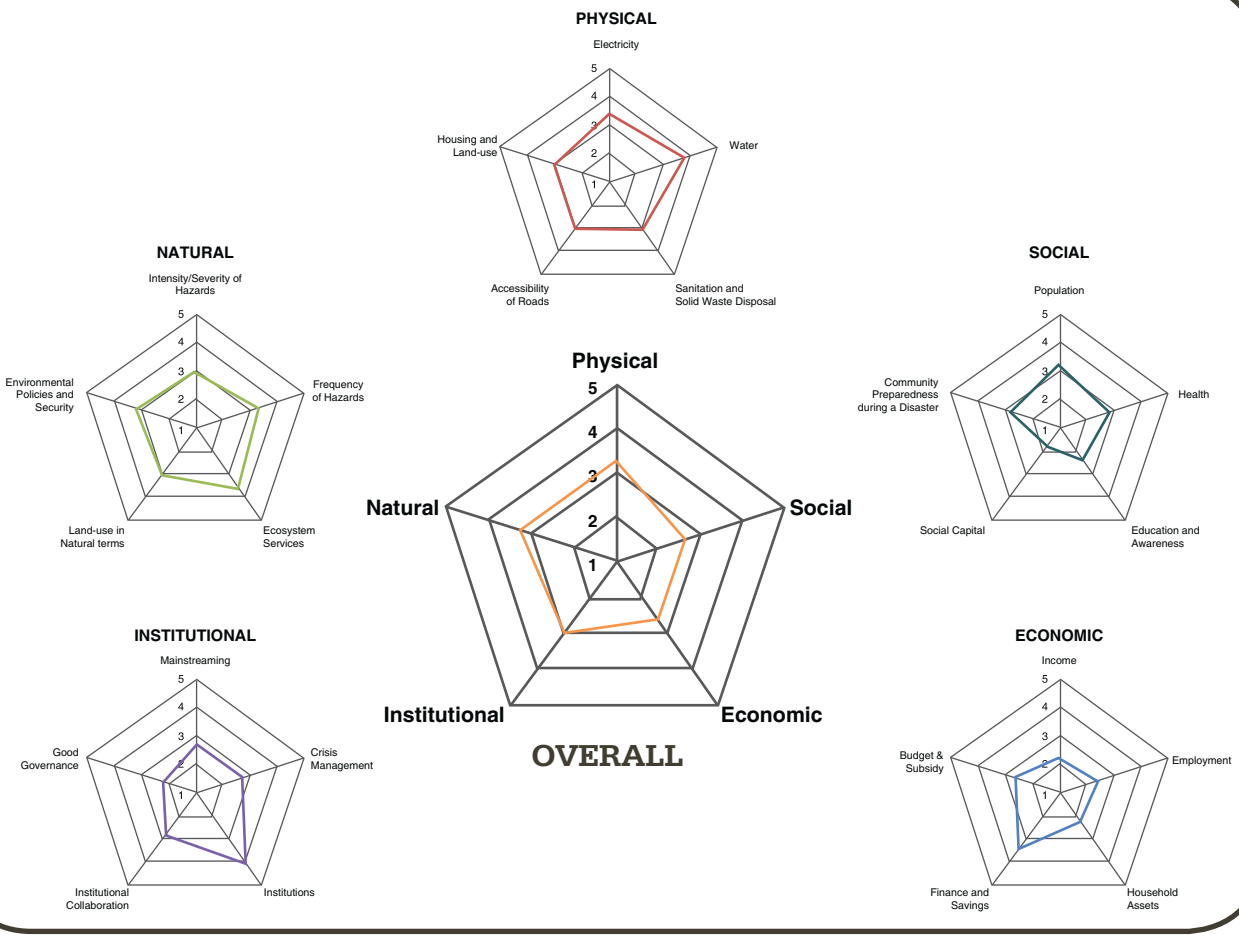
HFA-4 (Vulnerability Reduction):
The mainstreaming of DRR in city's plans/policies (land-use, housing, transport, or environmental) is not yet fully implemented. This may be a primary step to reduce the city's vulnerability to potential disasters. Various sectors of the city could benefit from DRR measures, for instance, in the housing sector more buildings could be constructed following a building code or natural resources (ecosystem, loss of green space) and would benefit from more protection initiatives.

HFA-5 (Disaster Preparedness):
The city may benefit from a well implemented disaster management plan to define the right responsibilities for the various stakeholders (communities, emergency team, NGOs, government, etc.) to handle a disaster situation. Collaborations with these stakeholders may be beneficial in case of a disaster. Accordingly, the city's institutions and emergency teams could be strengthened to make the city more prepared to climate-related disasters.

BHUBANESHWAR, Orissa: Mixed

The city is categorised as a mixed city because it is prone to several hazards, like floods, cyclones and heat waves which occasionally lead to disasters. The city's resilience is also characterised by limited provisions of urban services (for example, electricity, water, access to roads) due to reduced opportunities amongst other reasons of the Municipality to get funding for improvement. However, the city institutions, for instance the emergency teams, are effective even with restricted financial opportunities of the local government. Existing collaborations with other stakeholders (union government, NGOs, and private organisations) are likely to be of help in case of a disaster. A low rate of growing population is beneficial for the communities to further keep good health levels, social cohesion, and improve their social capital. Apart from that, the city is challenged by limited economic resilience as, for instance, more than 35 per cent of people live below the poverty line. The city may build upon its natural resilience in combination with institutional support to further introduce a sustainable development path for the city.

ANALYSIS RESULT



PHYSICAL DIMENSION:
Most citizens have access to electricity (up to 75 per cent) and usually at any times. However, in case of a disaster, the city's electric supply is dependent on external sources (cities/areas). Similarly, up to 75 per cent of the residents have access to water, but the availability is reduced to 1-2 hours per day. Hygienic access/provision of sanitation is available, but the city lacks an efficient solution to treat and recycle waste before dumping. Although most roads are paved in the city, they are likely to be flooded due to missing drainage systems. Few buildings are constructed following a building code for hydro-meteorological disasters and the majority is of non-permanent structure, lowering the physical resilience.

SOCIAL DIMENSION:
The population growth rate of the city is positive but less than one per cent providing an ideal prerequisite for establishing a strong social resilience of the city. However, at present more than 24 per cent of the residents are informal settlers and health condition of the citizens is fragile due to limited access and functionality of health facilities. Nevertheless, the health system is capable to respond in case of a disaster. The literacy rate of the city is about Indian average, but people are ignorant of potential disasters. The city also misses public awareness programmes or drills for disaster education. Social capital is low due to less than 10 per cent of the population participating in community activities or few people engaging in social activities sharing their interests/views, and different castes are not sufficiently interlinked with each other. Social cohesion is characterised by a high extent of residents volunteering in relief works and good support from NGOs/CBOs after a disaster, but it could be further increased if households would be better prepared (logistics, materials) against potential disaster.

ECONOMIC DIMENSION:
The economic resilience is characterised by a considerable number of people living below the poverty line (more than 35 per cent) and high per centage rates of unemployment (more than 25 per cent of labour). This is reflected in reduced opportunities of households to possess basic household assets such as motorized vehicles although most households have televisions. Access, availability, and effectiveness of credit facility exist for all residents to protect their properties, and around half of total households have their properties insured. Availability of subsidies/incentives offered, for instance, by the Municipality could be beneficial to provide alternative livelihood or health care in the aftermath of a disaster.

INSTITUTIONAL DIMENSION:
Mainstreaming of DRR and CCA is limited in city's land-use, education, and transport plans/policies, but implemented in housing and environmental plans/policies. The city's management framework may become even more strong if a disaster management plan would be introduced, as the emergency team is already effective (leadership/competence) and responds quickly in case of a disaster. The institutions of the city are quite effective and, most importantly, disaster training programmes for emergency workers are run more than twice a year. In case of a disaster, the Municipality can expect support from NGOs. However, the city is not yet linked well enough with the national government, private organisations or neighbouring cities. Good governance may be improved if DRM would be enforced, more information disseminated during a disaster, and building codes more vigorously implemented.

NATURAL DIMENSION:
The city is prone to many natural hazards such as severe floods, cyclones and heat waves. The quality of the city's ecosystem is moderate or good regarding urban biodiversity and soil quality, but is reduced for water bodies, air, and urban salinity. Although there is still more than 16 per cent of urban area green space, its loss over the past decades is severe and may further degrade the urban ecosystems, especially with regards to the intense land-use of the city. However, there are environmental preservation policies in place with a nearly high compliance rate, which may help protecting the various ecosystems.

POLICY IMPLICATIONS IN RELATION TO THE HYOGO FRAMEWORK FOR ACTION (HFA)

HFA-1 (Governance):
The city benefits from available financial resources targeting DRM, which may help in building key capacities (institutional setting) for successful implementation of DRR measures.

HFA-2 (Risk Assessment and Early Warning System):
The existence and operation of early warning systems led by the government is reduced. Thus, it may be improved and better operated to provide the necessary warning in case of a disaster to reduce potential losses (infrastructure, human lives). Furthermore, the dissemination of information during a disaster may be more transparent to reduce losses.

HFA-3 (Knowledge Management):
To increase the people's current limited knowledge about disasters, a full incorporation of DRR into the school curricula is one measure. Other measures are the organisation of more frequent disaster drills and public awareness programmes.

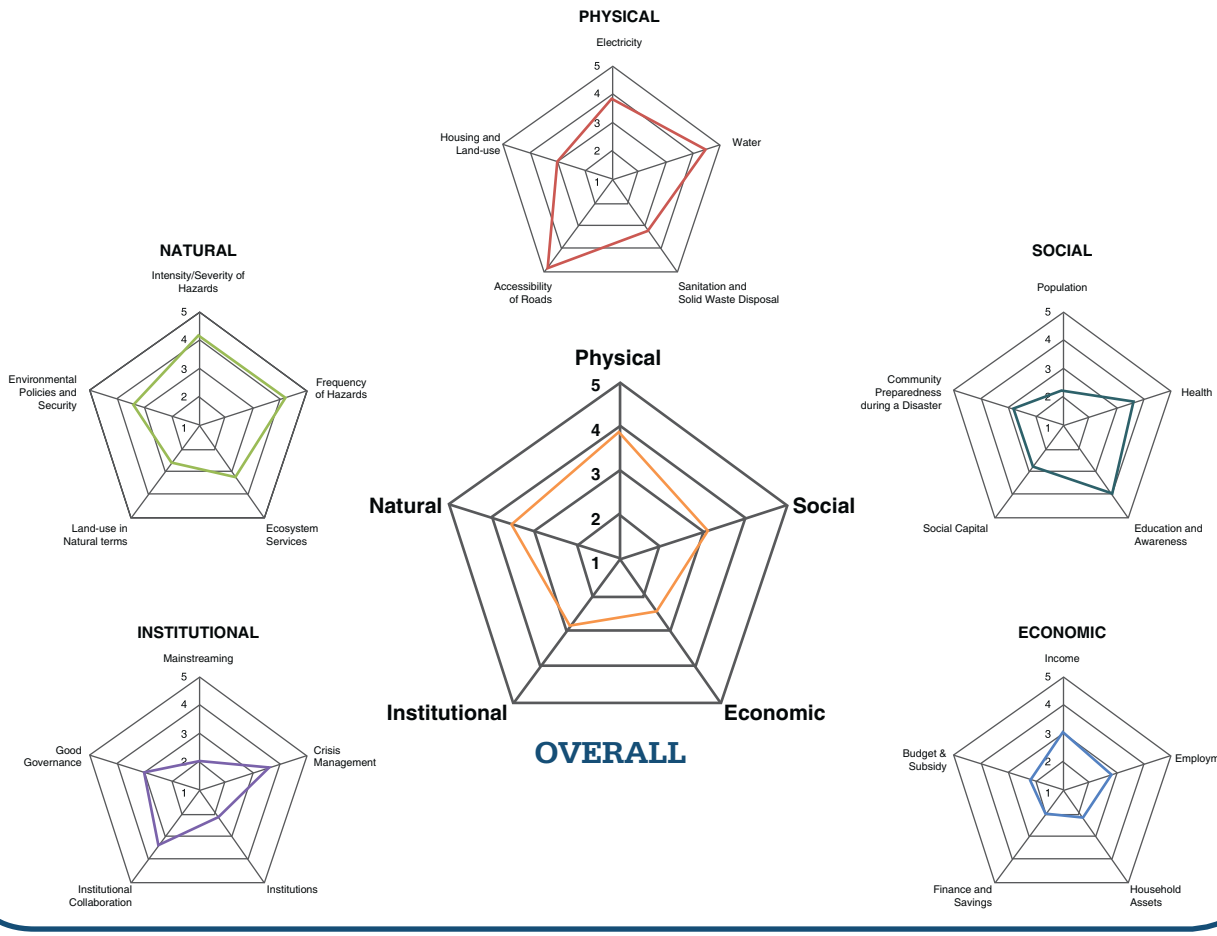
HFA-4 (Vulnerability Reduction):
At the planning level, the city has addressed DRR in housing and environmental plans, but may mainstream it also in land-use and transport plans/policies. In order to reduce the vulnerability of the city to climate-related disasters, various DRR measures could aim to protect natural resources (loss of urban green space, high intensity of land-use, ecosystems), improve the implementation of an efficient solid waste management system (RRR), create more jobs, improve the provision of health facilities, or increase the implementation of building codes and number of buildings of permanent structure.

HFA-5 (Disaster Preparedness):
The city's emergency team is quite efficient (leadership, readiness) to deal with disasters although a disaster management plan is not yet fully implemented. However, the benefit is that the emergency team is available and has a well trained staff to handle a disaster situation. Collaborations with NGOs exist during disasters to receive support is in place but not yet sufficiently with neighbouring cities, national government, and private organisations which would make the city more prepared to climate-related disasters.

DELHI, New Delhi: River Side

The city is prone to both the extremes--floods as well as droughts. The large size of the city challenges the resilience of all dimensions, for instance, the provision of electricity, part of the physical dimension, is sometimes struggling to meet the demand resulting in power-cuts, and therefore, might be fragile to fulfill demand in case of a disaster. However, the Municipality is aware about the challenges as disaster management plans exist at various administrative levels. The ongoing growth of the city in terms of improved infrastructure, population size, and improving financial opportunities may also have impacts on the natural environment with its fragile ecosystems. Moreover, communities may become more active in the city's decision-making process to shape and improve their livelihoods.

ANALYSIS RESULT



PHYSICAL DIMENSION:
At normal times, electricity is, for most citizens, usually provided apart from occasional short power-cuts on days when energy demand is highest. Thus indicating that in case of a disaster situation, the city may be dependent on external electric supply. Access to water is provided for most residents but often not available at all times. The city's safe water supply is expected to be independent to uphold its services even during a disaster. Hygienic access to sanitation is available for a large majority (up to 75 per cent) of people; accordingly, public facilities or open ground may serve for the remaining part. Solid waste is collected but less than 25 per cent is treated or recycled before dumping. Accessibility of roads is good (most are paved) as more than 60 per cent have roadside covered drain, however, in case of sporadic torrential rainfall during the monsoon period many roads tend to get flooded. Up to 50 per cent of buildings are constructed following a building code but more than 30 per cent are of non-permanent structure and half of the buildings are below normal flood water logging level.

SOCIAL DIMENSION:
The population consists of a large number (up to 34 per cent of all) of children below the age of 14 and a considerable number of people, living in urban poor areas (around 25 per cent). These figures in addition to an ongoing population growth (up to 3.9 per cent a year) may challenge urban infrastructure and administration and likely lead to unplanned development in some areas in the suburbs. Although most people (up to 90 per cent) have access to primary health facilities, up to 35 per cent of residents suffer from waterborne or vector-borne diseases every year. However, primary health facilities are also expected to provide the needed services in case of a disaster. The literacy rate is high (up to 87.5 per cent) and most people are aware about disasters. This could be further improved if the Municipality could organise public awareness programmes/disaster drills more often. Social capital is not yet fully established as few people participate in social activity groups or are part of the city decision-making process; however, various castes are quite well interlinked with each other and may strengthen the social entity.

ECONOMIC DIMENSION:
People living below the poverty line are relatively few (less than 15 per cent) and most household may rely on more than one income source. However, there is a high income disparity between the 10 per cent more often richest and poorest of the city and more than 26 per cent depend on income from the informal sector. Up to 18 per cent of available labour is unemployed and young people are slightly more affected (up to 24 per cent more often unemployed). The large majority of households have basic assets such as television, but only up to 45 per cent own a motorised vehicle. So far properties of households are not sufficiently protected/insured. Thus, better credit facility to face/prevent a disaster could support residents in this regard; however, up to five per cent of the city's annual budget targets DRM and may further help securing the urban infrastructure.

INSTITUTIONAL DIMENSION:
Mainstreaming of DRR and CCA in land-use, housing, transport, or environmental plans/policies is limited or does not yet exist. However, it is integrated to some extent in the school curricula. A disaster management plan exists and is incorporated. The effectiveness (leadership/competence) and response of emergency teams in case of a disaster is quite good. However, availability and efficiency of trained emergency workers is limited as they are trained once every two years. The municipality is capable to manage a disaster independently and is well connected with national government and NGOs, but it could probably benefit from better coordination and networking with neighbouring cities to manage a disaster. Practice of disaster drills on a more frequent basis would further raise the awareness among people.

NATURAL DIMENSION:
The city is prone to floods and especially droughts. The quality of the city's ecosystem is reduced especially regarding to the condition of many water bodies and air quality. The intensity of land-use is very high and up to 75 per cent of the urban area is vulnerable to the climate-related hazards. Although there is still more than 16 per cent of urban green space, its loss over the past decades is severe. Environmental preservation policies exist but improved compliance by citizens and authorities would reduce the exposure of the environment to potential hazards.

POLICY IMPLICATIONS IN RELATION TO THE HYOGO FRAMEWORK FOR ACTION (HFA)

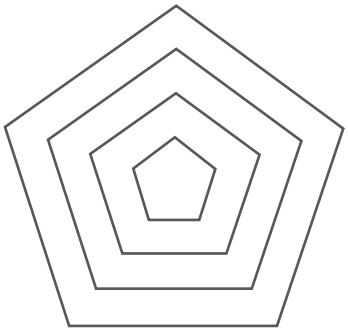
HFA-1 (Governance):
There is availability of financial resources for DRM activities, which may help in developing adequate capacities for successful DRR implementation.

HFA-2 (Risk Assessment and Early Warning System):
The existence and operation of early warning systems led by the government is reduced. Thus, it may be improved and better operated to provide the necessary warning in case of a disaster to reduce potential losses (infrastructure, human lives). However, the dissemination of information during a disaster is quite good, which may reduce losses in the aftermath of such an event.

HFA-3 (Knowledge Management):
The population of the city is quite knowledgeable about the potential threat of disaster, although disaster drills are not conducted frequently (at present, less than once every two years) and similarly few public awareness programmes are organised by the authorities. People may be aware about disaster due to the incorporation of DRR into the school curricula.

HFA-4 (Vulnerability Reduction):
The city's key plans/policies (land-use, housing, transport, or environmental) are not yet fully incorporating DRR. This is crucial to lay the foundations for DRR measures. Such measures could address the high number of buildings of non-permanent structure, limited availability of jobs, reduced provision of credits for households to finance disaster prevention measures, or to protect the natural resources (high intensity of land-use, loss of urban green space).

HFA-5 (Disaster Preparedness):
The city has disaster management plans (including uncertainties of climate change) which are implemented. The emergency teams are effective in terms of leadership but may be strengthened in terms of readiness and availability of alternative decision-making personnel. Moreover, number of emergency workers may be increased and better trained. Although the city is well linked with the national government and NGOs to receive support during a disaster, it may develop a network with neighbouring cities to collaborate during such an event. These measures would make the city more prepared to climate-related disasters.



PHYSICAL DIMENSION:
Most citizens have access to electricity and potable water, which are usually available at any time, but the supply of water may be limited in long periods of very dry weather. A newly constructed dam outside the city is expected to provide the city with additional capacities to meet the rising demand of water in the coming years. Hygienic access to sanitation is available for most people. Solid waste is collected and treated before dumping, but not necessarily recycled. Roads cover a significant area (up to 15 per cent) of the city and are mostly paved. Buildings constructed following a building code for hydro-meteorological disasters are up to 30 per cent. However, more than 30 per cent of buildings are of non-permanent structure; nevertheless, few people live in proximity to polluted industries.

SOCIAL DIMENSION:
The population density is high with more than 12,000 people living within one square kilometer and a current population growth, which is up to 5.9 per cent and also more than 24 per cent of the population are informal settlers. But regardless of these figures, overall health condition of residents is quite good as few (less than 23 per cent per year) suffer from waterborne or vector-borne diseases and almost all citizens (up to 95 per cent) have access to primary health services. However, the capacities of these facilities to treat patients in an emergency situation (disaster) may be slightly lower compared to normal times. The city runs public awareness programmes/drills approximately once a year which helps people to improve their knowledge about disasters. Social capital is established among the communities with up to 40 per cent of the population being engaged in community activities which contribute to the people's ability to build consensus over time and share common interests. Social cohesion is characterised by communities that are prepared for a disaster in terms of providing shelter, evacuating voluntarily, and also volunteering for relief work; nevertheless, most households are likely to benefit from more logistics and materials to face a disaster.

ECONOMIC DIMENSION:
Only about 15 per cent live below the poverty line but most households depend on just one income source and more than 25 per cent of them depend on income derived from the informal sector. Unemployment in the formal sector is high with more than 25 per cent of labour being without a job. Most households have a television and mobile phone/telecommunication but less than 30 per cent have either a motorised or non-motorised vehicle. Less than 20 per cent of city's household properties are insured; nevertheless, credits are available to tide over a disaster. So far less than 2.5 per cent of city's annual budget targets DRM. This is not yet sufficient to prevent the city from likely, more severe/frequent natural hazards. There is limited availability of subsidies/incentives for the residents provided by the Municipality to rebuild houses after a disaster to secure alternative livelihood or finance health care.

INSTITUTIONAL DIMENSION:
Incorporation and mainstreaming of DRR and CCA in land-use, housing, transport, and environmental plans/policies, and education system is limited. Overall, the city's crisis management framework is to some extent effective but may benefit from a more effective emergency team (leadership/competence, response), better (less than once every two years) trained emergency workers, and an enhanced amount of equipments. Additionally, a disaster management plan would be helpful in coordinating a disaster. The other formal and informal institutions/organisations of the city are only slightly effective in case of a disaster. The Municipality is dependent on external institutions during a disaster and is also not well connected with neighbouring cities and even the national government; however, there are good collaborations with NGOs and private organisations during a disaster. Good governance is characterised by reduced enforcement of DRM, effectiveness of an early warning system for disasters. Building codes are implemented but disaster drills are however rarely conducted (less than once every two years).

NATURAL DIMENSION:
The city is prone to occasional heat waves and droughts (water scarcity). The quality of city's ecosystem (biodiversity, soil, air, and urban salinity) is reduced; especially water bodies tend to be in a poor condition and may be further challenged by the intense land-use. Moreover, large areas (up to 75 per cent) of the city are susceptible to climate-related hazards. Although environmental preservation policies exist, for instance, mitigation policies for air pollution, the compliance of residents and authorities to such policies is limited.

POLICY IMPLICATIONS IN RELATION TO THE HYOGO FRAMEWORK FOR ACTION (HFA)

HFA-1 (Governance):
The city has the benefit of available financial resources targeting DRM, which may help in implementing DRR measures.

HFA-2 (Risk Assessment and Early Warning System):
The existence and operation of early warning systems led by the government is limited. Thus, it may be developed or better operated to provide the necessary warning in case of a disaster to reduce potential losses (infrastructure, human lives). Furthermore, the dissemination of information during a disaster needs to be vastly improved.

HFA-3 (Knowledge Management):
The city's population has only limited knowledge about the potential impacts of disasters, thus it would benefit from more often (at current: less than once every two years) run disaster drills. Furthermore, DRR could be fully mainstreamed into the school curricula.

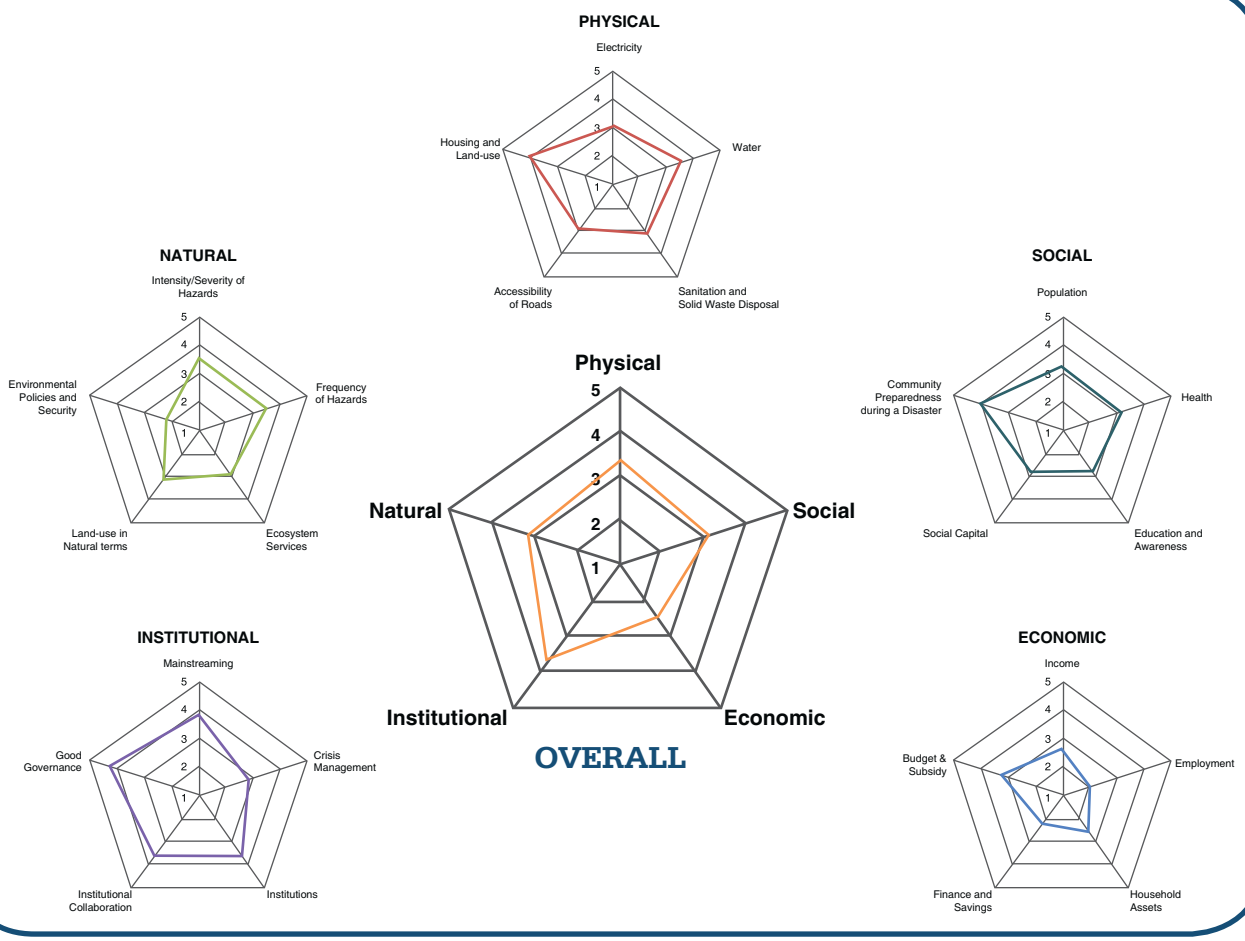
HFA-4 (Vulnerability Reduction):
An improved mainstreaming of DRR into city's land-use, environmental, housing, or transport plans/policies would mark a first step for addressing DRR at planning level. Furthermore, beneficial DRR measures aiming to reduce the vulnerability of the city could be those which, for example, reduce the number of buildings of non-permanent structure, improve the provision of employment, provide insurance schemes for households to protect their properties, or protection measures to safeguard the ecosystems of the city.

HFA-5 (Disaster Preparedness):
A disaster management plan exists (not including uncertainties of climate change), but the city's emergency team is not fully capable/efficient (leadership, readiness, alternative decision-making) to handle a disaster. It may benefit from more numerous and better trained staff. Furthermore, improved collaborations with neighbouring cities and the national government would make the city more prepared to climate-related disaster. The city is well interlinked with NGOs and private organisations during a disaster.

KANPUR, Uttar Pradesh: River Side

The city has a strong institutional resilience due to good mainstreaming of DRR and CCA in various plans/policies; furthermore, an effective emergency team exists, but it would benefit significantly from a fully incorporated disaster management plan. This would help to prevent the city from frequently occurring floods and heat waves. Social resilience is moderate as, for instance, most people enjoy good health and have access to primary health facilities, or social cohesion highlights communities that are capable of providing others with relief support (shelter, material, etc.) in case of a disaster. The economic resilience is characterised by limited financial opportunities to people, however, the majority of households have basic assets such as television or motorized vehicle. The physical resilience is in average strong due to well incorporated building codes and usually good structure of buildings and roads, however, not all residents have access to electricity and water so far; nevertheless, in case of a disaster the provision of basic urban services should be delivered.

ANALYSIS RESULT



PHYSICAL DIMENSION:
Only up to 75 per cent of the citizens have access to electricity, which is also not always available for more than 8 hours a day. Similarly, only up to 75 per cent of the residents have access to potable water but in case of a disaster the city's water supply is not (less than 10 per cent) dependent on external provision. Although waste is collected every day, its treatment and recycling (not available) before dumping remains a problem. Up to 70 per cent of roads are paved but less than 30 per cent of all roads have covered drain which may limit their access in times of disasters in form of yearly occurring floods. Up to 50 per cent of the buildings are constructed following a building code for hydro-meteorological disaster and most buildings are of permanent structure. However, up to 37.4 per cent of the buildings are located in proximity to industrial pollution.

SOCIAL DIMENSION:
The city's population is growing at a rate of approximately 3.9 per cent a year and has around one fifth of its population living in informal settlements. Primary health facilities are available for most people (up to 90 per cent), which may contribute to a relatively small number (less than 23 per cent) of people suffering from waterborne or vector-borne diseases every year. However, in case of a disaster, the capacity of these facilities to provide services may be limited. The current knowledge of people about disaster is still limited but may benefit from public awareness/disaster drills organised at least once a year. Social capital is characterised by reduced involvement of the communities (less than 20 per cent) in community or social activities, or to participate in city's decision-making process. However, different castes are well interlinked and thereby strengthen the communities. Social cohesion in terms of providing support (volunteering, relief assistance, provision of shelter) for other people is established.

ECONOMIC DIMENSION:
The population living below the poverty line is up to 24 per cent and more than 26 per cent depend on income derived from the informal sector. Also around half of the households depend on just one income source. The unemployment rate is high with more than 25 per cent being without jobs. Although the financial opportunities seem to be constrained, up to 70 per cent of households have televisions and up to 60 per cent own a motorised vehicle. There is also limited access and availability for residents to get credit to prevent or mitigate disasters. This credit may support households to protect their properties. Also, as less than 20 per cent of them are insured so far. Furthermore, the Municipality is capable to spend up to five per cent of the annual budget for DRM activities and there are subsidies/incentives available for citizens to provide them with support (livelihood, health care, rebuild houses) during a disaster.

INSTITUTIONAL DIMENSION:
The incorporation and mainstreaming of DRR and CCA in city's land-use, transport, education system and environmental plans/policies is quite good. So far the city's disaster management plan is not yet sufficiently incorporated; however, an emergency team exists, which is ready, effective and able to respond after a disaster strikes. The Municipality is dependent on external support during a disaster to manage it, but it may benefit from collaborations with national government, NGOs, and private organisations. Good governance is characterised as moderately established, as DRM is enforced; dissemination of information during a disaster is good, building codes are being implemented, and an early warning system is ready. Furthermore, the Municipality organises disaster drills once every year.

NATURAL DIMENSION:
The city suffers from several hazards like normal floods, severe heat waves (once a year), and though rarely, severe droughts. The quality of the ecosystem (biodiversity, air quality, water bodies, and urban salinity) is reduced, but moderate in terms of soil quality (contaminated land). Less than 25 per cent of the city's land area is vulnerable to climate-related hazards, but land-use is intense and less than six per cent of the urban area is green space. There is limited availability of environmental preservation policies and an efficient waste management system (Reduce, Reuse, Recycle), however, there are some mitigation policies existing to reduce air pollution.

POLICY IMPLICATIONS IN RELATION TO THE HYOGO FRAMEWORK FOR ACTION (HFA)

HFA-1 (Governance):
There is availability of financial resources for DRM activities which may help in developing adequate capacities for successful DRR implementation.

HFA-2 (Risk Assessment and Early Warning System):
Early warning systems exist to a large extent which may help reduce the potential losses (infrastructure, human lives). Similarly, the dissemination of information during a disaster is provided which may also reduce additional losses in the aftermath of such an event.

HFA-3 (Knowledge Management):
The city government has the capability to disseminate information during a disaster to make the people aware about potential impacts/threats. The city's school curricula incorporate DRR and the city government runs disaster drills frequently (more than once a year) which may enhance the people's limited knowledge/awareness about disasters.

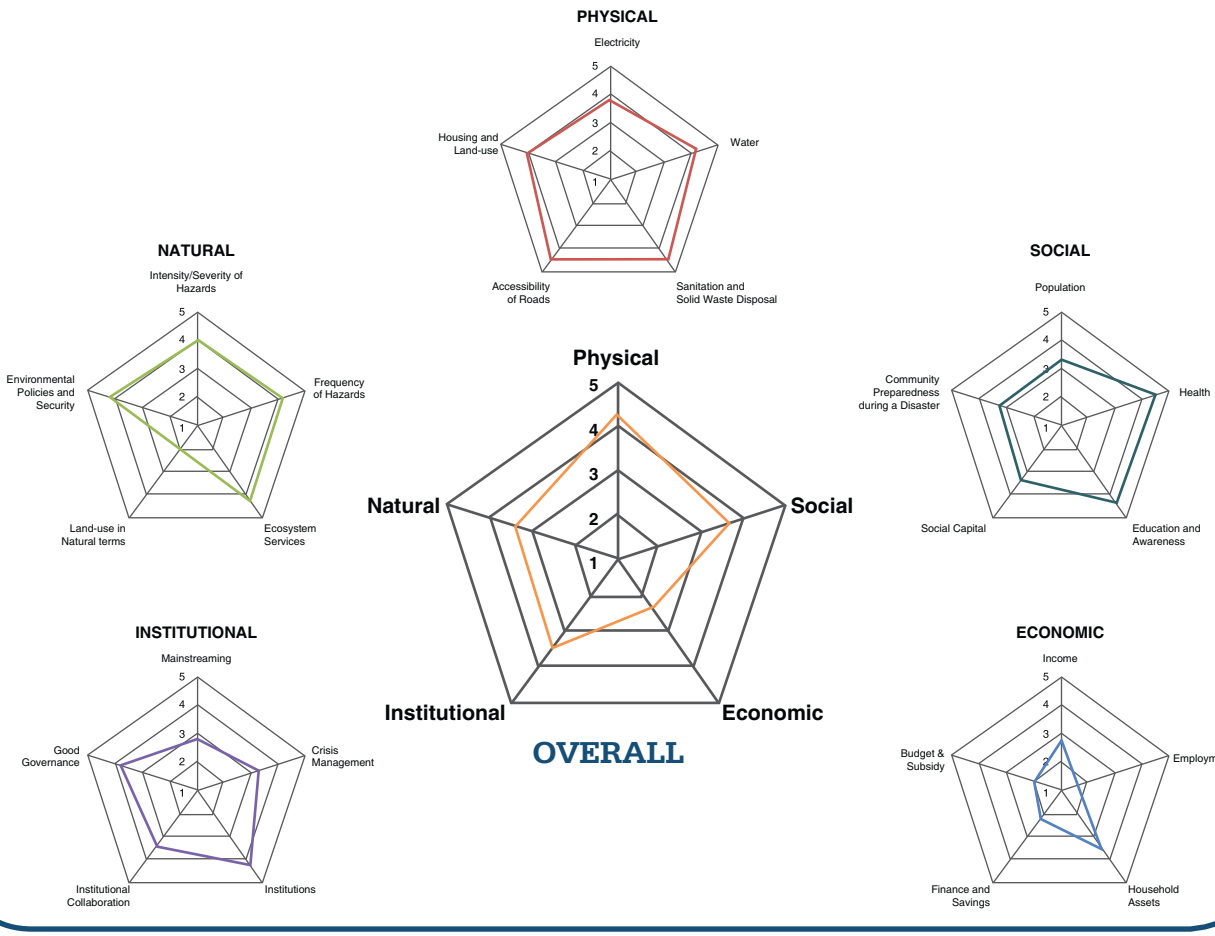
HFA-4 (Vulnerability Reduction):
The mainstreaming of DRR in land-use, transport, and environmental plans/policies is mostly performed. This may help to reduce the vulnerability of the city in the long-term. Accordingly, DRR measures may be in the form of, for instance, targeting the reduced employment situation of the city, addressing vulnerable ecosystems (for example, biodiversity), or introduce a sustainable waste management system (RRR).

HFA-5 (Disaster Preparedness):
The city may benefit from an existing network with neighbouring cities and an effective emergency team of well-trained emergency workers. It may, however, welcome a well implemented disaster management plan which may also include uncertainties of climate change. Moreover, city's institutions could be strengthened to make the city more prepared to climate-related disasters.

KOLKATA, West Bengal: River Side

Located in close proximity to the Ganges river-delta, natural hazards in form of heat waves, cyclones, and floods in Kolkata are expected albeit less than once every five years and with low intensity. After all, the city is characterised by good physical (people have access to electricity, water, sanitation, and roads are in good condition), social (good health of people, high awareness levels about disasters, and significant social capital of communities), and institutional (disaster prepared institutions) resilience to climate-related disasters. The economic resilience is shaped by high unemployment rates affecting especially young people, and also reduced financial resources of people/households to protect their properties against disasters. In general, the city shows some attributes of an emerging mega-city. For instance, the intensity of land-use (loss of urban green space, high population density) is high. A large number of people work in the informal sector, but the city is also attractive due to good availability of infrastructure and well-established institutions.

ANALYSIS RESULT



PHYSICAL DIMENSION:
The physical resilience is in general strong as access and availability of electricity, potable water and sanitation is available for most residents during normal times. However, alternative electricity and water supply may not be provided sufficiently in case of a disaster to keep emergency services functioning. Roads cover up to 10 per cent of the urban area and are accessible during normal and disaster times as they are equipped with drainage systems. Few buildings are constructed following building codes; nevertheless, most buildings are of permanent structure and few people live in proximity to polluted industry, reducing the risk of potential damage and harm.

SOCIAL DIMENSION:
People of the city are literate, knowledgeable about disasters (benefit from public awareness programmes/disaster drills), and enjoy good health. Primary health facilities are prepared for a disaster, however, communities are not fully prepared for such an event in terms of logistics, materials, and management to protect themselves. Nevertheless, social capital (up to 40 per cent of people participate in community activities, participate in city's decision-making process, and various castes are well interlinked) is quite high and may reduce the risk of communities being disrupted due to a disaster. The city's population is growing at the rate of up to 3.9 per cent a year contributing to densely populated communities and increased exposure in case a natural hazard strikes.

ECONOMIC DIMENSION:
Economic resilience is lower than other dimensions due to high unemployment rates especially of young people (more than 25 per cent), high percentages of people working in the informal sector (more than 25 per cent), reduced capabilities (less than 2.5 per cent targets DRM) of authorities to provide citizens with financial support to protect their buildings, and a high gap between the 10 per cent poorest and richest people. However, residents have basic household assets such as television, mobile telecommunication, etc. supporting them to be fore-warned in case a hazard occurs. Moreover, households seem to have a good habit of saving money which may be beneficial to recover from a disaster as credit facilities from city's financial institutions are limited.

INSTITUTIONAL DIMENSION:
The city's institutional resilience is high as the authorities are in general prepared for a disaster. This is highlighted by an existing disaster management plan and a crisis management team which is effective (leadership/competence) and ready to respond quickly. Moreover, emergency workers are trained and experienced as they undermore than twice a year through disaster training programmes. Although the emergency team is ready for a disaster, other institutions may depend on external support from existing collaborations with NGOs, national government, and private organisations. Good governance is likely to be a support in case of the occurrence of a disaster as DRM is enforced, building codes are being implemented, and early warning systems led efficiently by the city government. Moreover, DRR and CCA are mainstreamed in city's land-use and environmental plans/policies.

NATURAL DIMENSION:
The main natural hazards affecting the city are floods, cyclones, and heat waves, however, in a moderate intensity and once every five years or even less. The quality of the ecosystem (biodiversity, air pollution, water quality, etc.) is reducing the natural resilience of the city as it is in a rather fragile condition. The use of the available land is very high and up to 50 per cent of the city area is vulnerable to climate-related hazards; furthermore, severe loss of urban green space over the past few decades may challenge the natural environment of the city. However, environmental preservation policies exist, as well as policies to reduce air pollution and an efficient waste management (Reduce, Reuse, and Recycle) system.

POLICY IMPLICATIONS IN RELATION TO THE HYOGO FRAMEWORK FOR ACTION (HFA)

HFA-1 (Governance):
Limited financial resources for DRM may restrict the capacity developing process to efficiently implement DRR measures.

HFA-2 (Risk Assessment and Early Warning System):
Early warning systems exist to a large extent which may reduce the potential losses (infrastructure, human lives). Similarly, the dissemination of information during a disaster is provided which may also reduce additional losses in the aftermath of such an event.

HFA-3 (Knowledge Management):
Although DRR is not mainstreamed in the school curricula of the city and disaster drills are not conducted frequently (merely once in two years), people's knowledge about disasters is quite high. Nevertheless, DRR should be incorporated in the school education system to sensitise people more about disasters.

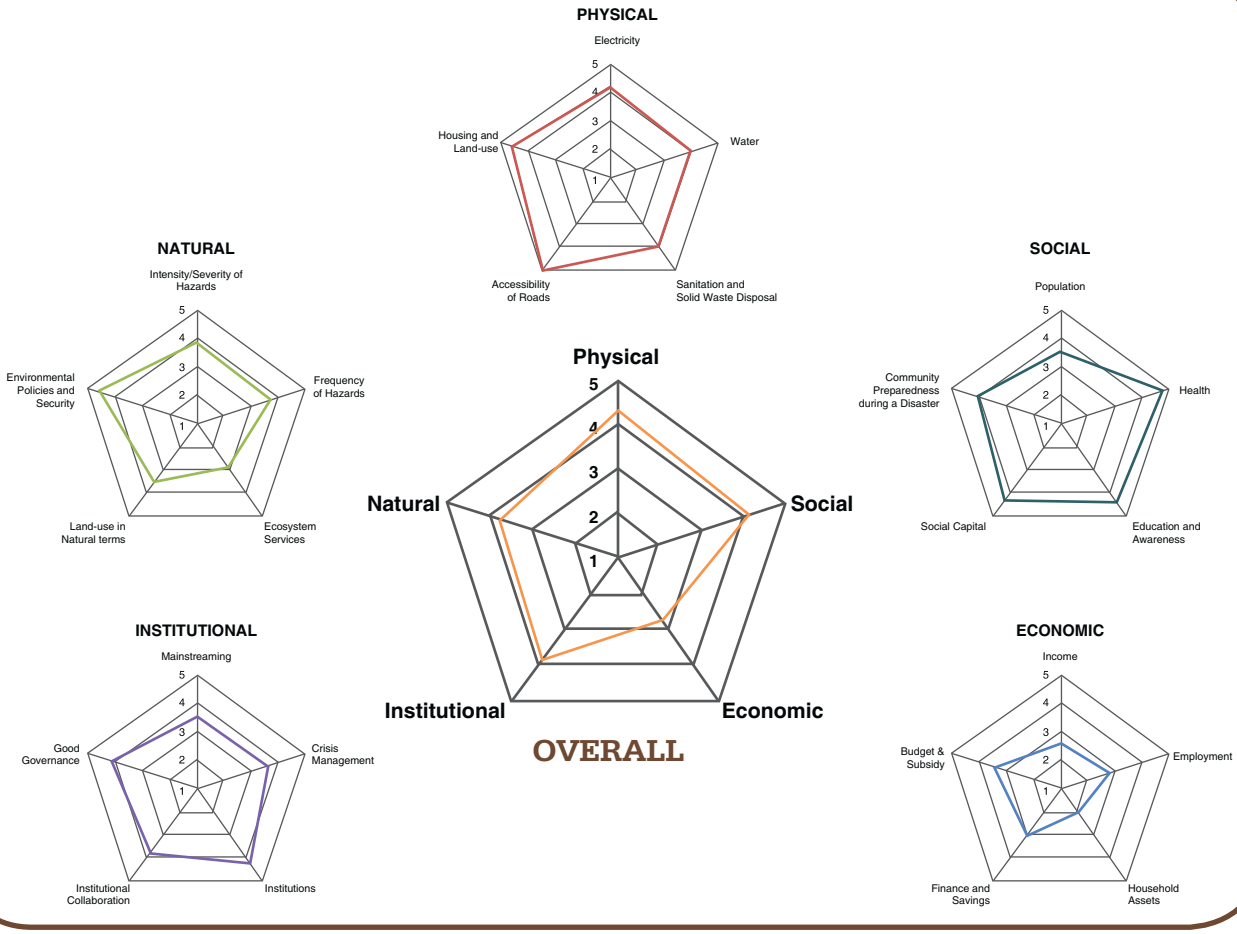
HFA-4 (Vulnerability Reduction):
The city's land-use plans and environmental plans incorporate DRR. This embedding of DRR may also be done for housing and transport plans/policies. Furthermore, the city could reduce underlying risk factors such as the loss of urban green space (high intensity of land-use), protection of ecosystems (biodiversity, water bodies, and air), or provision of credit facility for people to finance disaster prevention measures.

HFA-5 (Disaster Preparedness):
A disaster management plan exists but does not incorporate uncertainties of climate change. The city may increase its preparedness to climate-related disasters by fostering more collaboration with neighbouring cities and also by further strengthening of the emergency team (alternative decision-making). However, city's institutions are strong and there is good availability of emergency workers during a disaster.

NAGPUR, Maharashtra: Arid

The city is characterised by strong physical (good condition of roads, access and availability of electricity, and water) and social resilience (capable and prepared health facilities, good social capital and cohesion) to climate-related disasters. The institutions are in good shape and mostly prepared for such events. The economic resilience could be improved by increasing income through the availability of more employment, especially targeting the youth. Existing environmental policies are expected to protect the nature of the city from potential harm of striking hazards and may also improve the current quality of the ecosystem.

ANALYSIS RESULT



PHYSICAL DIMENSION:
Most citizens have access to electricity which is available for most part of the day. However, in case of a disaster, the alternative electric supply to keep emergency services functioning (for example, hospitals, evacuation centres, etc.) is less than 25 per cent of its demand. Access to potable water is also provided for most citizens but only available for up to five hours a day. A challenge is the low capacity of the alternative emergency safe water supply system to provide sufficient water in the event of a disaster with a percentage less than 25 per cent. Hygienic access to sanitation is provided for most residents. Solid waste is collected but its treatment and recycling is less than 25 per cent available. Roads are paved, equipped with a drainage system, and remain accessible during flooding. Up to 50 per cent of the buildings are built following a building code for hydro-meteorological disaster and most buildings are of permanent structure. Few people live in proximity to industrial pollution.

SOCIAL DIMENSION:
The city's population is currently growing at a rate of up to 5.9 per cent per year. In this context, the percentage of people being informal settlers (less than 17 per cent) is moderate. The health condition of the residents is good as well as access to primary health facilities during normal times and during a disaster. The literacy rate is high (>87.5 per cent) and above Indian average. The Municipality organises disaster awareness programmes/drills more than once every year which contribute to a knowledgeable population regarding disasters. Social capital is quite good with more than 40 per cent of the people participating in community or social group activities. The ability of the citizens to build consensus and share interests is good as well as their ability to participate in city's decision-making processes. Various castes are also well interlinked with each other. Social cohesion is characterised by not sufficiently prepared households (logistics, materials) and reduced volunteering in times of a disaster. However, people provide support in form of shelter and evacuate voluntarily.

ECONOMIC DIMENSION:
The percentage of people living below poverty line is high with up to 34 per cent and there is also a high gap between rich and poor people. Up to 24 per cent of households also depend on income derived in the informal sector. Although the overall unemployment rate is relatively low (less than 12 per cent), more than 25 per cent of young people are without jobs in the formal sector. The number of people working in the informal sector is high with up to 24 per cent of labour. Less than 70 per cent of households have television and basic furniture. Also less than 45 per cent of households have a motorised vehicle. Access and availability for all residents to receive credits to face/prevent a disaster is quite good. However, poorer people have more difficulties to avail credit benefits. At least up to 40 per cent properties of households are insured. Up to five per cent of city's annual budget is targeting DRM and there are sufficient funds provided to support climate change related DRR measures. However, subsidies/incentives for residents to rebuild houses, alternative livelihood and to receive health care are limited.

INSTITUTIONAL DIMENSION:
Incorporation and mainstreaming of DRR and CCA is reduced for city's land-use and housing plans/policies but improved for education, transport, and environmental plans/policies. Regarding the city's crisis management framework, the incorporation of a disaster management plan is reduced which should also include uncertainties of climate change. However, the emergency team is competent, ready and prepared in case of a disaster. The city's formal and informal institutions are effective during a disaster. Emergency workers are trained more than twice a year and are fairly competent. The Municipality is dependent on external support in case of a disaster but it is quite good connected with the government, NGOs, and private organisations. Further collaboration efforts with neighbouring cities could strengthen the city's institutional resilience. Good governance is characterised by a Municipality which is enforcing DRM, implementing building codes, and effectively operating early warning systems. Moreover, drills/disaster scenarios are carried out more than once a year in the city.

NATURAL DIMENSION:
Main hazards, but only occasionally occurring, are floods, heat waves, and droughts (water scarcity). The quality of city's ecosystem is poor with regards to its biodiversity and soils (contamination), and reduced air quality; however, water bodies (lakes, rivers, etc.) are in good condition. Less than 25 per cent of the city area is vulnerable to climate-related hazards and few settlements are located on hazardous ground. The loss of urban green space is low although up to 15 per cent of the city area is green area. Policies to protect the environment exist and residents are following their guidance. An efficient waste management system (Reduce, Reuse, and Recycle) is in place as well as mitigation policies to reduce air pollution.

POLICY IMPLICATIONS IN RELATION TO THE HYOGO FRAMEWORK FOR ACTION (HFA)

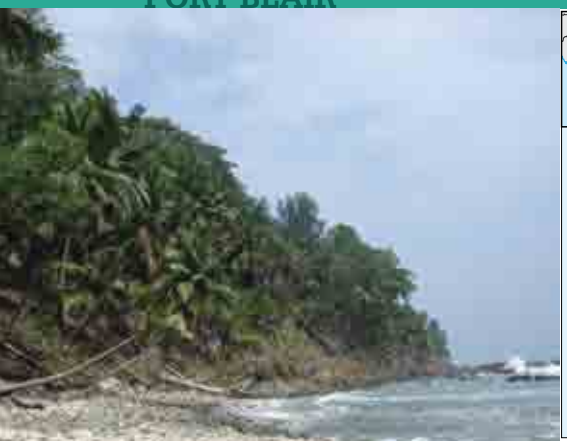
HFA-1 (Governance):
The city has the benefit of available financial resources targeting DRM which may help in implementing DRR measures.

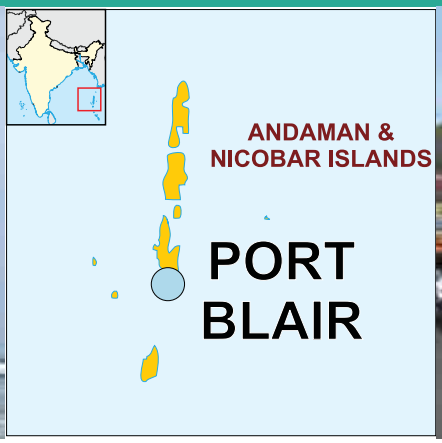
HFA-2 (Risk Assessment and Early Warning System):
Early warning systems exist to a large extent which may reduce the potential losses (infrastructure, human lives). Similarly, the dissemination of information during a disaster is provided which may also reduce additional losses in the aftermath of such an event.

HFA-3 (Knowledge Management):
The city's school curricula addresses DRR, disaster drills are run more than once a year and people are benefitting from government led public disaster awareness programmes resulting in a knowledgeable population.

HFA-4 (Vulnerability Reduction):
DRR is mainstreamed in the transport and environmental plans. To form a strong institutional framework addressing DRR, it could be further incorporated in city's land-use and housing plans. DRR measures may, however, be implemented in various sectors, for instance, better provision of employment especially for young people, safeguarding of the ecosystems (biodiversity, soil, and air quality), or developing tools (incentives) to help communities insuring their properties against disasters.

HFA-5 (Disaster Preparedness):
A disaster management plan exists but not yet fully implemented, however, an emergency team should be better prepared for a disaster. A stronger network with other cities would help the city to deal with a disaster and be better prepared to face such an event.

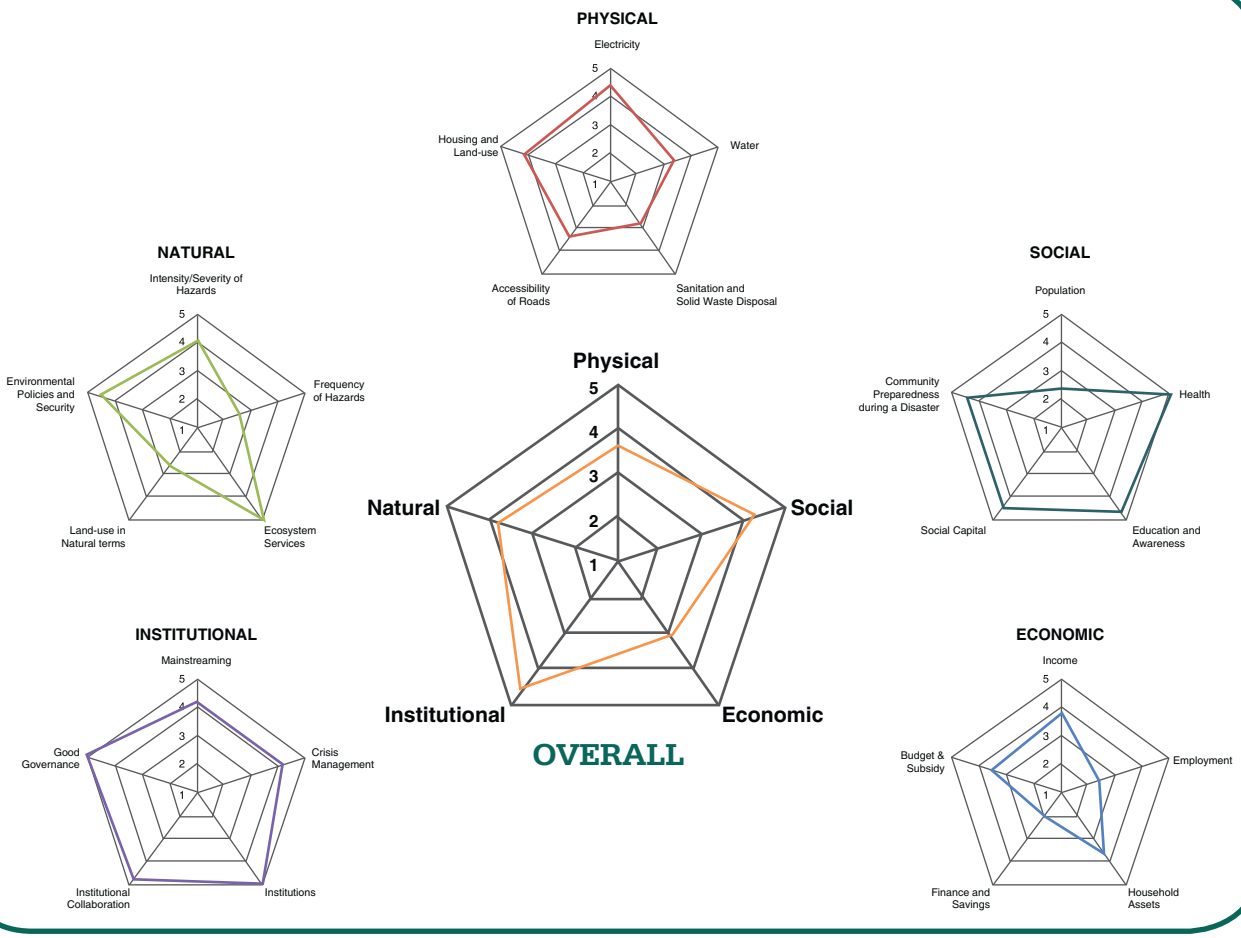




PORT BLAIR, Andaman & Nicobar Islands: Coastal

Port Blair is characterised by a strong institutional (well-established and efficiently operating institutions) and social resilience (good health condition of residents and effective and prepared health facilities, strong social capital and cohesion, and high awareness about disasters). The physical resilience is moderate due to good availability of electricity and good condition of buildings in the city. The natural dimension is reflected by an intact ecosystem and existing environmental policies. The city is vulnerable to high frequency of floods, cyclones and rainfall-induced landslides and intense land-use. The city's economic resilience points to a good income situation of the population contributing to most households being in possession of basic household assets. However, the unemployment rate is high and needs to be tackled by creating jobs in the formal sector.

ANALYSIS RESULT



PHYSICAL DIMENSION:
Access to electricity and availability is provided for most residents during normal times and also in the event of a disaster. Access to potable water is available for most people but only up to 1 hour per day. The capacity of alternative safe water supply is less than 25 per cent. Hygienic access is available for up to 75 per cent of citizens. Also up to 75 per cent of waste produced per day is collected but not treated or recycled before dumping. Up to 10 per cent of the city's land is used for transportation network, but less than 30 per cent is equipped with a drainage system. Up to 50 per cent of buildings are constructed following a building code for hydro-meteorological disasters, but up to 29 per cent of buildings are of non-permanent structure.

SOCIAL DIMENSION:
Urbanisation is very high with more than six per cent population growth per year and a very large proportion (up to 34 per cent) of young people below the age of 14. However, less than 17 per cent of the people live in informal settlements and the population density is less than 8,000 people per square kilometer. Health condition of residents is good and facilities are operating effectively and are prepared for disasters. Citizens are educated and aware of disasters and trained for disaster scenarios through organised disaster awareness programmes/drills by the Municipality. Social capital is also good with up to 40 per cent of people participating in community or social activity groups. Furthermore, residents are able to build consensus and share their interests to influence the city's decision-making process. Different castes are also well connected with each other. As well social cohesion is high reflected by prepared (logistics, materials, etc.) and volunteering communities.

ECONOMIC DIMENSION:
Up to 24 per cent of the people live below the poverty line, however, less than 16 per cent depend on income derived in the informal sector. Unemployment rate is high with more than 25 per cent working force without jobs. As a result, than 18 per cent of the working force are working in the informal sector. Households possess key assets such as television, motorised vehicle, and basic furniture. Access to credit is to mitigate damage in case of a disaster and is not readily available during normal times. Less than 20 per cent properties of households are insured. The City's annual budget targeting DRM is insufficient with less than 2.5 per cent of the total budget allocation. At least residents get support (alternative livelihood, health care) if a disaster happens.

INSTITUTIONAL DIMENSION:
The DRR and CCA are mainstreamed and incorporated in city's housing, education, transport, and environmental plans/policies, but not in land-use plans/policies. A well incorporated disaster management plan exists but does not include uncertainties of climate change. The emergency team is competent, ready, and prepared in case of a disaster. Formal and informal institutions are effective and emergency workers are fully trained (including drills). The Municipality is independent and does not require support in case a disaster strikes. It also has a good collaboration with the national government, NGOs, and private organisations. DRM is integrated and enforced; moreover, building codes are being implemented, early warning system is effectively operating, and the city runs drills more than once a year.

NATURAL DIMENSION:
Floods and cyclones are the key hazards and occurring frequently (more than once a year), however, affecting less than 25 per cent of the city area, which is of very high use. Urban green space is less than 10 per cent of the urban area and experienced a severe loss over the past decades. Environmental preservation policies are in place as well as mitigation policies to reduce air pollution. A problem remains the treatment of waste as there is no efficient waste management system (Reduce, Reuse, Recycle) existing.

POLICY IMPLICATIONS IN RELATION TO THE HYOGO FRAMEWORK FOR ACTION (HFA)

HFA-1 (Governance):
Funding for DRR is available but may be increased for enhanced implementation of DRR activities in the city.

HFA-2 (Risk Assessment and Early Warning System):
Early warning systems exist and the dissemination of information about disaster during an event is transparent and accountable.

HFA-3 (Knowledge Management):
This priority is well addressed in the city as public awareness about disasters exists, the DRR is addressed in the school curricula, and disaster drills are run frequently (more than once a year).

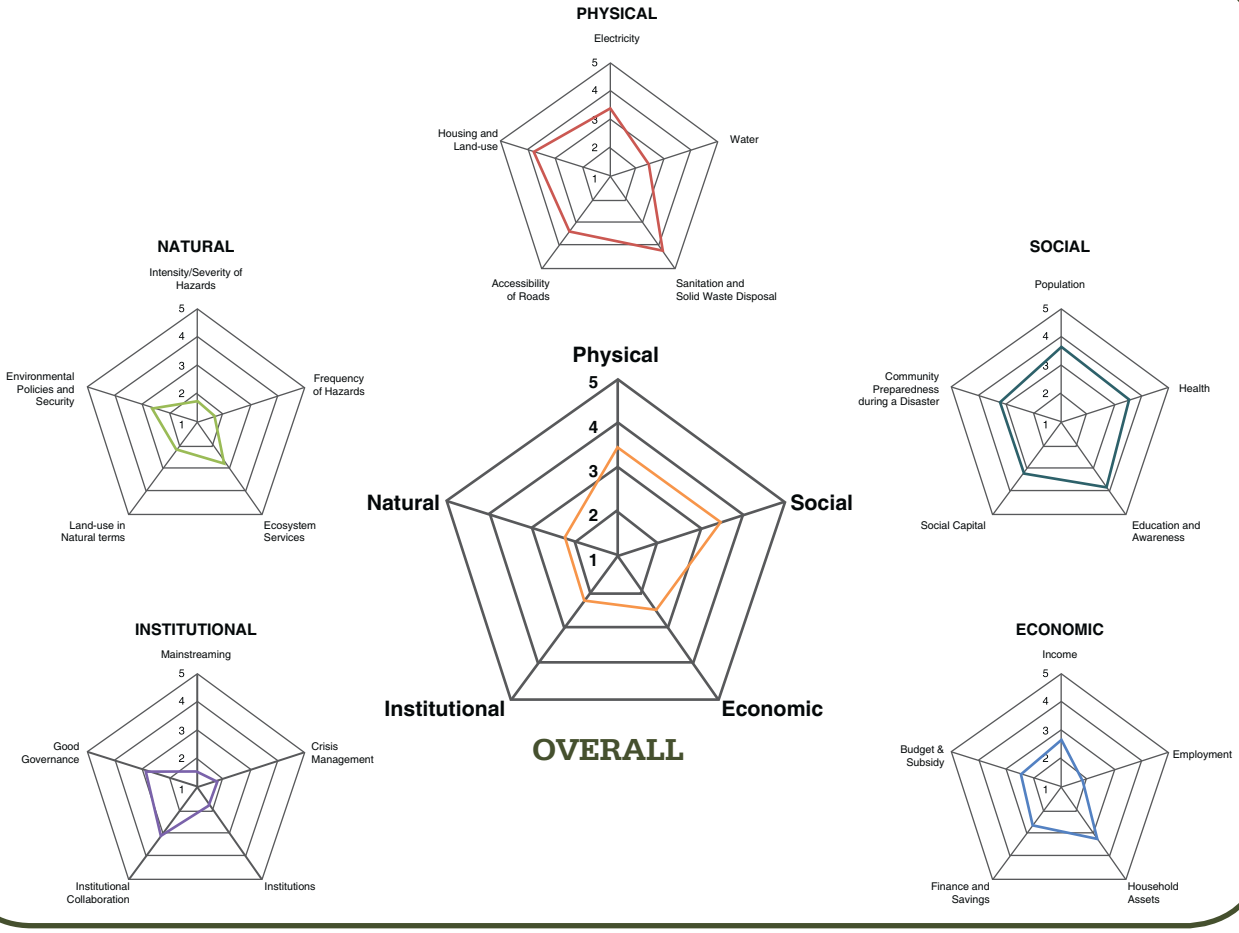
HFA-4 (Vulnerability Reduction):
The city's housing, transport, and environmental plans incorporate DRR which is a primary step for vulnerability reduction at plan/policy level. Accordingly, incorporating DRR into land-use plans would complement this process of mainstreaming DRR in plan/policies of the city. This is important as the city could well reduce the underlying risk factors by promoting, for instance, the sustainable use of natural resources (high loss of urban green space, high intensity of land-use), support communities (especially urban poor) by creating employment and income for households, or increase building safety in the city by reducing the number of buildings of non-permanent structure.

HFA-5 (Disaster Preparedness):
The existence of a disaster management plan and a strong emergency team (leadership, readiness, alternative decision-making) make the city prepared for climate-related disasters. Moreover, the city is well linked with other cities, national government, NGOs and private organisations to receive support during a disaster.

SHIMLA, Himachal Pradesh: Mountainous

The city is quite resilient in physical and social aspects due to good access for citizens to electricity, water, and sanitation; furthermore, city's communities are knowledgeable about disasters also because of moderate existing social capital and cohesion. High unemployment rates, low incomes, and lack of funds to prevent the city from disasters are reflected in the economic resilience. The institutional resilience is relatively low due to the yet to be incorporated DRR and CCA in various plans/policies. For example, the city has a disaster management plan which only needs to be adopted at district level to become effective. Because of its mountainous or steep exposition (up to 60 degrees) the city is heavily prone to climate-related disasters, lowering the natural resilience dimension. The protection of the environment (for example, ecosystem) might be improved through improved planning, policies, and protection measures.

ANALYSIS RESULT



PHYSICAL DIMENSION:
Most people have access to electricity, which is usually available at all times. In the event of a disaster the city is dependent on external sources; accordingly, the capacity of the alternative electric supply to keep emergency services (for example, hospitals, evacuation centres, etc.) functioning is less than 25 per cent of its demand. People have access to safe water supply but its availability is less than one hour per day and during most frequent disasters the water supply depends on external provision. Hygienic access to sanitation is available for most residents. Solid waste is collected and treated before dumping but not necessarily recycled. The percentage of city land used for the road network is more than 20 per cent and most of roads do not have a drainage system. Less than 30 per cent of buildings follow a building code for hydro-meteorological disasters and less than 50 per cent are above normal/ flood water logging. Very few houses are in the proximity of polluted industry.

SOCIAL DIMENSION:
The city is experiencing rapid urbanisation which is reflected in high population growth rates (up to 5.9 per cent per year). Large shares of its residents are informal sectors with a percentage of up to 23 per cent. At least the population density per square kilometer is still very low for a city. Overall health condition of the people is quite good but primary health facilities are having a reduced capacity to deal with emergency situation (disaster). Literacy rate of the population is very high and above Indian average. People are knowledgeable about disasters also because of the city organising awareness programmes/disaster drills once a year. Social capital is moderate with up to 30 per cent of the people participating in community or social activity groups. Different castes are also quite well interlinked with each other. Social cohesion is also moderate as people evacuate voluntarily after a disaster and provide shelter; however, households are not prepared for a disaster in terms of logistics, materials and management to deal with it.

ECONOMIC DIMENSION:
Up to 24 per cent of the population lives below the poverty line and up to 75 per cent of the households depend on just one income source. Also the gap between the 10 per cent richest and 10 per cent poorest people is very large. Nevertheless, less than 15 per cent of the households depend on income derived in the informal sector. Unemployment rate is high with a percentage of up to 24 per cent but affecting young people less than others. More than 80 per cent of the employees in the formal sector come from outside the city and more than 25 per cent of labour is working in the informal sector. Most households are equipped with basic needs. Less than 20 per cent properties of households are insured. Credit availability for disaster prevention for individuals is reduced. Less than five per cent of city's annual budget is targeting DRM. There are few subsidies/incentives for residents after a disaster to help them to rebuild houses, livelihood, or receive health care.

INSTITUTIONAL DIMENSION:
Mainstreaming and incorporation of DRR and CCA is poor for city's land-use, housing, education, transport, and environmental plans/ policies. A disaster management plan exists but not yet incorporated. The emergency team is lacking of competence, preparedness and ability to respond to a disaster. The formal and informal institutions of the city are poorly effective during a disaster and emergency workers are not trained sufficiently. In case of a disaster the Municipality is dependent on external institutions for support, however, it has a quite good collaboration with national government, NGOs, and private organisations. The DRM is poorly enforced and building codes are not sufficiently implemented in newly constructed buildings. An early warning system led by the Municipality is poor in its efficiency. At least the city authority organises disaster drills once a year.

NATURAL DIMENSION:
The city is mainly affected by floods and rainfall-induced landslides which occur more than once a year. The quality of the city's ecosystem is reduced or in a poor condition (biodiversity, water bodies, air, soil). Most areas of the city are vulnerable to climate-related hazards and the majority of the settlements are located on hazardous ground. The land-use is also high and although there is still more than 16 per cent green space, the loss of it over the past decades is severe. Few environmental preservation policies exist and communities' compliance to them is limited. Although there are many bins provided throughout the city, a more efficient waste management (Reduce, Reuse, and Recycle) could be introduced.

POLICY IMPLICATIONS IN RELATION TO THE HYOGO FRAMEWORK FOR ACTION (HFA)

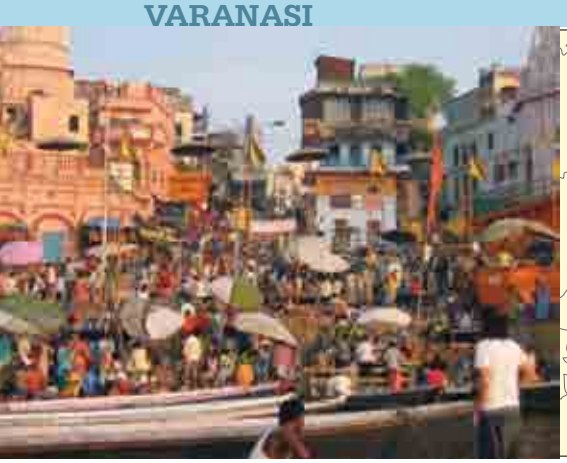
HFA-1 (Governance):
The institutional basis for DRR could be enhanced by a better trained and enhanced staff, provided sufficient funding is available, for delivering all the administrative tasks, which may be required or expected from the Municipality to provide a strong platform for DRR implementation.

HFA-2 (Risk Assessment and Early Warning System):
A well established early warning system, especially with regards to hydro-meteorological hazards and increased efforts to develop hazard maps, may reduce the risk of disasters and their associated losses (infrastructure, human lives).

HFA-3 (Knowledge Management):
As people are quite knowledgeable about the potential threat of disasters and also how to react due to yearly occurring disaster awareness programmes/drills, this priority is addressed to some extent in the city. Further strengthening of the capacities of communities to be aware of disaster may be achieved through increased dissemination of disaster-related information at schools but also if more people could get access to information, for instance, by having better access to internet.

HFA-4 (Vulnerability Reduction):
Improved compliance and enforcement to building codes, introduction of environmental protection plans, or financial instruments to protect properties could demonstrate an important step towards efficient DRR. Furthermore, mainstreaming of DRR into land-use, housing, transport and environmental policies could demonstrate a positive approach to strengthen development plans of the city.

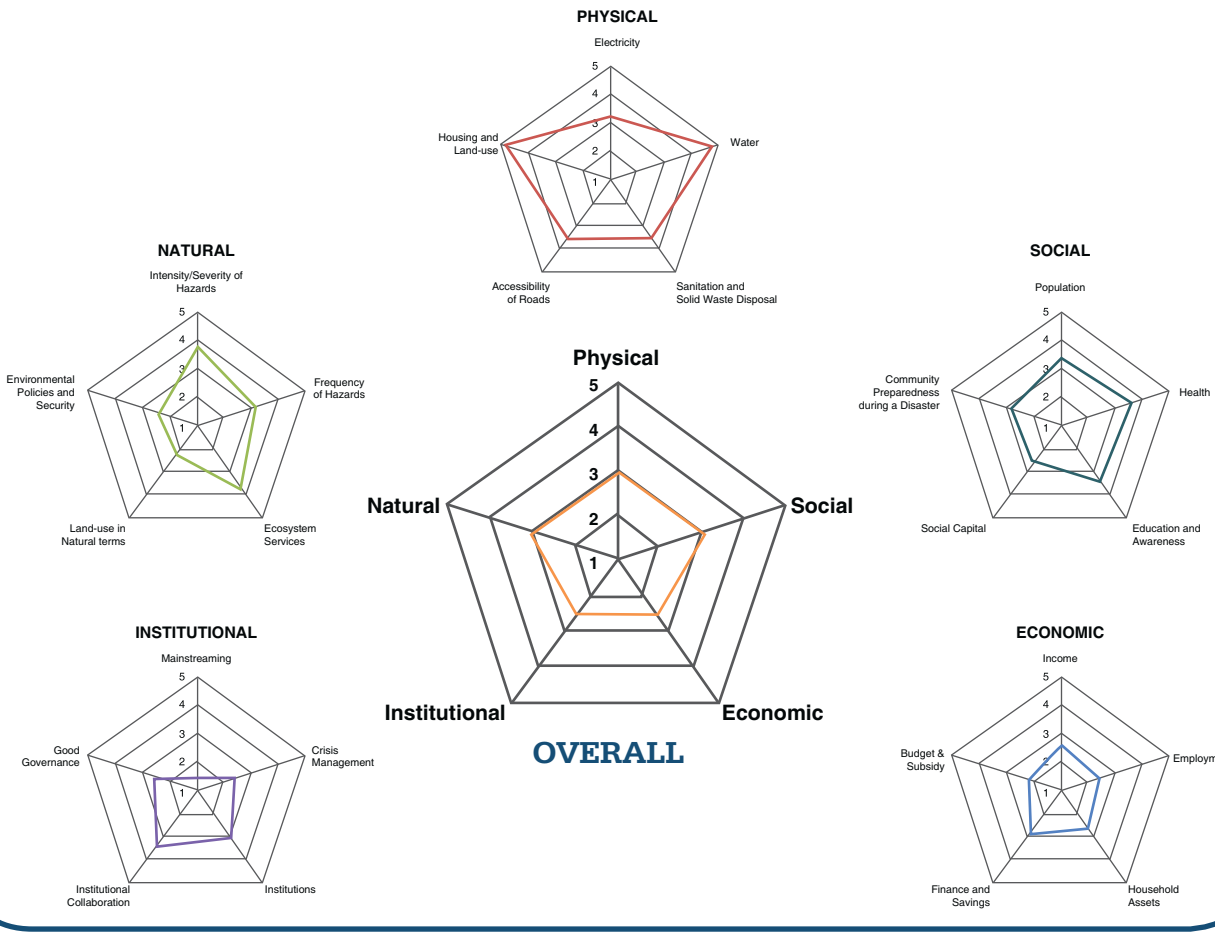
HFA-5 (Disaster Preparedness):
The final adoption of the already existing draft disaster management plan would lay the foundation for overall disaster preparedness of the city. Strengthening the capacities of the institutions associated with the Municipality (disaster management team) to increase the competence and leadership to handle disasters is recommended to make the city more prepared.



VARANASI, Uttar Pradesh: River Side

All resilience dimensions (physical, social, economic, institutional, and natural) are performing in similar strength in the holy city of Varanasi. However, there are many deviations from the average results within the respective dimensions. The city may be characterised in general as one which is experiencing regular (once a year) natural hazards in the form of moderate floods, heat waves, and droughts. It may also be in the process of developing many basic urban services like, for instance, better access and provision of electricity or providing roads with appropriate drainage systems to become more resilient to climate-related disasters. There may also be some potential to make use of the quite knowledgeable and literate communities to foster social cohesion and preparedness in case of an approaching disaster. The institutions of the city play a crucial role and could be involved more in establishing the ideal environment for a strong and resilient city.

ANALYSIS RESULT



PHYSICAL DIMENSION:
The access to electricity and availability is limited as less than half of the people have access for less than eight hours per day; moreover, electric supply of the city is dependent on external sources (other cities/areas) in case of a disaster. Potable water is available for up to 75 per cent and usually at all times, but may also be reduced in the event of a disaster. Solid waste is collected every day, however, is often not treated or recycled. Most roads remain accessible at all times, but may also increase in capacity if equipped with drainage systems. Few buildings are in proximity to polluted industries and the majority is of good permanent structure.

SOCIAL DIMENSION:
The general health of people is good as few (less than 23 per cent) suffer from waterborne or vector-borne diseases every year. Primary health facilities are functioning and capable to provide services during normal disasters, however, not all people have access to them (less than 75 per cent). The communities are literate and knowledgeable about disasters but may further benefit if public awareness/disaster drills would be initiated by the Municipality. Social capital is established among the communities to some extent as many (up to 40 per cent) people participate in social activities. It may further increase if communities would have more opportunities to engage into the city's decision-making process and different castes would be mixed more with each other. Accordingly, social cohesion would also gain as communities would become more prepared to resist against disasters.

ECONOMIC DIMENSION:
The economic resilience is characterised by reduced opportunities of people to accumulate wealth, as up to 24 per cent live below the poverty line and availability of jobs is not available for all labour, up to 18 per cent are unemployed and young people are more affected. Nevertheless, households have basic items such as housing furniture (for example, television, kitchen, etc.). People are likely to benefit from increased economic development as their habit to save money is good, which may help them to recover more quickly from a disaster in the future. People may also benefit from increased funding provided by the city authority in the field of DRM (targeting up to five per cent of annual budget per year).

INSTITUTIONAL DIMENSION:
The institutions of the city (for example, emergency team) are limited in their capacity to deal with a disaster as on one hand a disaster management plan is not sufficiently implemented and effectiveness (leadership/competence) of emergency team is reduced, and on the other hand emergency workers are trained and the Municipality is collaborating with other institutions such as national government, NGOs, and private organisations which would be beneficial during a disaster. The city authority may also improve its resilience, for instance, by implementing DRR and CCA in development plans, or implement DRM more efficiently.

NATURAL DIMENSION:
The city is prone to frequently occurring floods, heat waves, and droughts with a usually moderate intensity. The city's ecosystem is still in quite good shape as the quality levels of urban biodiversity, soil (contamination), and water bodies are moderately affected by the ongoing development processes (urbanisation, economic growth). The high intensity of land-use may challenge the urban resources if the existing environmental preservation policies are not implemented.

POLICY IMPLICATIONS IN RELATION TO THE HYOGO FRAMEWORK FOR ACTION (HFA)

HFA-1 (Governance):
There is availability of financial resources for DRM activities which may help in developing adequate capacities for successful DRR implementation.

HFA-2 (Risk Assessment and Early Warning System):
A more effective early warning system with regards to hydro-meteorological disaster may be beneficial for the city's response in case a hazard strikes to reduce the potential losses (infrastructure, human lives).

HFA-3 (Knowledge Management):
To build a culture of safety, the mainstreaming of DRR in the school education system would be a primary step. Additionally, the introduction of public awareness programmes and more frequent (more than once every two years) disaster drills would further increase the knowledge of the city's population about disasters.

HFA-4 (Vulnerability Reduction):
To develop a strong institutional framework for DRR, the mainstreaming of DRR in city's land-use, housing, transport, and environmental plans/policies could be a primary step for addressing it at plan/policy-level. Other measures to reduce the underlying risk factors could be, for instance, a more sustainable use of land resources (for example, high loss of urban green space), improved credit facility for all members of the society to help them finance measures which would protect them against disasters and also better access for people to health facilities. To summarise, the city may fully address DRR in all sectors of the city (institutions, communities, and infrastructure) to increase its resilience to climate-related disasters.

HFA-5 (Disaster Preparedness):
To become a disaster prepared city, Varanasi would benefit from a well implemented disaster management plans to perform efficiently during a disaster. Improved collaboration with neighbouring cities may be supportive in case of a disaster, like it is the case with national government and NGOs. A stronger emergency team (improved leadership, readiness, alternative decision-making) would make the city more prepared to climate-related disasters.

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