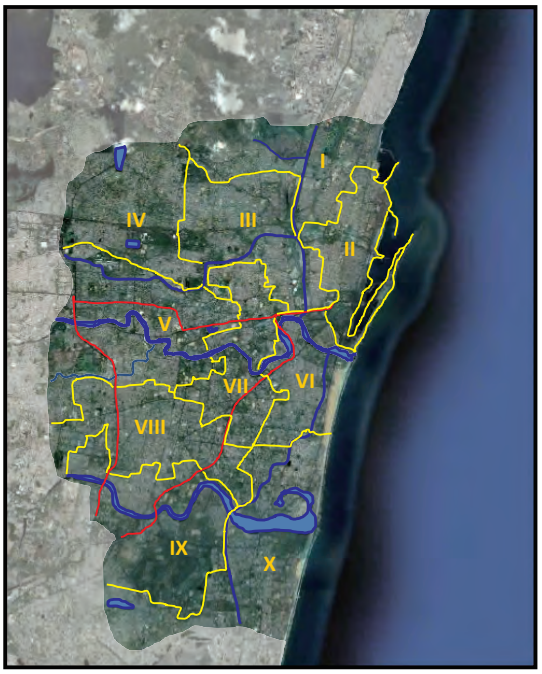
Chennai
Zone Profile

Climate and Disaster Resilience

Tondiarpet, Basin Bridge, Pulianthope, Ayanavaram, Kilpauk
Ice House, Nungambakkam, Kodambakkam, Saidapet, Mylapore

About the Initiative

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 the Corporation of Chennai and University of Madras. Zone data were collected through questionnaire survey. The cooperation and inputs from all the zones listed here are highly appreciated.



Area	Name	Size in km2	% popl. growth p.a, 1971-2001	Population density in 2001
Zone I	Tondiarpet	17.3	2.40	23699
Zone II	Basin Bridge	11.52	0.15	32638
Zone III	Pulianthope	13.51	1.07	34048
Zone IV	Ayanavaram	19.76	2.72	25151
Zone V	Kilpauk	26.38	3.08	20545
Zone VI	Ice House	10.15	0.15	33694
Zone VII	Nungambakkam	12.9	0.60	26976
Zone VIII	Kodambakkam	13	2.12	35846
Zone IX	Saidapet	23.56	2.66	17614
Zone X	Mylapore	27.92	2.25	17478
City		176	1.72	26768.9

Ten administrative zones of Chennai

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Kyoto University

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Acknowledgements

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Foreword

MA. Subramanian
Chennai Mayor

MA. SUBRAMANIAN, B.A., L.L.B.,
MAYOR

CHENNAI CORPORATION
RIPON BUILDINGS
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FOREWORD

India is passing through an unprecedented phase of urbanization where cities experience rapid population, but also economic growth. Chennai is not excluded by this trend and is also affected by the consequences of this growth, as enormous pressures are put on the physical infrastructure, socio-cultural fabric, institutional systems and natural environment of our city. Although, urban development planning is recognising these problems, there are rising concerns that due to impacts of climate change, natural hazards could gain in intensity and frequency which ultimately lead to more severe disasters, the risks could be amplified and threaten the ability of Chennai to completely withstand such events. Since there is a definite link between urban disaster and climate risks, the concept of climate resilience presented in this report aimed to assess the urban disaster risks comprehensively in adopting a multi-stakeholder approach in order to build resilience.

While this study focuses on the condition of the ten administrative zones, it adopts a micro-level approach and is very much align with the international risk reduction framework for risk reduction to which India is committed, primarily the priorities of the Hyogo Framework for Action. The comprehensive character of this effort to understand the condition of our city and to provide us with valuable information on how Chennai could become more resilient and prepared to future climate-related disasters is very much appreciated.

Chennai is committed to the global Campaign of Making Cities Resilient, promoted by the United Nations International strategy for Disaster Reduction (UN ISDR) for the period of 2010-2011. In this regard, I express my appreciation to the research team led by Prof. R. R. Krishnamurthy of the University of Madras and the active support from their partner, Kyoto University, Japan. I am happy to note that my city is leading pioneering and implementation oriented research in the field of disaster risk reduction with international cooperation. I am confident that this study will contribute significantly to put Chennai onto a path where building urban resilience is manifested in the developmental and policy agenda of my city.

MA. Subramanian
Worshipful Mayor
Corporation of Chennai

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Message

Col. Dr. G. Thiruvasagam

Vice - Chancellor, University of Madras

UNIVERSITY OF MADRAS

(Established under the Act of Incorporation XXVII of 1857 - Madras University Act 1923)
(State University)
Accredited at the "A Grade Level" by NAAC
Conferred with the " **University with Potential for Excellence**" Status by UGC

CHEPAUK, CHENNAI - 600 005

Col. Dr. G. Thiruvasagam
Vice - Chancellor

FOREWORD

In India, climate change and urban risk are some of the biggest challenges, as cities are faced by the consequences of large population growth rates, economic growth, and greenhouse gas emissions. There are now serious concerns about how Indian cities, as major engines of growth, are embedded in a changing environment which are likely to become more susceptible to increasing and more frequent natural hazards.

This study takes an innovative attempt to measure the resilience of Chennai to climate-related disasters (floods, cyclones, heat waves, droughts, etc.) by taking a truly multi-sectoral and developmental approach. Based on five dimensions (physical, social, economic, institutional, and natural), the focus in this study is to understand the capability and condition of the ten zones of Chennai to cope with such events. In this approach, the belief is that micro-level analysis is best in addressing urban disaster risks adequately and comprehensively in order to build resilience. The report provides the base information that can help to build such resilience through taking appropriate action.

We are grateful for the support and partnership that the Corporation of Chennai provided in facilitating this study to its successful completion. Special thanks are due to Mr. Rajesh Lakhoni, I.A.S., Chennai Corporation Commissioner and Mr. P. Murugesan, Chief Engineer, Corporation of Chennai, for their approval and recognition for this effort. Mr. N. Mathavan, Assistant Executive Engineer, Corporation of Chennai, who was crucial in implementing the approach and ensuring a fruitful engagement with the participating zones. The Kyoto University, an active partner of our bilateral Memorandum of Understanding, has developed this methodology and we are grateful to them for having shared it and guiding the data collection and analysis of results. We are particularly grateful to Rajib Shaw, Yukiko Takeuchi and Jonas Joerin of Kyoto University's Graduate School of Global Environmental Studies. I also gratefully acknowledge the support of the Department of Applied Geology, and the guidance and support provided by my colleague Dr. R. R. Krishnamurthy, Associate Professor towards the conduct of this study.

As the head of the 152 year old academic institution, I take pride and privilege to note and acknowledge that our research collaboration is serving the people and communities of the city of Chennai. I will be happy to see that the Corporation of Chennai finds this report useful, and uses it for their future work in developing Chennai as a disaster resilient city.

Col. Dr. G. Thiruvasagam

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Message

Yuzuru Matsuoka
Professor, Kyoto University

Kyoto University Global COE Program
Global Center for Education and Research on Human Security Engineering for Asian Megacities

MESSAGE

Asia is increasingly becoming vulnerable due to its rapid urbanization and associated human induced problems, in combination with occurrences of natural events, especially hydro-meteorological or climate related hazards. Insufficient knowledge, resources and applicable technology add to this problem. This, in fact, is linked to the human security issues in the Asian urban areas. To address these problems, Kyoto University launched a Global Center of Excellency (GCOE) Program titled "Global center for Education and Research on Human security Engineering for Asian Megacities" in the year 2008, with financial support from the Japanese Ministry of Education, Culture, sports, Science and Technology (MEXT). The GCOE aims to help in designing and managing cities that enables their citizens to live with dignity, in comfort, and free from the potential threats of environment and disaster related issues.

Over last two years, GCOE was supporting innovative research practices all over Asia. As a part of the GCOE research project "Climate and Disaster Resilience Initiative (CDRI)," the International Environment and Disaster Management (IEDM) Laboratory of the Graduate School of Global Environmental Studies of Kyoto University had conducted field based action research in participation with local governments, academic institutes and nongovernment organizations in Asia. CDRI developed and tested a multi-disciplinary planning tool to assess city's resilience to climate related hazards by measuring five dimensions: physical, social, economic, institutional and natural. Through an exhaustive questionnaire, data are collected at city, district/ zone or sub-district levels, and the analysis is used for the training and capacity building of the local government officials to enhance the disaster resilient city planning process.

I am very happy to present the findings of the analysis of ten zones of Chennai, which has been done in close cooperation with the Municipal Corporation of Chennai and the University of Madras. There has been a series of consultation processes and workshops over last one year to produce this output, and I am thankful to the Mayor of Chennai and the Vice Chancellor of University of Madras for their support in making this study successful. I believe that the key strength of this study is its potential implementation in making Chennai a disaster resilient city. I am confident that with the strong determination and leadership of the Mayor, and with the support of the University of Madras, the findings of this study will be actually used in the expansion plan of the Chennai, which will set a standard of excellence in disaster risk reduction. On behalf of the GCOE, I am committed to extend technical support in future, and looking forward to bring this fruitful collaboration to a success. I congratulate Kyoto University team for making this happen.

Yuzuru Matsuoka
Professor and Program Leader
Kyoto University GCOE Human Security Engineering for Asian Megacities

Introduction

Climate and Disaster Resilience Index for Zones of Chennai

Over the last decades, Chennai has experienced a rapid growth of its population. While the city was founded in 1639, based on only a few settlements, the city expanded its size and population steadily and totalled 4.34 million inhabitants in 2001. The size of the city is 176 km2 and accepted plans by the Corporation of Chennai (Municipality) suggest an expansion of the city area by up to 426 km2. This plan and the formation of new administrative zones and districts are expected to become effective once the present term of elected Councillors is over in June 2011. Key reasons for this enlargement of the city is to better meet the demands of the citizens in and around Chennai, for example, to ensure enhance planning for new infrastructure projects or to better channelize and regulate investments in areas adjacent to the current boundary of the city.

Beside of dealing with the effects of urbanisation, Chennai is vulnerable to climate-related hazards. Although the number of registered cyclones, one of the main natural hazards, has not yet significantly increased, impacts of occasionally succeeding intense rainfall events from cyclones are likely to become more severe in the future (IPCC, 2007). The post-monsoon period between October and December is the time when most of the annual rainfall (122 cm) is recorded, resulting in occasional flooding after intense rainfall events. This is also the period when most cyclones form over the Bay of Bengal and occasionally hit Chennai. Although, droughts are hardly occurring there are occasional periods of hot days leading to smaller heat waves in the Month of April- June.

The combination of densely populated areas in Chennai and increasing risks of climate-related hazards makes the city particularly vulnerable to disasters. Therefore, the study, shown in this publication, aims to assess the resilience of the currently existing 10 administrative zones of Chennai to climate-related disasters (e.g. floods, cyclones, heat waves, droughts).

Scope

In this publication (consultation version) results are shown from the 10 zones (see figure 1) regarding their resilience to climate-related disasters.

Concept of Resilience

Resilience to climate-related disasters applied in an urban area, and at micro-level (zone), tries to disclose on one hand the capacity of a city's urban infrastructure and services to withstand against disasters, and on the other, how communities and institutions are expected to deal with such an event. The questions are basically how resilient is a particular zone today and how is the city going to absorb, maintain and recover (bounce back) from a hazard leading to a disaster.

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

Methodology

This study is based on a questionnaire covering five dimensions (see above) in which every dimension consists of another five parameters defining it in more detail. Each of the five parameters is then again represented by another five variables. Accordingly, 125 variables define the overall resilience of a city (see table 1 for content of questionnaire). Using a simple arithmetic function named weighted mean scores for variables, parameters, and dimensions are calculated.

Results

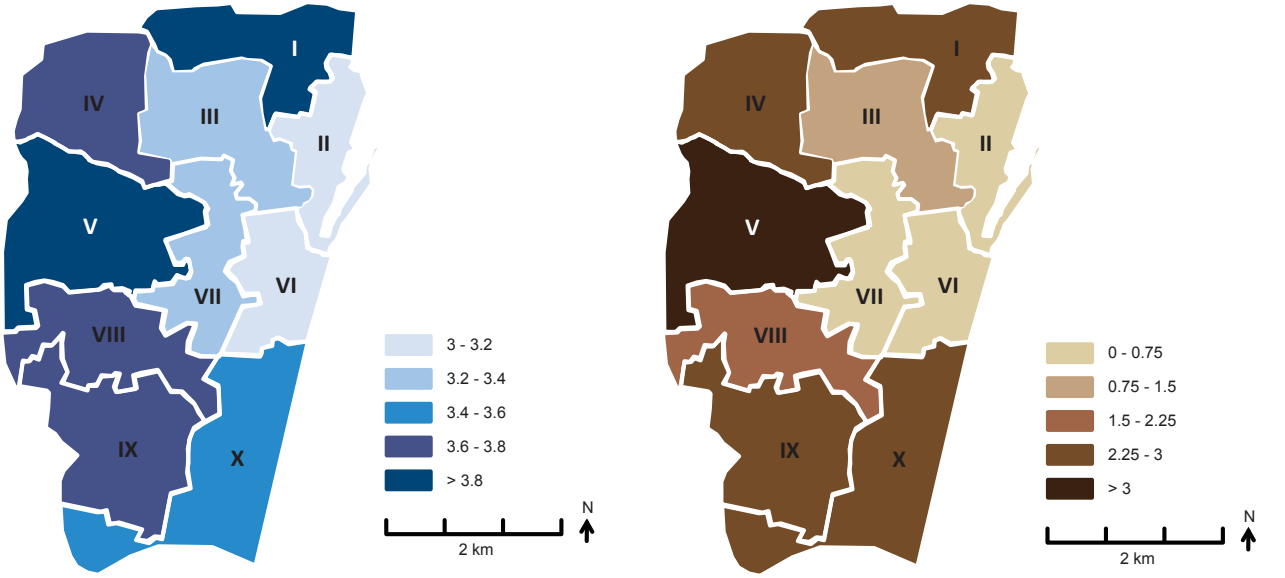
The following pages show the results for each of the 10 zones in form of a detailed report and maps (spiders) providing a visual idea about the current condition of a particular zone. A graphic line crossing the line of a dimension/parameter closer to 1 means the city has a low resilience in this aspect. A result approaching the score of 5 is showing high resilience.

DIMENSIONS	PARAMETERS AND VARIABLES
Physical	**Electricity** (access, availability, supply capacity, alternative capacity)
	Water (access, availability, supply capacity, alternative capacity)
	Sanitation and solid waste disposal (access to sanitation, collection of waste: treated, recycled, collection of solid waste after a disaster)
	Accessibility of roads (% of land transportation network, paved roads, accessibility during flooding, status of interruption after intense rainfall, roadside covered drain)
	Housing and land-use (building code, buildings with non-permanent structure, buildings above water logging, ownership, population living in proximity to polluted industries)
Social	**Population** (population growth, population under 14 and above 64, population informal settlers, population density at day and night)
	Health (population suffer from waterborne/vector-borne diseases, pop. suffer from waterborne diseases after a disaster, access to primary health facilities, capacity of health facilities during a disaster)
	Education and awareness (literacy rate, population'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, acceptance level of community leader (in ward), ability of communities to build consensus and to participate in city's decision-making process (level of democracy), level of ethnic segregation
	Community preparedness during a disaster (preparedness (logistics, materials, and management), provision of shelter for affected people, support from NGOs/CBOs, population evacuating voluntarily, population participating in relief works)
Economic	**Income** (population below poverty line, number of income sources per household, income derived in informal sector, % of households have reduced income due to a disaster)
	Employment (formal sector: % of labour unemployed, % of youth unemployed, % of women employed, % of employees come from outside the city; % of child labour in zone)
	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 to credits, accessibility to credits for urban poor, saving practice of households, household's properties insured)
	Budget and subsidy (funding of DRM, budget for DRR sufficient, availability of subsidies/incentives for residents to rebuild houses, alternative livelihood, health care after a disaster)
Institutional	**Mainstreaming of DRR and CCA** (mainstreaming of CCA and DRR in: zone's development plans, ability (manpower) and capacity (technical) to produce development plans, extent of community participation in development plan preparation process, implementation of disaster management plan)
	Effectiveness of zone's crisis management framework (existence and effectiveness of an emergency team during a disaster: leadership, availability of evacuation centres, efficiency of trained emergency workers during a disaster, existence of alternative decision-making personnel)
	Knowledge dissemination and Management (effectiveness to learn from previous disasters, availability of disaster training programmes for emergency workers, existence of disaster awareness programmes for communities, capacity (books, leaflets, etc.) to disseminate disaster awareness programmes (disaster education), extent of community satisfaction from disaster awareness programmes)
	Institutional collaboration with other organisations and stakeholders, during a disaster (zone's dependency to external institutions/ support, collaboration and interconnectedness with neighbouring zones, zone's cooperation (support) with central corporation department for emergency management, cooperation zone's ward officials for emergency management, zone's institutional collaboration with NGOs and private organisations)
	Good governance (effectiveness of early warning systems, existence of disaster drills, promptness of zone body to disseminate emergency information during a disaster to communities and transparency of zone body to to disseminate accurate emergency, capability of zone body to lead recovery process)
Natural	**Intensity/severity of natural hazards** (floods, cyclones, heat waves, droughts (water scarcity), tornados)
	Frequency of natural hazards (floods, cyclones, heat waves, droughts (water scarcity), tornados)
	Ecosystem services (quality of city's: biodiversity, soils, air, water bodies, urban salinity)
	Land-use in natural terms (area vulnerable to climate-related hazards, urban morphology, settlements on hazardous ground, amount of Urban Green Space (UGS), loss of UGS)
	Environmental policies (use of zone level hazard maps in development activities, extent of environmental conservation regulations reflected in development plans, extent of implementation of environmental conservation policies, implementation of efficient waste management system (RRR), implementation of mitigation policies to reduce air pollution)

Table 1: Parameters (bold) and variables of CDRI

Overall Zone Profile

Physical Resilience

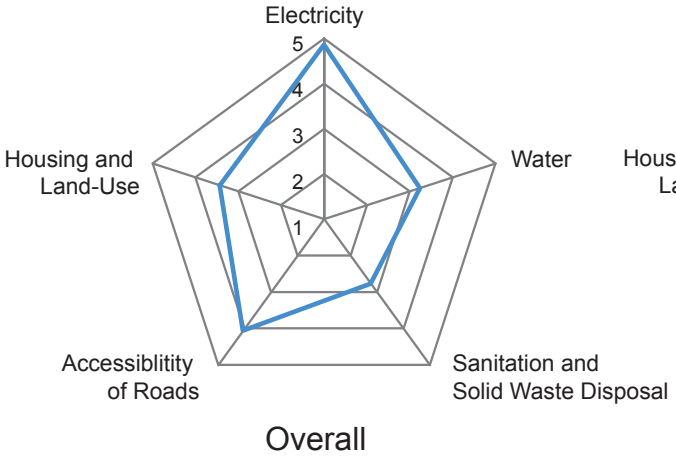


Average % Population Growth Per Year, 1971-2001

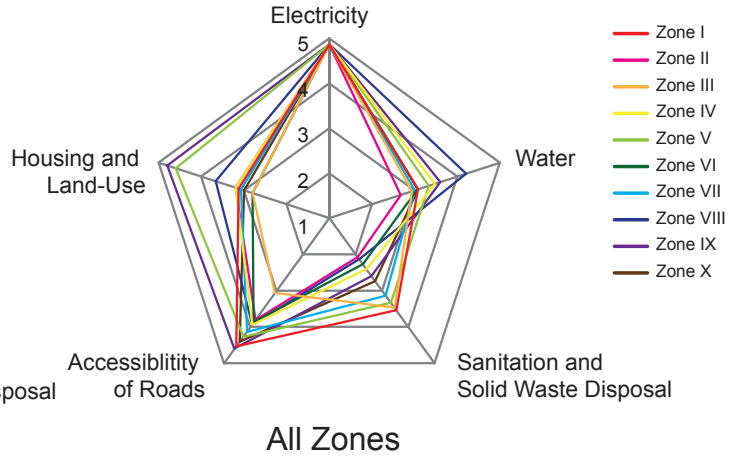
Electricity services are provided from a central supplier (Tamil Nadu Electricity Board) for all zones equally so there is no differentiation in this parameter. Water services are also provided centrally from the Chennai Metro Water Supply and Sanitation Board (CMWSSB) and therefore, all zones are affected by the regular supply hours of water which are usually only 3-5 hours per day, lowering the resilience score. However, most houses are equipped with rooftop water tanks where sufficient water can be stored for the rest of the day.

Similarly, the capacity of alternative emergency safe water supply is limited to 20-40% of the needed amount. The CMWSSB is capable to provide at least 76% of the water demand for all zones, and in most zones it provides up to 100% of the needed amount.

Another interesting finding is between the zone's population growth rates and physical resilience scores (see figure below). A very significant correlation coefficient of r = 0.96 underlines that urbanisation may not necessarily lead to a deterioration of basic urban services. It is notable that the 'older' zones (2, 3, 6, and 7), earlier and densely populated, have lower population growth rates compared to the 'newer' developed areas along the urban fringe and also have lower physical resilience.

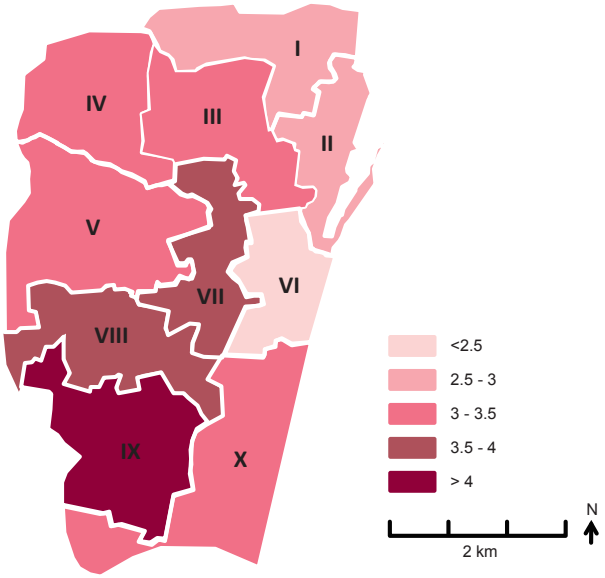


Overall

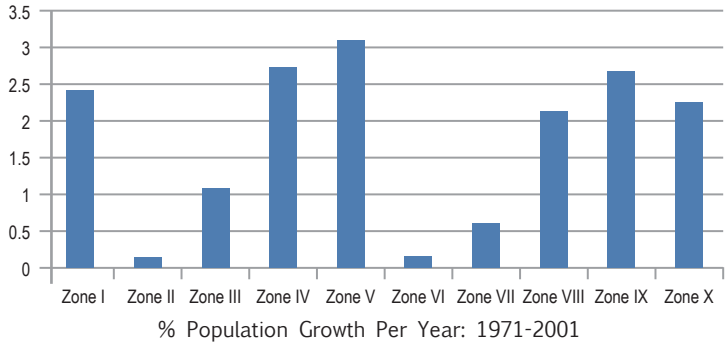


All Zones

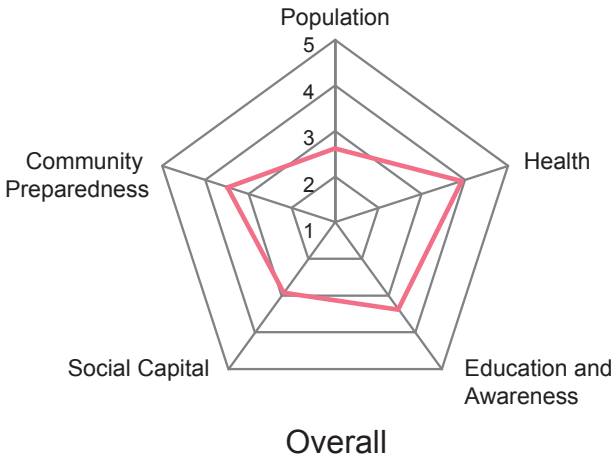
Social Resilience

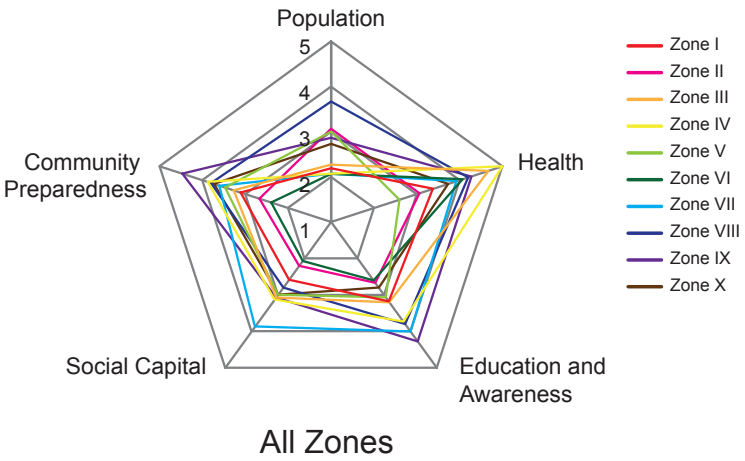


Due to high average population growth rates (1.72%, 1971-2001) over the past decades many zones are densely populated (city average is 26,768 per sq/km) and continue to grow (CMDA, 2008): Population growth rates are higher in 'older' zones (2, 3, 6, and 7) than in those along the prospering urban fringe.

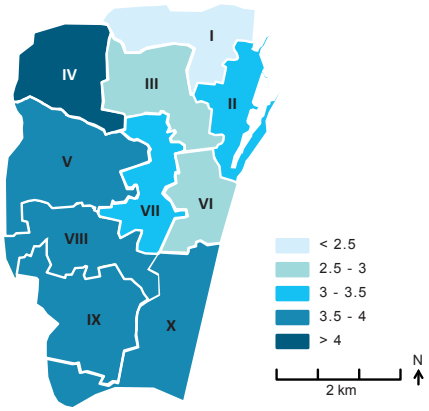


Social resilience levels show that population scores tend to be lowest, as mentioned due to urbanisation. The map below indicates that to some extent the northern zones (1, 2, and also 6) have lower social resilience compared to the more prosperous southern and western parts of Chennai.





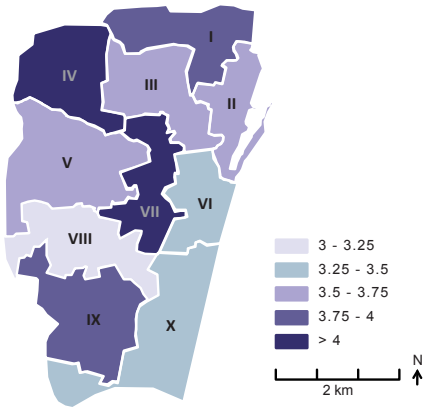
Economic Resilience



The economic resilience map shows that particularly zones 1-3 have lower scores unlike the southern parts of Chennai which tend to be more resilient. Probably, due to many recently established projects which may have lifted the economic resilience of these areas.

Economic resilience is varying largely among zones as no regular or uniform resilence map is detectable. However, correlation coefficients (see table 1) among certain parameters indicate a correlation between income and household assets. The economic resilience is particularly low for zone 1-3 and tends to be higher in the southern parts of Chennai where many newly established projects have lifted the economic resilience of these areas.

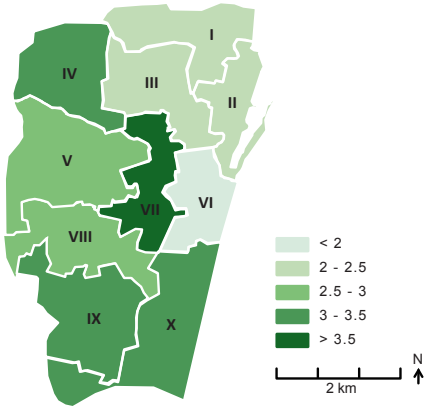
Institutional Resilience



The institutional resilience is not bound to population density, intensity of land-use or economic and natural characteristics. It confirms largely the administrative purpose of the zones to act on behalf of the decisions taken by the central Corporation of Chennai departments.

There is a harmonised structure among the different institutional parameters within the zones. Table 1 shows several significant correlation coefficients between institutional parameters.

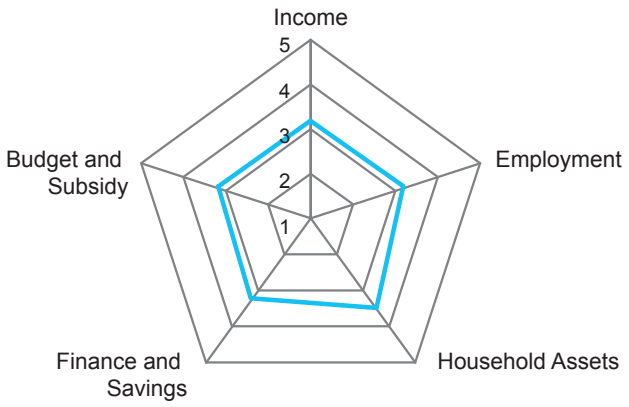
Natural Resilience



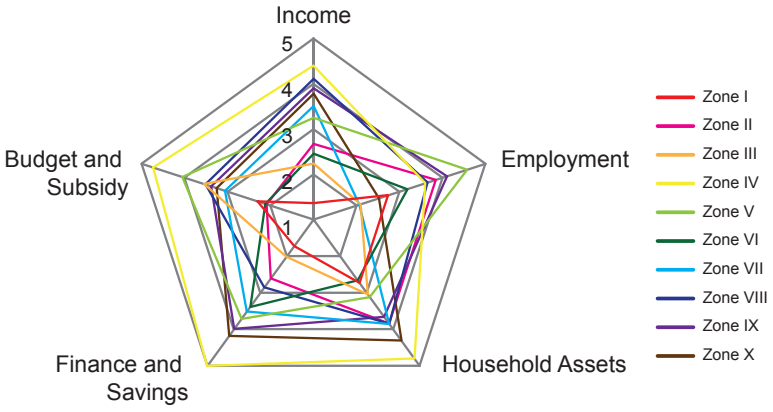
The rather poorer areas and socially disadvantaged areas in the north of Chennai also tend to have a lower natural resilience.

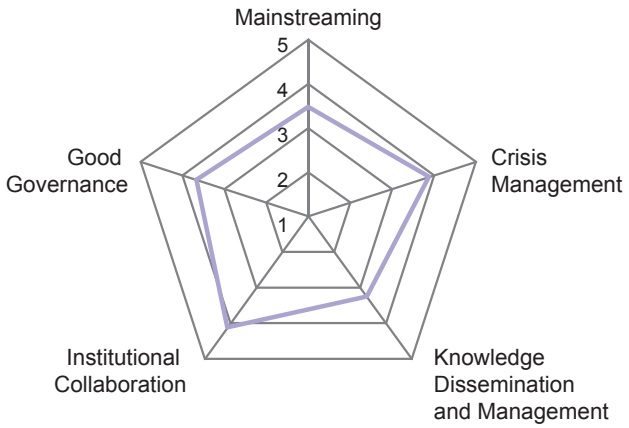
The key climate-related hazards threatening Chennai are occasional floods, cyclones, and to some extent heat waves and rarely occurring droughts. Since the zones are neighbouring each other within a rather small geographical scale the intensity and frequency of hazards has obviously a low variation unlike the implementation of environmental policies, land-use or ecosystem services which point out large variations between the zones.

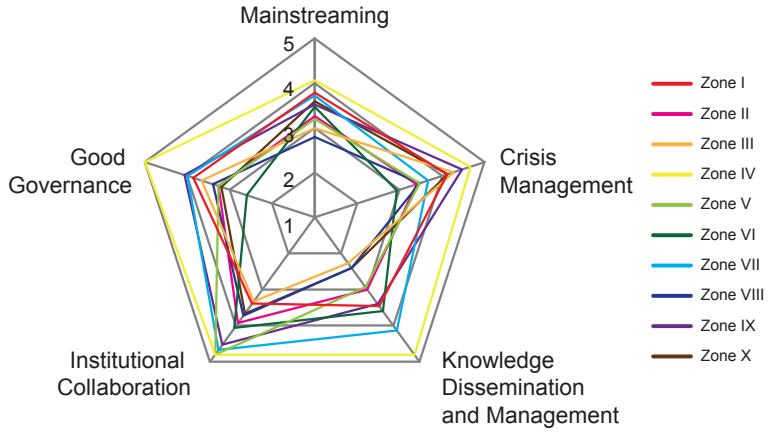
Overall

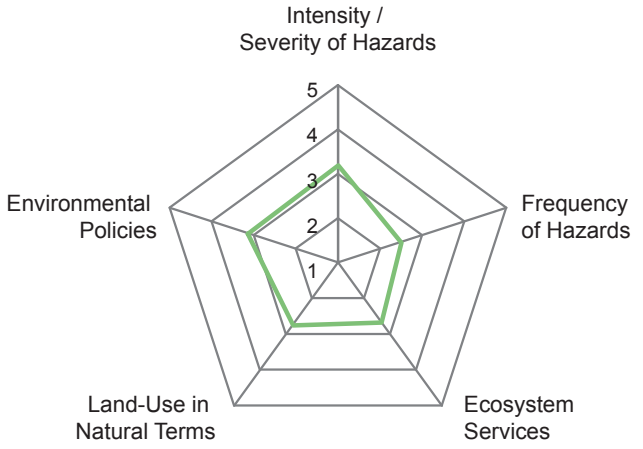


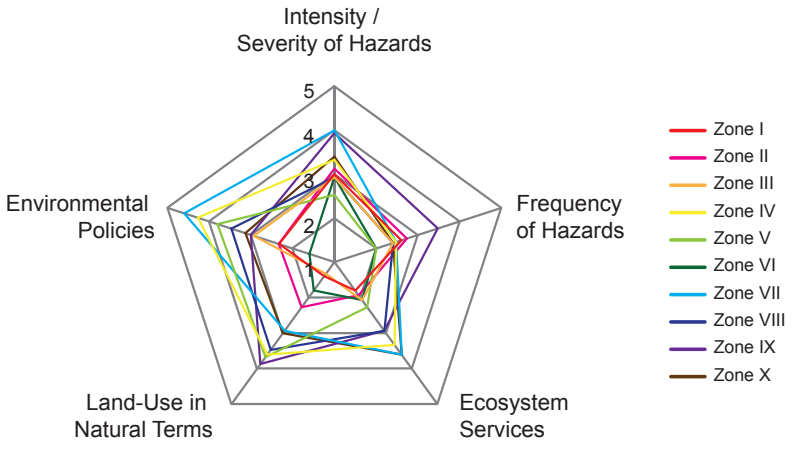
All Zones



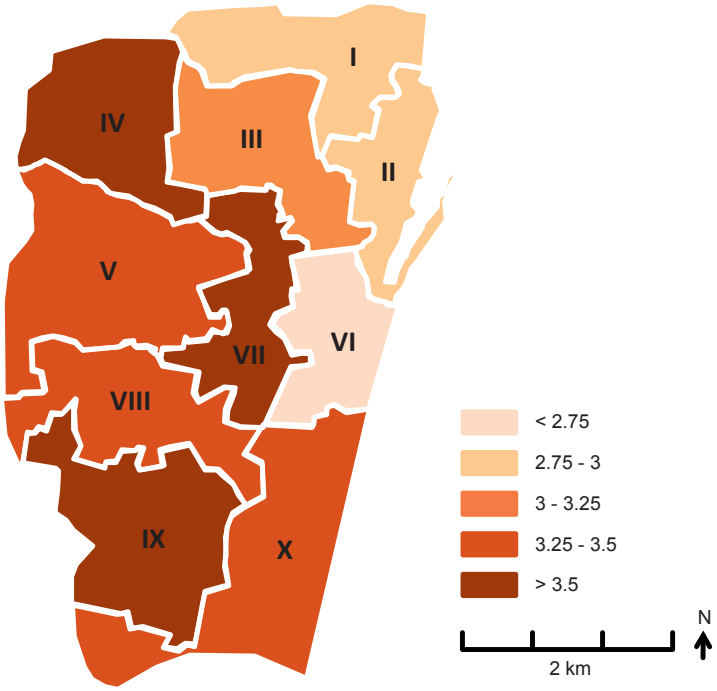






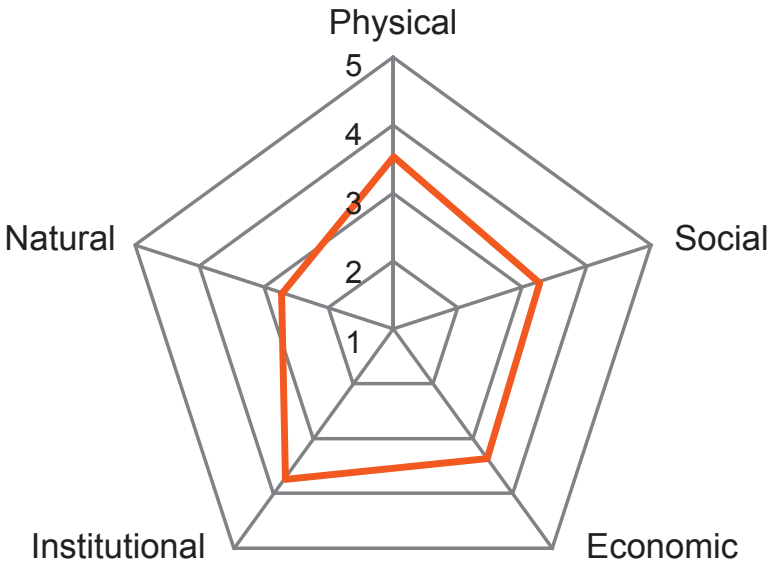


Overall Resilience



The map shows the northern parts of Chennai have overall lower resilience compared to areas in the south and west.

Although, the overall resilience map shows differences between the ten zones of Chennai the variation of scores are small. This small range of varying scores is exemplified in the diagram below where different dimensions do have similar overall scores.



While the five dimensions (see spider) have resilience scores between 2.7 and 3.7 and may not point out key issues it is crucial to look at the details and relationships within the individual dimensions. Nevertheless, the natural resilience is lowest and the institutional resilience highest.

Weighting Statistics

Parameters: average weighting of parameters, highest to lowest	Weight
Sanitation and Solid Waste	4.2
Community preparedness	4.2
Water	3.8
Environmental policies	3.6
Mainstreaming of DRR and CCA	3.5
Crisis management	3.5
Budget and subsidy	3.4
Income	3.3
Education and awareness	3.2
Land-use	3.2
Finance and savings	3.1
Frequency of natural hazards	3.1
Employment	2.9
Good governance	2.8
Health	2.7
Electricity	2.6
Knowledge dissemination	2.6
Institutional collaborations	2.6
Ecosystem services	2.6
Social capital	2.5
Intensity/severity of natural hazards	2.5
Population	2.4
Accessibility of Roads	2.3
Household assets	2.3
Housing and land-use	2.2

Table2: Prioritisation of parameters

Parameter	CDRI Score
Electricity	4.87
Institutional collaboration	4.09
Accessibility of Roads	4.05
Health	3.89
Crisis Management	3.86
Good governance	3.64
Household assets	3.54
Mainstreaming	3.45
Community preparedness	3.44
Finance and savings	3.43
Housing and land-use	3.43
Education and awareness	3.33
Water	3.24
Knowledge dissemination	3.24
Intensity/severity of hazards	3.21
Employment	3.20
Budget and subsidy	3.17
Income	3.15
Environmental policies	3.15
Social capital	2.88
Sanitation and Solid Waste Disposal	2.77
Land-use in natural terms	2.73
Ecosystem services	2.65
Population	2.60
Frequency of hazards	2.49

Table3: CDRI scores of parameters

Variables: average weighting highest to lowest	Weight
Extent of implementation of environmental policies	4.125
Zone's electric supply authority capable to provide electricity	4
Awareness of people about the threat and impact of a disaster	4
Extent of zone's population participate in community activities	4
% of youth unemployed in formal sector	4
Effectiveness of emergency team during a disaster (leadership/competence)	3.9
Intensity/severity of floods	3.9
Intensity/severity of cyclones	3.9
Extent of zone's population provide shelter or emergency support for affected people after a disaster	3.8
% of zone's annual budget targeting disaster risk management	3.8

Table 4: Prioritisation of the ten most important variables out of 125

Table 2 shows that respondents regarded sanitation and solid waste and community preparedness as the most important parameter to influence the resilience scores, as highest weight was given to these two parameters.

Looking at Table 3, it is exemplified that particularly sanitation and solid waste is not highly resilient so it confirms that action is needed in this sector.

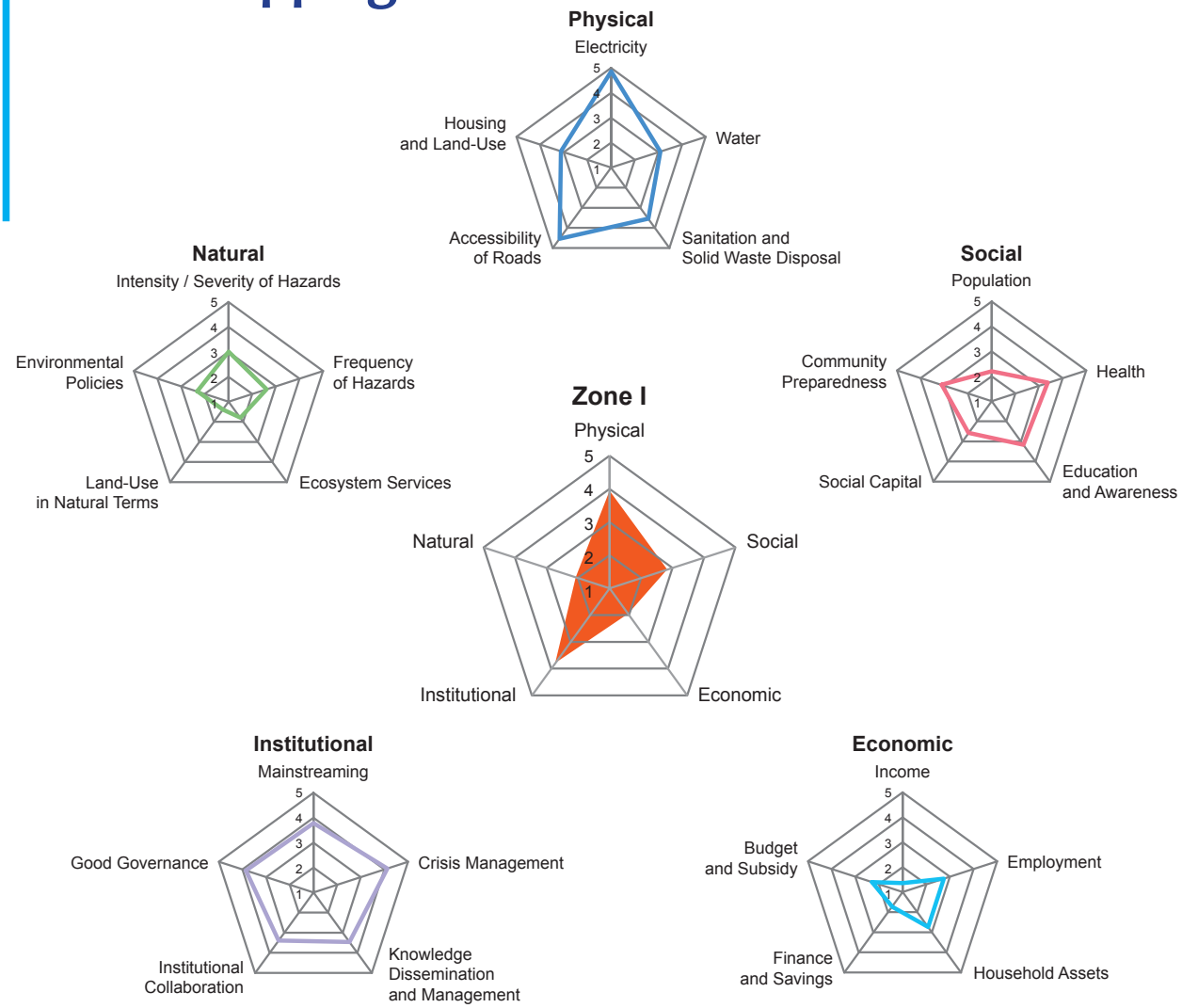
Table 4 highlights the variables which were given highest importance in shaping the resilience of their parameters/dimensions. It is seen that the implementation of environmental policies is most important to raise the resilience of the city to climate-related disasters. Basically, the highest weightings were assigned to increasing the awareness and capacity of communities to respond to disasters.

ZONE I : TONDIARPET

Zone I, Tondiarpet, lies at the northern end of the city and along the coastal line of the Bay of Bengal. The area of zone I spreads over 17.3 km2 and had a population of around 410,000 in 2001. The population is predominantly constituted by labour class people working in the informal sector. This area is characterised by two canals (Buckingham and Link canal) which cater the drainage of flood water into the sea. In earlier times various big industries were located here and now replaced by smaller entities. This zone has also a big landfill site for dumping of solid waste accommodating garbage for five zones (almost 50% of waste accumulation in city). Furthermore, a sewerage treatment plant is located in Kodungaiyur. Flooding may occur occasionally along the canals, but no major damages/ losses recorded so far.

The overall resilience indicates that Zone I is below average, particularly for the dimensions of economic and natural.

CDRI Mapping



Physical

Up to 95% of all people have access to potable water which is available 3-5 hours every day. Most people have access to hygienic sanitation. Up to 100% of all solid waste is collected every day, however, less than half of it is treated and less than 25% is recycled. Most roads are paved and remain accessible during normal flood events in affected areas. It is likely that parts of the road network are interrupted for more than 12 hours after heavy rainfall and around half of all the roads are equipped with a drainage system. Up to 50% of all houses are built following building codes and less than 19% are of non-permanent structure. However, less than half of all houses are constructed to be above the plinth level and more than half of the people live in proximity to polluted industries, dumping grounds, etc.

Social

Although, the population growth rate per year is only around 2% more than 23,000 people on average live on one sq/km. The demographic structure shows that more than 45% of the population is below 14 or over 64. The zone's population is less affected by waterborne diseases, but more than 24% of them suffer from vector-borne diseases every year. Access and capacity of primary health facilities before and during a disaster is well provided. Once a year the zone authority organises disaster awareness programmes/drills to further increase the awareness to disasters. The literacy rate is less than 62.5% and Indian average. Schools are mostly functional after a disaster. Social capital is characterised by less than 10% of people participating in community activities and medium ability to build consensus and deliver shared interests or participate in zone's decision-making process. Ethnic groups (Hindus, Christians, and Muslims) are more or less mixed. Even though households are not entirely prepared for a disaster in terms of logistics they provide shelter for affected people in case of such an event. Voluntary evacuation is limited as well as the communities' participation in relief works.

Economic

In this zone more than 40% of the people live below the poverty line and most households (up to 75%) depend on only one income source and up to 40% of all households depend on incomes derived from the informal sector. Unemployment is rather high with more than 25%, also affecting young people in the same extent. Child labour is less than 11%. Due to limited income and employment levels, household assets are not largely available. However, most households have television and most people have non-motorized vehicle. There is limited credit facility in this zone to receive financial support for private initiatives to prevent from future disasters and few people (less than 20%) have good saving practice for such an event or that their houses are insured. Less than 1% of zone's annual budget is targeting DRM and there are limited incentives given to people to rebuild, receive alternative livelihood, or health care after a disaster.

Institutional

The institutional resilience of Tondiarpet is slightly above average compared to other zones in Chennai due to an efficient crisis management which is effective (available emergency team, leadership, evacuation centres, etc); however, emergency workers are not well trained as regular disaster awareness programmes are not available for them. Mainstreaming of DRR and CCA into development plans is done to some extent and a disaster management plan is well implemented. Institutional collaboration during disasters is good with Central Corporation and ward officials, but less efficient with NGOs and private organisations and neighbouring zones. Early warning system is effective and people may experience once a year disaster drills; however, the transparency of the zone body to disseminate accurate information during disaster times is limited.

Natural

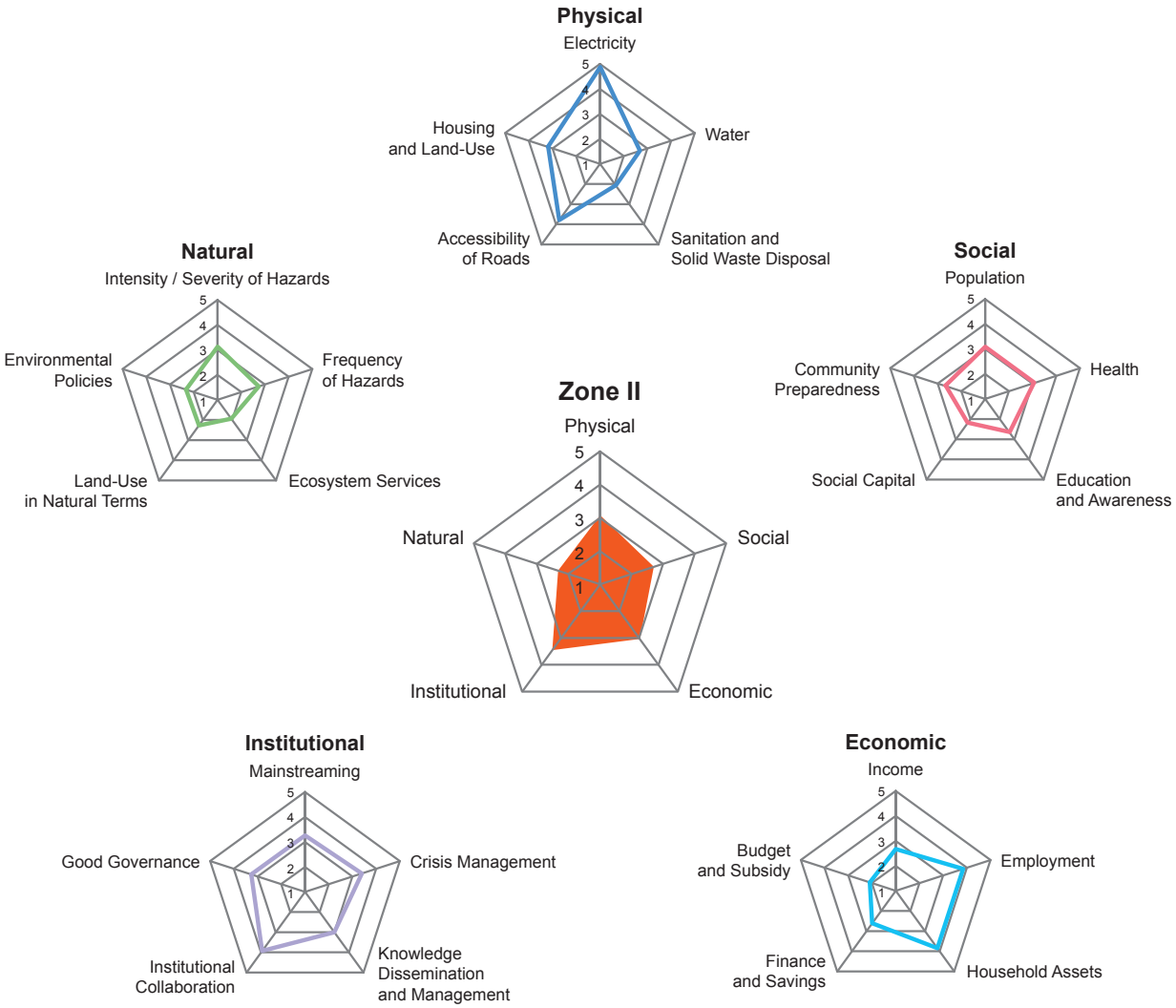
The natural resilience in Tondiarpet is below average due to highly vulnerable ecosystem services (biodiversity, soil, air, and water quality) and lack of proper incorporation of environmental conservation regulations into development plans and implementation in general. The amount of urban green space is less than 1% because of significant losses in the last decades leading to a highly intense land-use. Almost all land of this zone is vulnerable to climate-related hazards, as it also has a coastal exposure it is particularly prone to cyclones.

ZONE II : BASIN BRIDGE

Basin Bridge is located in the northern part of Chennai and had a population of around 376,000 in 2001. This zone features the port, a centre for trade all around the world. Basin Bridge constitutes one of the oldest parts of Chennai where also the Fort of Chennai, the founding place of Chennai, is located.

The zone's overall resilience is lower than average mainly because of reduced physical, social and natural resilience levels. All resilience dimensions are below average.

CDRI Mapping



Physical

Up to 80% of the people have access to safe water which is usually available for 3-5 hours every day and up to 75% of the people have access to hygienic sanitation. Around three quarter of all solid waste is collected every day, but not treated or recycled. More than 20% of the land is used for the transportation network and up to 80% of all roads are paved, and around half remain accessible during normal flooding in affected areas. Similarly, around half of the roads are equipped with a drainage system. Around 30% of all houses were built following a building code; however, the same percentage of houses is of non-permanent structure. Up to 60% of all houses are above normal water logging. Less than a quarter of all people live in proximity to polluted sites.

Social

Population growth rates are close to 0% per year and the demographic structure is good; however, the population density is high with more than 32,000 people living per sq/km. The share of people living in slums is less than a quarter of the whole population. Up to 23% of the population suffers every year from waterborne diseases, but most people (up to 95%) have access to primary health facility. The literacy rate is below Indian average (62.5%) and people's awareness about disasters is limited, but once a year the zone's authority organises disaster awareness programmes/drills. Social capital is characterised by less than 20% of the people participating in community activities and reduced ability to build consensus and deliver shared interests or participate in the zone's decision-making process. Different ethnic groups are not well interlinked. The preparedness of communities to disasters is medium in terms of logistics, materials, and management. People poorly evacuate voluntarily in case of a disaster and there is medium support for others in terms of providing shelter or participate in relief works.

Economic

The share of people living below the poverty line is rather high with up to 30%. Up to three quarters of all households depend on just one income source and up to 40% gain their income from activities in the informal sector. The unemployment rate is relatively high with 24% of people without jobs; however, affecting less young people (up to 18%). More than half of all women are employed. Household assets in form of television and non-motorized vehicle are provided for most people. Availability of credit facility is available to some extent to prevent from future disasters; however, there is reduced saving practice among households and few residential houses are under any sort of insurance scheme. Less than 1% of the zone's annual budget is targeting DRM and is not at all sufficient. There are some availability of subsidies/incentives for rebuilding houses, provision of alternative livelihood, and health care after a disaster.

Institutional

Basin Bridge's institutional resilience is slightly lower compared to other zones, but still relatively high as the institutional collaboration is well organised especially with regards to connections with the Central Corporation and ward officials of the zone. On the other hand disaster drills for the public are organised less than once every two years and people show limited satisfaction from disaster awareness programmes. Mainstreaming of DRR and CCA in development plan is to some extent done; likewise, a disaster management plan (contingency plan) is implemented. Frequent disaster training programmes for emergency workers (more than twice a year) are reflected in their ability to efficiently (leadership) manage a potential crisis situation.

Natural

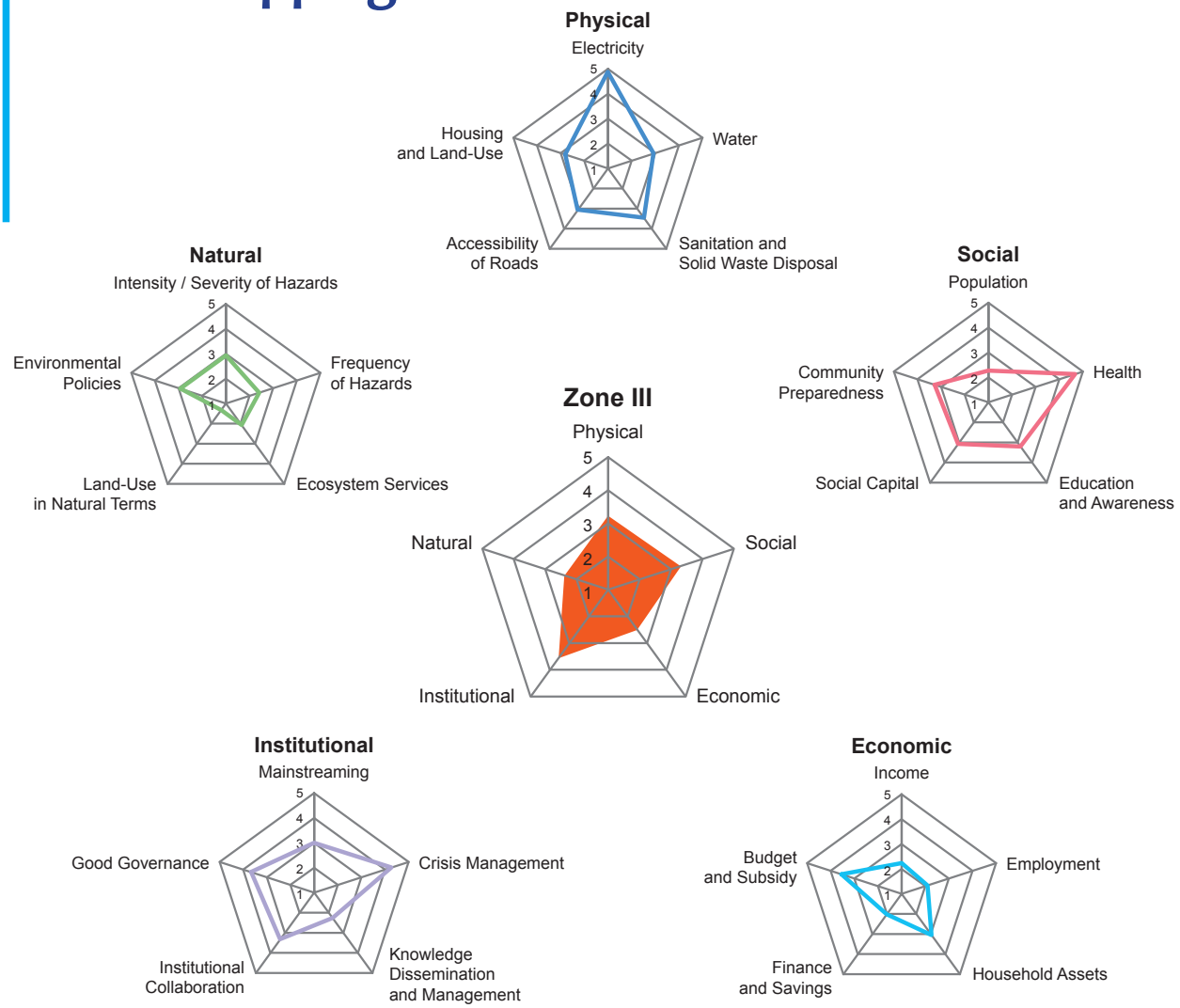
The natural resilience is particularly low due to vulnerable ecosystem services (biodiversity, soil, air, water, urban salinity). Although, less than 25% of the zone's area is vulnerable to climate-related hazards, up to half of all settlements are located on hazardous ground (e.g. flood prone area). Accordingly, there is a high intensity of land-use reflected by little amount of existing urban green space (less than 5%) of the zone's land area. The implementation of environmental policies is limited, but at least recognised to some extent in zone's development plans.

ZONE III : PULIANTHOPE

Pulianthope is a low-lying flood prone area (around 60%). The population was recorded as around 460,000 in 2001. The population density is high with more than 34,000 people per sq/km on average living in this zone. This area is one of the poorer areas of Chennai where many slums are located and large numbers of people live below the poverty line (around 40%). Moreover, many waterways and roads are inadequately managed and would require improvement.

The overall resilience level of Zone III is slightly below average mainly for economic aspects while the social dimension is performing above average. The other dimensions are below average, but to a lesser extent.

CDRI Mapping



Physical

Close to 100% of all the people have access to safe water which is available for a limited time period of up to 5 hours every day. Less than 60% of the zone's population have access to hygienic sanitation. Up to 100% of solid waste is collected every day, but less than a quarter of it is treated or recycled before dumping. Most roads are paved and up to 60% remain accessible during normal flooding in affected areas which are likely to be interrupted for more than 12 hours after a heavy rainfall event. Less than half of the roads are equipped with roadside covered drain. Less than 30% of all buildings are constructed following building codes and the same amount is of non-permanent structure. However, around half of all houses are above plinth level. Around one third of the population lives in proximity to polluted sites.

Social

Population growth is only about 1% per year (city average 2%), but still more than 40% of the people live in slum areas and the demographic structure is unfavourable with up to 46% of people being below 14 or above 64 in case of a disaster (losses). The population density per sq/km is high with more than 34,000 people. Few people suffer from waterborne or vector-borne diseases and capacities of primary health facilities are provided before and during a disaster. The literacy rate is Indian average and the medium awareness of people about disasters is addressed by the zone authority to organise once every year disaster awareness programmes. Social capital is medium with less than 30% of the people participating in community activities, community participation in zone's decision-making process, or acceptance of community leader in wards. However, different ethnic groups are well interlinked. Community preparedness to disasters is characterised by medium prepared households in terms of logistics, materials, and management. However, people tend to evacuate voluntarily after a disaster and provide some support in relief works or to provide shelter for affected people.

Economic

The economic situation for many people/households is difficult as up to 30% of all people live below the poverty line; more than 40% depend on income from the informal sector and are usually experiencing reduced incomes in the aftermath of a disaster. Furthermore, most households depend on only one income source. Unemployment rates are high with more than 25% of people without jobs. Child labour is marginal. Reflecting the limited opportunities for wealth accumulation, households do have essential household assets like television, but less than 30% have non-motorized vehicle. The provision of credit facility for residents to finance prevention measures to future potential disasters is limited and also, there are less than ten percent of all residential houses insured. However, the zone's authority is spending up to 3% of its annual budget for DRM measures and there are some subsidies/incentives available for residents to receive health care after a disaster.

Institutional

The institutional capacity to deal with a disaster situation is relatively high, but still slightly below city average partly due to a lack of sufficient provision of disaster awareness programmes and drills for the communities and training opportunities for emergency workers. Mainstreaming of DRR and CCA is reduced among other reasons due to limited participation of the communities in the development plan preparation process. However, the crisis management of this zone is effective (good leadership of emergency team) and sufficient availability of evacuation centres. Pulianthope is heavily dependent on external institutions in case of a disaster, but may rely on well established collaborations with the Central Corporation, NGOs/private organisations and neighbouring zones.

Natural

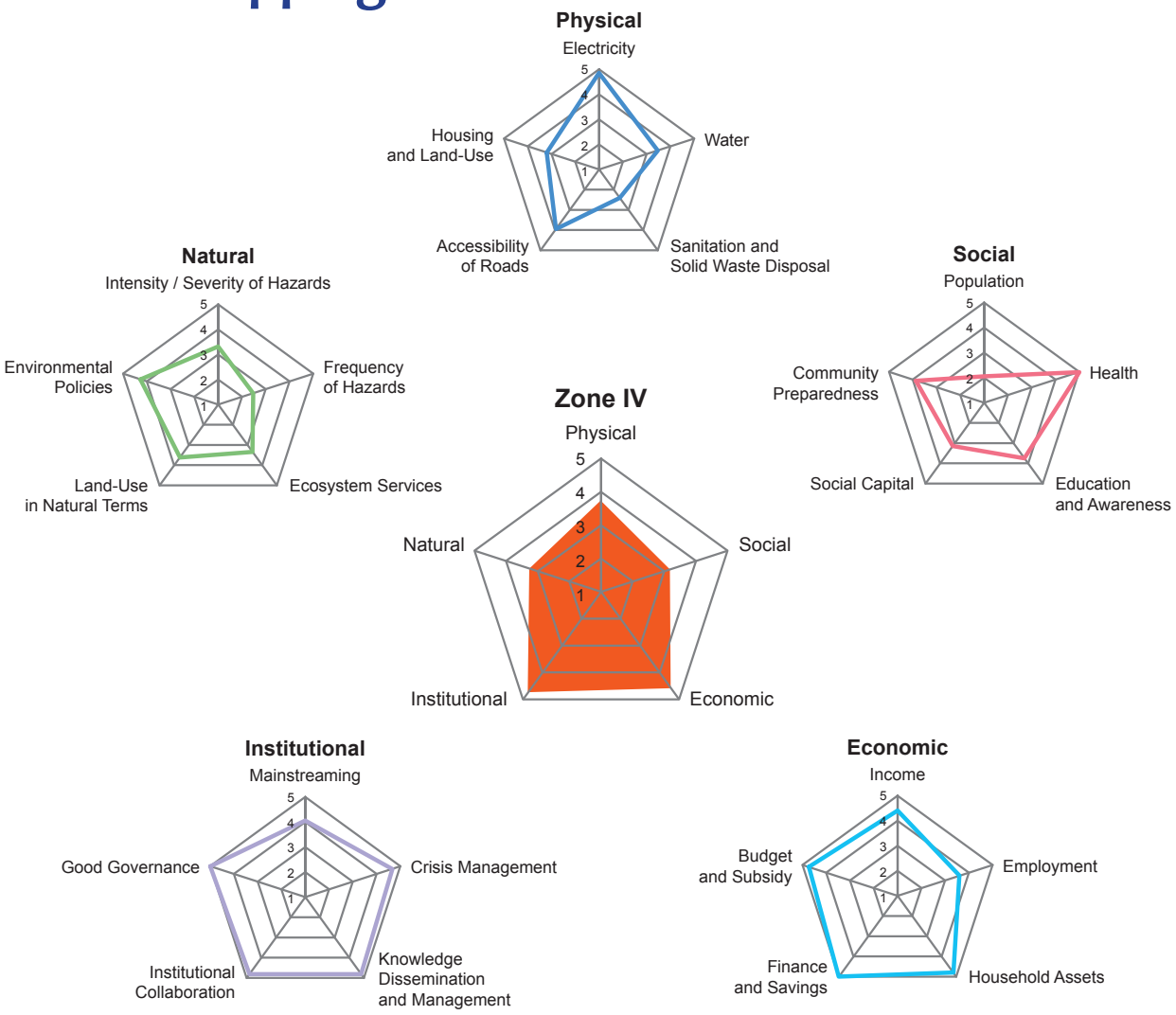
The natural resilience of this zone is below average and characterised by reduced quality of ecosystem services (biodiversity, soil, air, water), but no problems with urban salinity. Although the loss of urban green space was only less than 11% in the last 50 years, current existing green space is less than 5% of the total zone area. Most parts of the zone are intensely used and built and prone to climate-related hazards. However, there is recognition of hazard maps in development activities and environmental conservation policies are reflected in development plans. But, so far environmental policies are not yet well implemented.

ZONE IV : AYANAVARAM

Ayanavaram is located in the north-western part of Chennai. It is a low-lying area (near sea-level) where in some parts occasional flooding may occur. The population was around 497,000 in 2001 and average population density (around 25,000 per sq/km). The zone's population has grown considerably in recent years by around 2.7% per year in the period of 1971-2001 and is continuing to grow in this pace.

The overall resilience of Zone IV is highest compared to the other zones because of well above average economic and institutional resilience levels. Social and physical resilience are closer to average, but still above.

CDRI Mapping



Physical

Up to 95% of all people have access to potable water which is available 3-5 hours every day. Most people have access to hygienic sanitation. Less than three quarter of the population has access to hygienic sanitation. Solid waste is mostly collected, but not treated or recycled before dumping. Most roads are paved and remain accessible during normal flooding in affected areas; however, in case of a heavy rainfall event some roads (less than 30%) are not accessible for more than 12 hours. More than 60% of the roads are equipped with a drainage system. Less than 20% of all buildings were constructed following building code and less than 50% are above normal water logging; however, only up to 19% of all buildings are of non-permanent structure. Less than 12.4% of all people live in proximity to polluted sites.

Social

Population growth rate is above city average (2% p.a.) with around 2.7% per year contributing to more densely populated areas (around 25,000 per sq/km) and a rather high percentage (up to 37.5%) of people living in informal settlements (slums). People do not significantly suffer from waterborne or vector-borne diseases and access to primary health facilities is very good during and before a disaster. The literacy rate is above Indian average (62.5%) up to 87.5%. The knowledge about disasters is medium, but might be increased through yearly recurring awareness programmes/drills. Social capital is good with up to 40% of people participating in community activities and participating in zone's decision-making processes. The acceptance of the community leader in wards is medium like the ability to build consensus and deliver shared interests. Community preparedness to disasters is good with most households being prepared in terms of logistics and materials; however, people tend not to evacuate voluntarily in case of a disaster. Nevertheless, communities support each other by providing shelter and in relief works.

Economic

Income levels are quite high compared to other zones as few people live below the poverty line and depend on incomes derived in the informal sector (less than 11%). However, unemployment rates are high (more than 25%). Most households have basic furniture, television and motorized-vehicles probably due to relatively high income levels. Credit facility is provided to all groups to prevent for future disaster prevention. There is funding available for DRM and subsidies/incentives for residents to rebuild houses after a disaster.

Institutional

Ayanavaram has above average institutional resilience as the zone's institutions are performing well during a disaster. The zone's ability (manpower) to produce development plans is reduced, but overall the mainstreaming of DRR and CCA into such plans is done. Good governance, knowledge dissemination, and institutional collaboration are well prepared/efficient to provide sustainable protection for the zone's population.

Natural

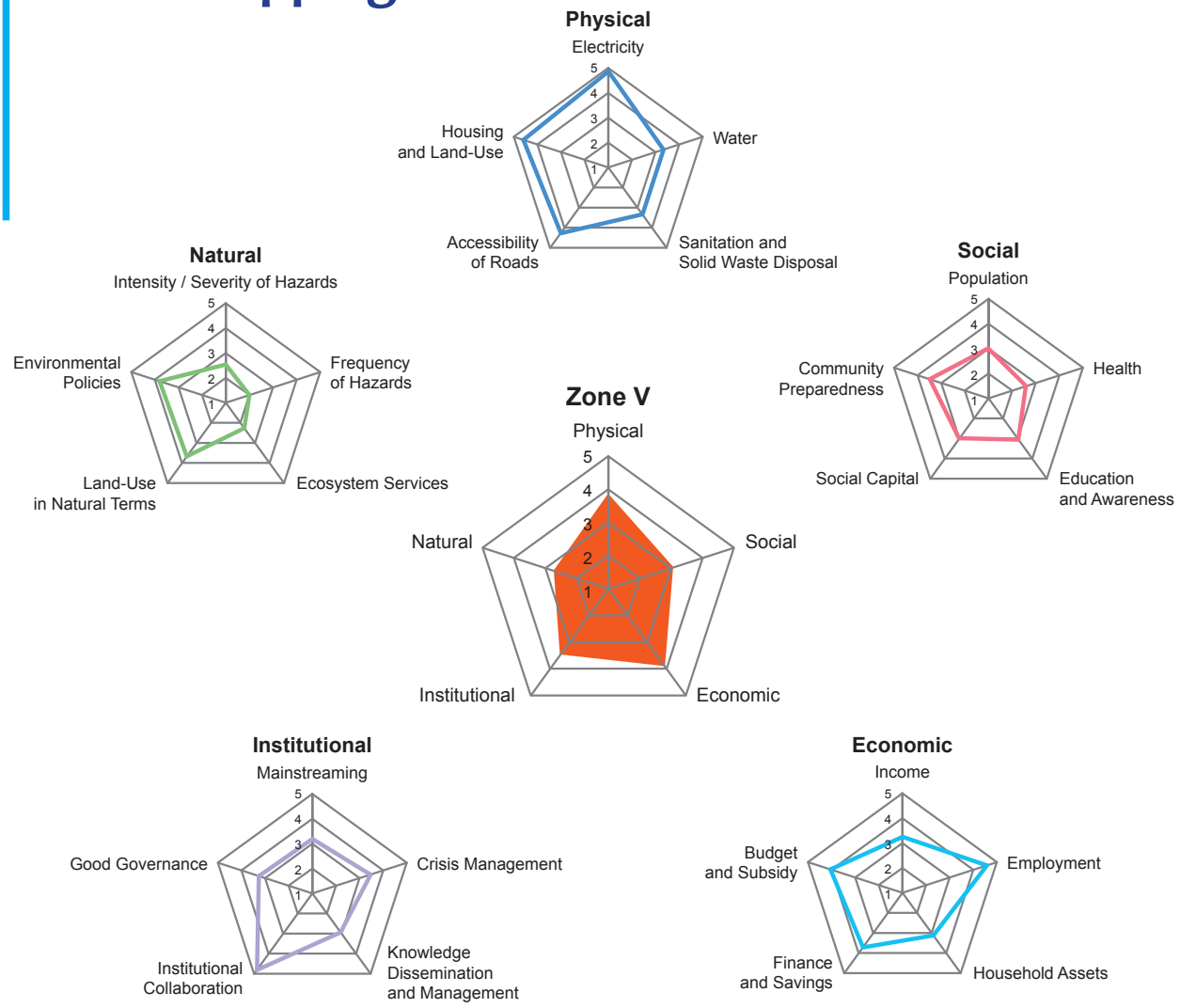
The zone's natural resilience is clearly above average as environmental preservation policies are well implemented and recognised in development plans and activities; however, the implementation of environmental policies reducing the emissions from air pollution is still limited. Nevertheless, large parts of the zone (more than 15%) are urban green space and few settlements are located on hazardous as well as less than 25% of the zone area is vulnerable to climate-related hazards. The quality of zone's ecosystem services (biodiversity, soil, air, water, urban salinity) is medium.

ZONE V : KILPAUK

Zone V is located in the central-western part of Chennai and has many low-lying areas at the western fringe which are susceptible to floods, for example, alongside Virugambakkam Canal which leads into the Coom River. The zone experiences rapid population growth rates with more than 3% per year. The population was 542,000 in 2001, however, the population density was only around 20,000 per sq/km by that time. In recent years many areas along the urban fringe and also in upcoming areas, like Anna Nagar, experienced large migration of new people.

Kilpauk's overall resilience is slightly above average mainly because of high economic and physical scores. On the other hand, social and institutional resilience levels are below average.

CDRI Mapping



Physical

Most people have access to safe water and receive water for 3-5 hours every day and most people have access to hygienic sanitation. Solid waste is collected every day by up to 80%; however, few of it is treated before dumping. Most roads within the zone are paved and remain accessible during normal flooding in affected areas; however, few roads remain not accessible in case of a heavy rainfall event for a maximum time up to 12 hours in the affected areas. Almost half of all roads are equipped with a drainage system. Also, more than half of all buildings are constructed following a building code and less than 10% are of non-permanent structure and the same percentage of all houses is built above plinth level. Few (less than 12.4%) people live in proximity to polluted sites.

Social

Although the population density per sq/km is lower than city level with around 20,000, the high population growth rate at 3.1% per year indicates that urbanisation is occurring. Many people (up to 23%) suffer every year from waterborne diseases triggered without or during disaster times, but primary health facilities are available for most people (up to 90%) which are also likely to perform well during disasters. Disaster awareness is average with disaster awareness programmes occurring only once every two years. Social capital is also medium as only up to 30% of people participate in community activities or get interested in participating in zone's decision-making process and share common interests. Community preparedness is characterised by limited preparedness of households regarding logistics, materials, and management, and people evacuating voluntarily during a disaster. However, there is very high support to provide shelters for others in case of a disaster and NGOS/ CBOs are available to provide support.

Economic

Less than 20% of the people live below the poverty, but most households depend on one income source and from incomes derived in the informal sector (up to 40%). Unemployment rates seem to be low (less than 6%), but affecting young people more than others (up to 12%). More than half of all women are employed in this zone. Most households (more than 80%) have television; however, few of them have furniture to secure key items during a disaster. There is some availability of credit facility to prevent from future disasters, but access is limited especially to low income groups. However, more than a third of all residential houses are insured. More than 3% of zone's annual budget is targeting DRM and there is availability of subsidies/incentives for residents to rebuild houses, receive alternative livelihood, and health in the aftermath of a disaster.

Institutional

Kilpauk's institutional resilience is close to average and mainly characterised by strong institutional collaboration, but lowered due to weakened knowledge dissemination and management. The zone's communities have limited availability of disaster awareness programmes and are not really satisfied with the existing provision. Additionally, disaster drills are organised less than once every two years. DRR and CCA are to some extent mainstreamed in the development plans; however, public participation is medium in the formulation of such plans.

Natural

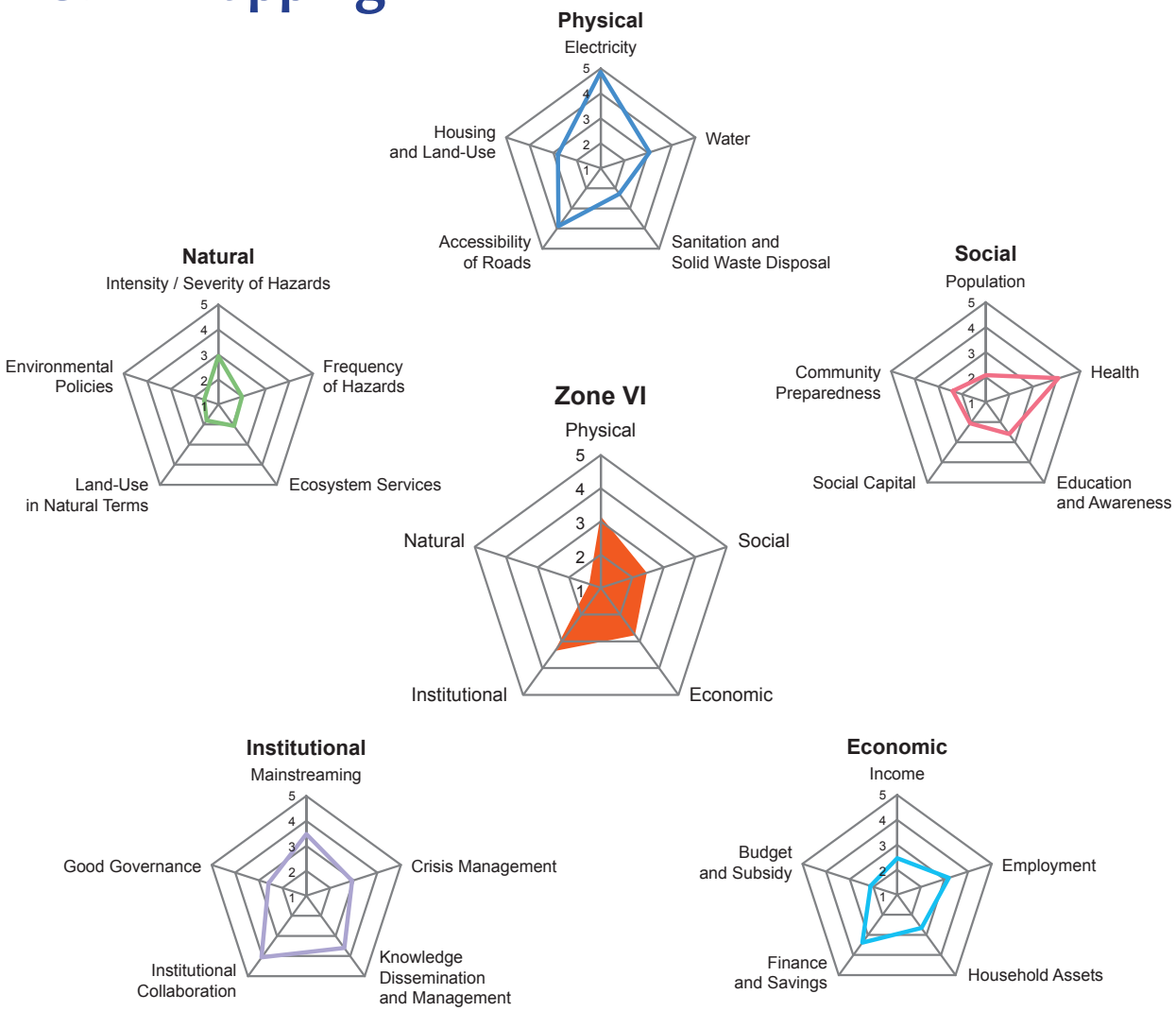
The natural resilience of Kilpauk is around average partly due to existing environmental policies which are implemented in development plans and provide an efficient waste management system (Reduce, Reuse, Recycle). Less than 25% of zone's area is prone to climate-related hazards few (less than 10%) of settlements are located on hazardous ground. The availability of green space is relatively high with up to 15% of the area. The quality of zone's ecosystem services is low in particular the level of biodiversity, soil, and water bodies.

ZONE VI :
ICE HOUSE

Ice House is located at the central-eastern part of Chennai and features among other attractions the Marina Beach which is one of the main tourist targets for visitors coming to this city. The area is densely populated with more than 33,000 people per sq/km in 2001, however, has a stable population over the last decades. The areas of Zone VI represent the older part of Chennai where also many governmental and institutional building are located (e.g. universities).

The overall resilience of Zone VI is lowest compared to all the ten zones of Chennai especially in dimensions, like natural, economic, and social. No dimension is close to average.

CDRI Mapping



Physical

Almost all (close to 100%) people have access to potable water which is available 3-5 hours every day. Most people have access to hygienic sanitation. Solid waste is mostly collected every day, but not treated before dumping or recycled. The zone's roads are mostly paved and remain accessible during normal flooding event in affected areas. However, less than 45% of all roads are equipped with a drainage system. Less than 10% of all buildings in the zone were constructed following building code. Up to 29% of all buildings are of non-permanent structure, but few people (less than 12.4%) live in proximity to polluted sites.

Social

High concentration of number of people living in this area (more than 33,000 per sq/km) characterise this zone; however, the population growth rate is close to 0% indicating that the capacity of additional people living in this area is limited. Health conditions are good as few people suffer from waterborne or vector-borne diseases (less than 11% per year) and people have access to primary health facilities before and during a disaster event. The literacy rate is very high and the knowledge of people about disasters is good although disaster awareness programmes were hardly ever held so far. Social capital is limited as few people participate in community activities (less than 20%) or in the zone's decision-making process, or try to deliver shared interests. Communities are not well prepared to disasters in terms of logistics, materials, and management; however, they evacuate voluntarily in case of a disaster and provide shelter for others if needed. Support of communities in relief works is also limited.

Economic

In this zone less than 11% of all people live below the poverty line. Most households depend on just one income source and up to 30% of all households depend from incomes derived in the informal sector. Furthermore, up to 40% of all households' income might be reduced due to a disaster. Unemployment rates are average (less than 18%) and less than 20% of children are engaged in working activities. Most households (more than 80%) have television and up to 40% have motorized-vehicles, reflecting well the available financial opportunities. There is availability and access for residents to credit facility to finance measures to face and prevent from potential future disasters. There is a good habit (up to 50% of all households) to save money among households and around one quarter of all residential houses is insured. However, there is less than 1% spent from the annual zone budget for DRM measures which is not yet sufficient. There is also no availability of incentives/subsidies for residents to rebuild houses and only limited availability for alternative livelihood after a disaster.

Institutional

Good governance has the lowest resilience out of the five institutional parameters because of limited (less than once every two years) availability of disaster drills for zone's communities and promptness of zone's authorities to disseminate emergency information. This zone is also likely to be challenged in case of a disaster as there is limited existence of an emergency team. Beside these major shortcomings, Ice House benefits from established collaborations with the Central Corporation and Ward officials, and to some extent also from NGOs/private organisations and neighbouring zones.

Natural

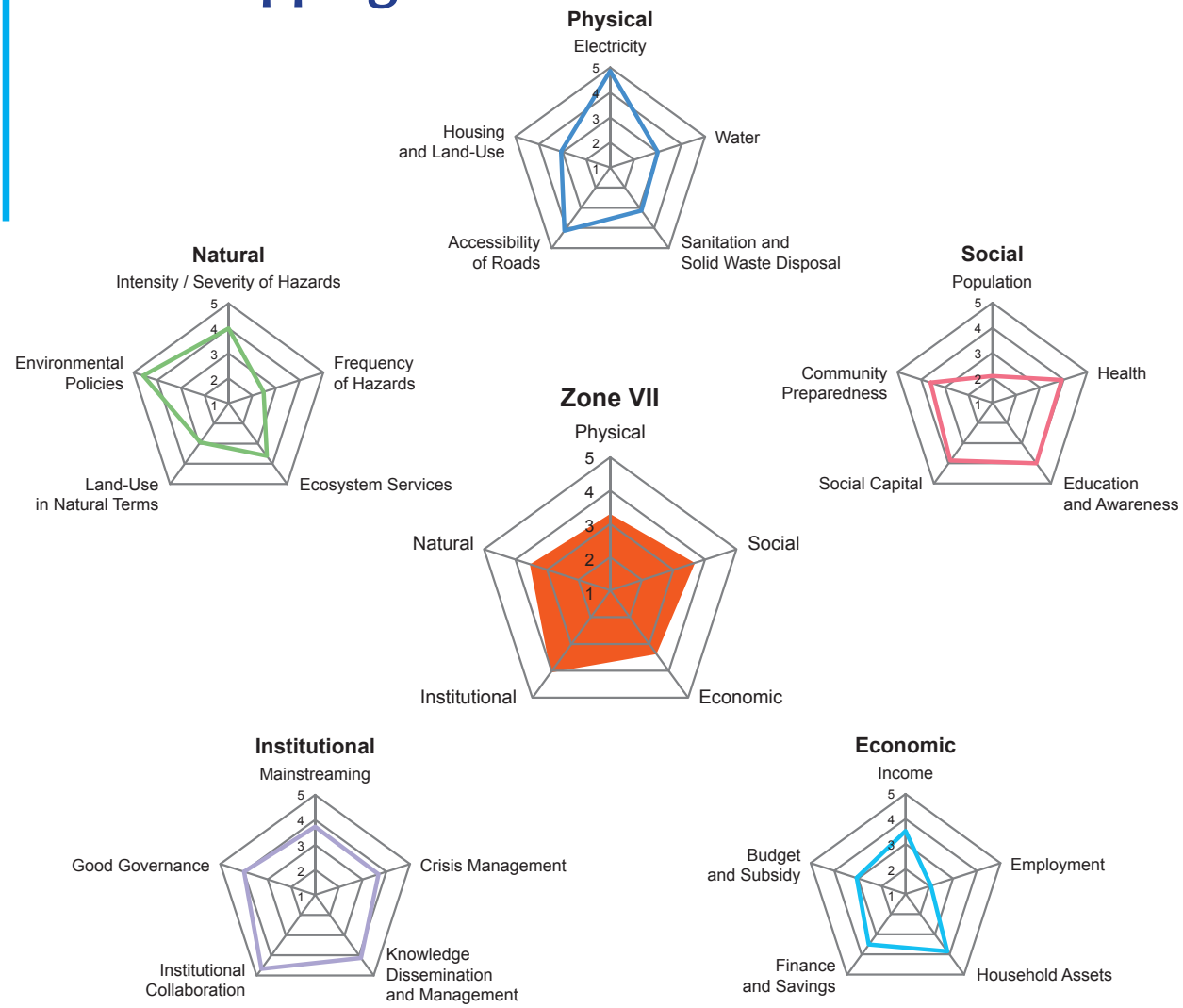
Ice House's natural resilience is below average due to rather low implementation of environmental policies in development activities or development plans; additionally, the loss of urban green space was considerable (more than 40% of zone's area) over the past decades resulting in less than 1% of the zone's area being covered by green space. Most parts (up to 75%) of the zone's area are vulnerable to climate-related hazards reflecting Ice House's coastal exposure. The quality of zone's ecosystem services is reduced; particularly vulnerable are the urban biodiversity, soils, and air.

ZONE VII : NUNGAMBAKKAM

Zone VII is located in the central part of Chennai and is largely a commercial area. One of the main transport corridor, Anna Salai, leads through this zone which is one of the older one's in Chennai. The population growth rates are much lower (around 0.5% p.a.) and the population density per sq/km is around average with around 26,000 people in 2001.

Nungambakkam's overall resilience is above average mainly due to high natural, institutional, and social scores. The economic resilience is around average, but the physical resilience is below.

CDRI Mapping



Physical

Most people have access to safe water which is provided between 3-5 hours every day. The CMWSSB is only capable to cover up to half of the demand. Less than 75% of all people have access to hygienic sanitation. Solid waste is mostly (up to 95%) collected but not treated before dumping and few (less than a quarter) solid waste is recycled. Most roads of the zone are paved and remain accessible during normal flooding in affected areas. Water logging may lead in some parts of the road network in the affected areas to interruption of maximum 4 hours in case of a heavy rainfall event. Less than 45% of all roads are equipped with roadside covered drain. Around 30% of all buildings are constructed following building code, but very few houses are of non-permanent structure. However, less than half of the houses are above normal /flood water logging.

Social

The zone's population density is rather high with more than 26,000 people living on average per sq/km, but current population growth rates are lower than at city level with only around 0.6 per year. Waterborne diseases affect less than 11% of people every year, but are likely to increase in case of a disaster like flooding event. Most people (up to 95%) have access to primary health facilities which are also expected to function fully during times of disaster. Awareness to disasters is good and probably supported by yearly recurring disaster awareness programmes led by the zone's authority and/ or high literacy rate. Social capital is rather high as people try to deliver shared interest and participate to some extent in the zone's decision-making process (workshops, etc.). However, less than 30% of the people are engaged in community activities. Community preparedness is quite high although households are not entirely provided with materials in case of a disaster and do not fully evacuate voluntarily in such an event. Nevertheless, support for others during a disaster and from other NGOs/CBOs is available.

Economic

This zone has higher income levels compared to other zones as few people live below the poverty line (less than 11%) and most households depend on two income sources. Nevertheless, up to 40% of all households depend on incomes derived from the informal sector and the same percentage is likely to experience reduced incomes in case of a disaster. Although, the income levels are comparatively high, unemployment rates are high with more than 24% of people without jobs. Reflecting the relatively high income levels, most households are having television and motorized-vehicles. There is limited availability of credit facility; however, there is good habit among households to save money for potential future disaster, and more than one third of all residential houses are under any sort of insurance scheme. There is still insufficient funding available for DRM measures as less than 1% of zone's annual budget is available for such measures. Nevertheless, there is availability of subsidies/incentives for residents to rebuild their houses, receive alternative livelihood, or health care after a disaster.

Institutional

The institutional resilience of Nungambakkam is above average mainly due to well established collaborations with different institutions (neighbouring zones, NGOs/private organisations, Central Corporation, and zone's wards). Similar than in other zones, disaster drills are organised less than once every two years for the public; however, disaster awareness programmes are held occasionally for communities. An emergency team exists and is efficient, but emergency workers are trained only once every two years. DRR and CCA are to a large extent incorporated into development plans. A disaster management plan (contingency plan) exists and is implemented.

Natural

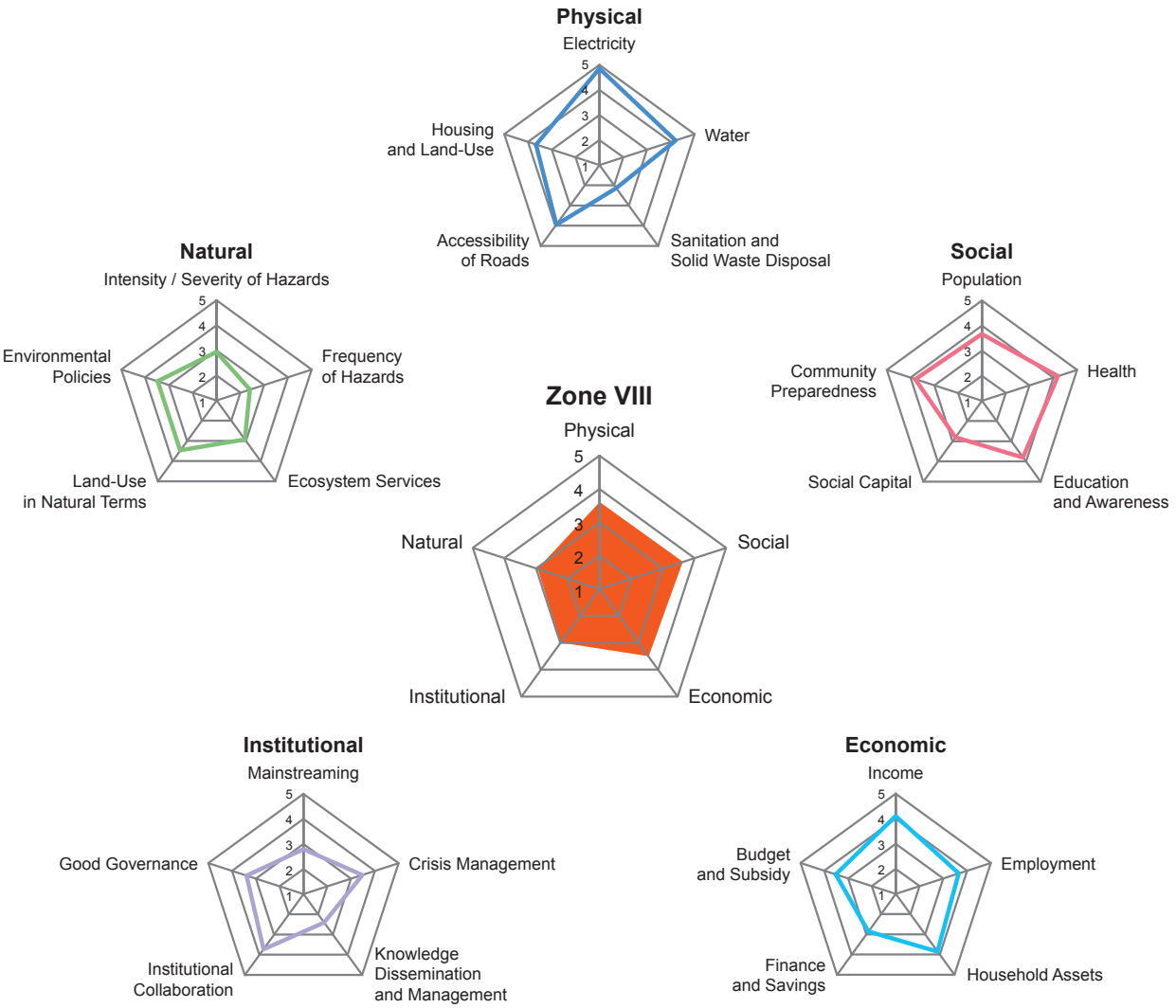
The natural resilience of Nungambakkam is highest within the ten zones of Chennai, probably due to its central location away from the coast and extreme low-lying areas in the northern and southern parts, but also along the urban fringes. Therefore, less than 25% of the area is vulnerable to climate-related hazards and few settlements (less than 10%) are located on hazardous ground. Environmental conservation policies are reflected in development activities as well as in development plans. Ecosystem services are of medium quality.

ZONE VIII : KODAMBAKKAM

Kodambakkam is located at the western part of Chennai and is one of the most densely populated areas (more than 35,000 people per sq/km) of this city. T Nagar is a key attraction in this zone for tourists due to its large market-style shopping streets and malls. The area lies at the urban fringe and is interconnected with neighbouring urban areas. Kodambakkam is attractive for commercial interests as around half of all employees come from outside the city, otherwise it also serves residential purposes.

The overall resilience of Zone VIII is slightly above average where only the institutional dimension is below it.

CDRI Mapping



Physical

Most people (up to 100%) have access to safe water which is available for 3-5 hours every day. Less than three quarters of the people have access to hygienic sanitation. Solid waste is collected (up to 80%), but not treated before dumping or recycled. Most roads of the zone are paved and remain accessible during normal flooding in affected areas, but around 30% of the roads in these areas are not accessible for up to 8 hours in case of a heavy rainfall event. More than 60% of all roads are equipped with roadside covered drain. More than half of all buildings were constructed following a building code and only less than 19% are of non-permanent structure. Similarly, around half of all buildings are above plinth level and few (12.4%) people live in proximity to polluted sites.

Social

Population density is highest in this zone with more than 35,000 people living on average per sq/km. This urbanisation trend is continuing as the population growth rate is still around 2.1% per year. However, not too many people live in slum areas (less than 12.4%). People suffering from waterborne or vector-borne diseases are few and the provision of primary health facilities before and during disaster times is given. Community's awareness to disasters is rather high and likely supported by yearly recurring disaster awareness programmes/drills. Access to internet is not yet available for all people. Social capital is shaped by people being interested in participating in zone's decision-making and willing to deliver shared interests, but so far less than 20% of them are engaged in community activities. Furthermore, different ethnic groups are not well interlinked. The zone's households are more or less prepared to disasters in terms of logistics, materials, and management. Support of people to others in case of disaster is high as well as the participation in relief works; moreover, NGOs/CBOs are available to provide additional support.

Economic

Income levels are rather high in this zone as few people live below the poverty line (less than 11%) and most households depend on more than one income source; additionally, less than 20% of all households depend on incomes from the informal sector. Unemployment rates are relatively low (less than 11%) compared to other zones but affecting young people more (up to 18%) than others. Interestingly, around half of the employees come from outside the city. As income levels are rather high, households are able to finance basic household assets such as television and motorized-vehicles. Credit facility is available to some extent to face and prevent from future disasters and more than one third of all residential houses are insured. There is availability of funding for DRM measures (up to 3%), but not yet sufficient.

Institutional

Kodambakkam has the lowest institutional resilience of all zones due to limited participation of communities in development plan preparation process, reduced awareness of communities to disasters because of a limited existence and capacity for proper disaster education in form of awareness programmes, and rare (less than once every two years) organisation of disaster drills. However, the crisis management framework is quite strong as sufficient evacuation centres (schools, community centres, etc.) exist, but also due to a rather efficient emergency team (leadership).

Natural

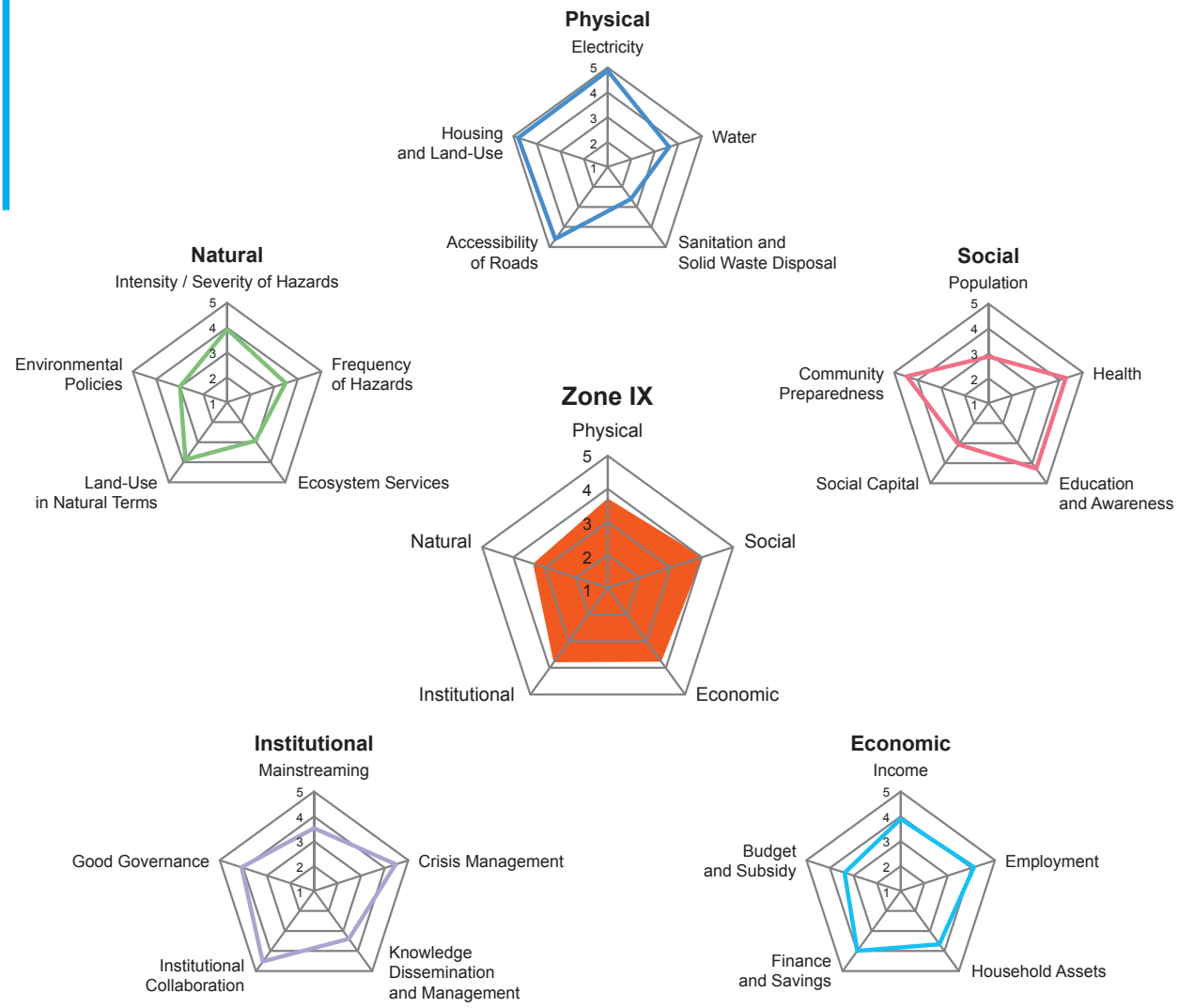
The natural resilience of this zone is above average mostly due to relatively large existence of green space (more than 15%) and few (less than 10%) settlements being located on hazardous ground; moreover, environmental conservation policies are reflected in development plans. However, improved implementation of such policies to reduce air pollution would be welcomed as well as better protection measures to secure the fragile ecosystem services.

ZONE IX : SAIDAPET

Saidapet is an emerging part of Chennai and located in the southern-western part of the city. It features the Adyar River which provides home for many slums alongside the riverbed. The area experiences rapid population growth with more than 2.6% per year because of its rising attractiveness due to emerging businesses and economic opportunities for people along the zone's fringe.

The overall resilience of Zone IX is clearly above average especially supported by high social resilience, but also all other dimensions are above average.

CDRI Mapping



Physical

Most people (up to 100%) have access to potable water which is available for 3-5 hours every day. Less than 75% of all people have access to hygienic sanitation. Although solid waste is mostly collected (up to 95%), less than a quarter of it is treated before dumping or recycled. Only up to 10% of waste is collected within 48 hours after a disaster. Most roads are paved and remain accessible during normal flooding in affected areas. Interruption of access to roads in case of a heavy rainfall event is less than 4 hours for less than 30% of all roads in affected areas. More than 60% of all roads are equipped with a drainage system. More than half of all buildings were constructed following building code and close to 100% are of non-permanent structure. Few people (less than a quarter) live in proximity to polluted sites.

Social

Although, the current population density is not yet very high, the current population growth rate per year is above city level with more than 2.6%. The demographic structure of this zone is medium as up to 39% of the people are either below 14 or above 64. Health conditions regarding waterborne and vector-borne diseases are unproblematic as also most people have access to primary health facilities before and during a disaster. The literacy rate is high and people are aware about the potential threat of disasters which is likely to be supported by yearly recurring disaster awareness programmes/drills and high functionality of schools after a disaster. Social capital is characterised by few people (less than 20%) engaged in community activities; however, there are opportunities for people to participate in zone's community activities. Although, not all households are fully prepared to disasters support is given during disasters from NGOs/CBOs, and people support each other in providing shelter or participating in relief work activities.

Economic

The income situation of this zone is reflected by most households depending on two income sources and few affected in terms of reduced incomes due to a disaster. Up to 30% of all people live below the poverty line. Unemployment rates are lower and affecting young people less (up to 12%) than others. A considerable proportion (up to 39%) of all labour comes from outside the city highlighting the zone's interconnectedness with neighbouring regions. As income levels are high, household have the opportunity to have television and other household assets; however, less than half of all households have furniture to secure key items (documents, money, etc) from potential disasters. Credit facility is available and accessible and households have good saving practice to face future disasters. However, less than 16% of all residential buildings are insured. Up to 2% of zones' annual budget is targeting DRM which is not yet sufficient. Subsidies/incentives for residents are available to rebuild houses, receive alternative livelihood, or health care in the aftermath of a disaster.

Institutional

The institutional resilience of Saidapet is above average due to a well established crisis management framework which has sufficient evacuation centres (schools, community centres, etc.) and an existing emergency team ready to lead a disaster. Similar than in other zones community awareness and the availability of disaster awareness programmes (disaster education) for communities is limited; however, disaster drills are at least organised once a year. Although this zone is heavily dependent on external support in case of a disaster well established collaborations with Central Corporation, and neighbouring zones exist. DRR and CCA are incorporated into development plans; additionally, a disaster management plan (contingency plan) is well implemented.

Natural

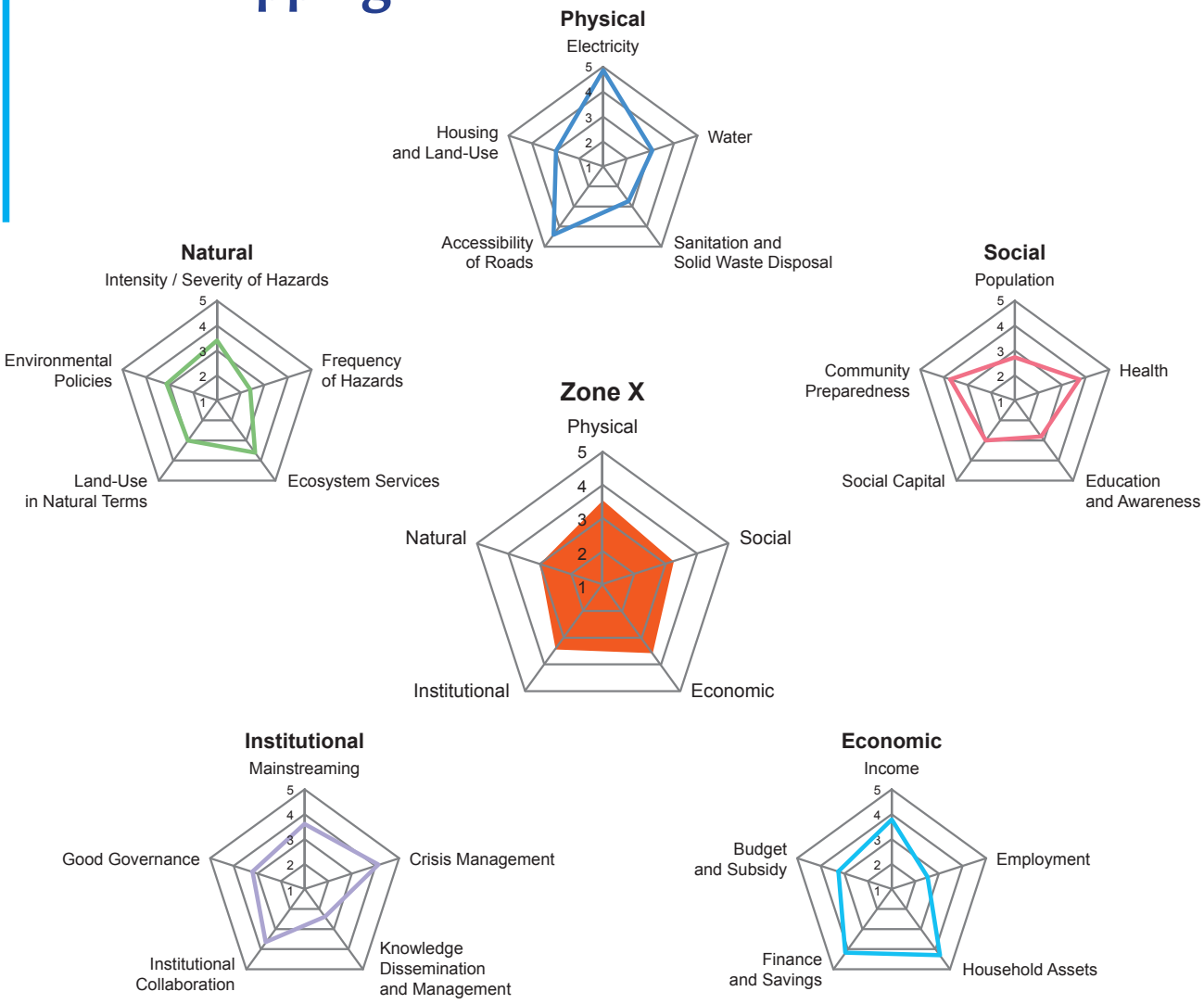
Saidapet's natural resilience is clearly above average mostly due to the circumstances that less than 25% of the zone's area is prone to climate-related hazards (including few settlements located on hazardous ground). Furthermore, hazard maps are recognised in development activities. However, better implementation of environmental policies would be beneficial for the zone's natural environment since ecosystem services are still in medium to good quality, but are very fragile to be impaired in the future.

ZONE X : MYLAPORE

Mylapore is located along the Bay of Bengal, but also forms part of the southern areas of Chennai. It has various types of residential areas ranging from low- to middle and upper-class. In the southern fringe of Zone X new businesses are emerging, like the Tidel Park or Ascendas IT Park in Taramani. However, it is also has prone to occasional flooding due to its low-lying character especially in the area around Velachery. The population in this zone rose a bit more than average (of the city) by 2.3 % per year during the period of 1971-2001; however, the population density is still low with around 20,000 per sq/km because new undeveloped areas are now being populated.

The overall resilience of Zone X is slightly above average. As natural and economic aspects perform above average, institutional resilience is below. The remaining dimensions are just above the average within the ten zones.

CDRI Mapping



Physical

Potable water is accessible for up to 95% of all people, but available only 3-5 hours every day. Less than 60% of the people have access to hygienic sanitation. Only up to 80% of all solid waste is collected and less than 25% is treated before dumping or recycled. Most roads of this zone are paved and remain accessible during normal flooding in affected areas. In case of a heavy rainfall event up to 30% of all roads in affected areas are interrupted for up to 4 hours. Around half of the roads have roadside covered drain. Regarding, buildings constructed following building code half of all buildings have done so; however, more than 30% are of non-permanent structure and less than 50% are above normal/flood water logging.

Social

This zone is experiencing urbanisation trends due to above average population growths (at least 2.2% per year) and a rather young demographic structure with up to 46% below 14 or above 64. Although, the number of people suffering from waterborne diseases is not very high (less than 11%) during disaster times this trend is likely to increase even if access to primary health facilities is provided for most people and these facilities function in times of disasters. The literacy rate of the zone is above Indian average, but communities are not sufficiently aware about the potential threat of disaster perhaps also due to the circumstances that so far no disaster awareness programmes/drill were organised by the zone authority. Access to internet is limited for many people. Social capital is rather high as many (more than 40%) people are engaged in community activities; however, there are limited opportunities for communities to participate in the zone's decision-making process, and different ethnic groups are not well interlinked with each other. Communities are prepared to disasters and evacuate voluntarily and support each other in case of such an event. There is also support from NGOs/CBOs after a disaster.

Economic

Income levels in this zone are high as less than 11% of people live below the poverty line and most households depend on more than one income source. However, many people are unemployed especially young people (more than 25%). Household assets like television or motorized-vehicle is available for most households. There is availability and accessibility to credit facility to face and prevent future disasters and up to 32% of all residential houses are insured. The amount of around 2% of the annual zone budget provided for DRM measures is welcomed but not yet fully sufficient. There are some subsidies/incentives available for residents to rebuild houses, receive alternative livelihood, or health care after a disaster.

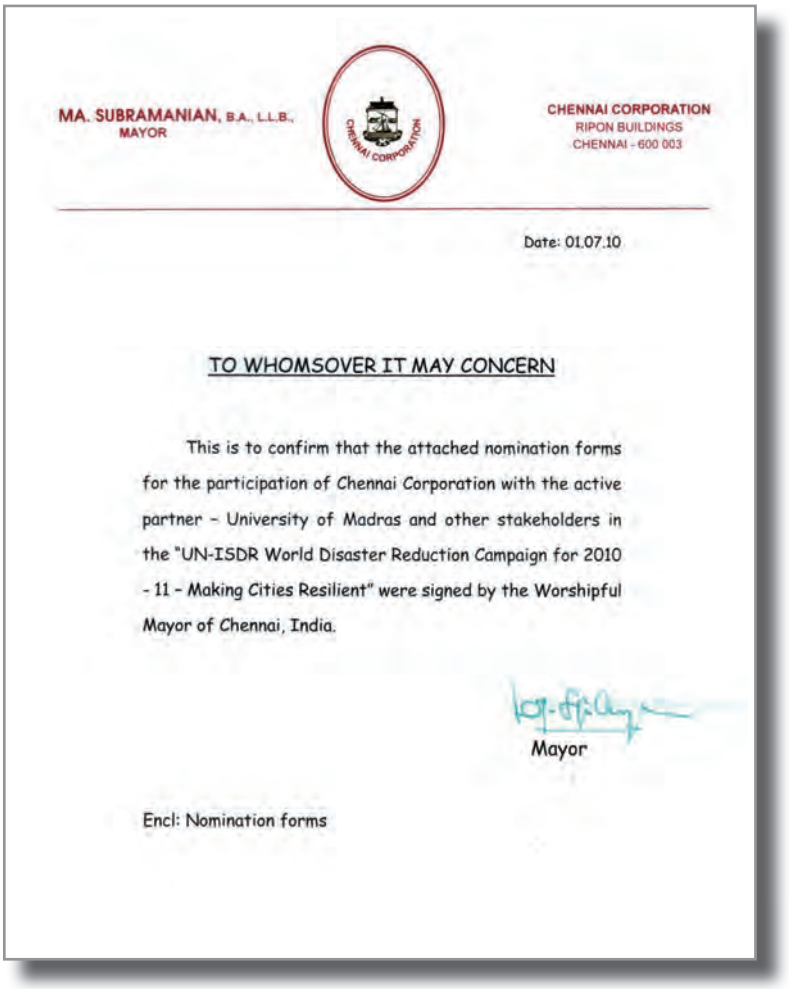
Institutional

Mylapore's institutional resilience is slightly below average mainly because of its not well informed people with regards to awareness about disasters. The reasons are lack of public awareness programmes and disaster education, and absence of disaster drills. On the other hand, the crisis management framework is strong due to sufficiently existing evacuation centres and availability of an emergency team; however, there is no availability of training for emergency workers leading to a more ad hoc disaster management team. DRR and CCA are to some extent incorporated into zone's development plans, and a disaster management is more or less implemented. Good governance is characterised by the existence of early warning system and a transparent and capable zone authority with regards to leading the recovery process in the aftermath of a disaster.

Natural

The natural resilience of Mylapore is above average due well functioning ecosystem services and no settlements located on hazardous ground. The loss of urban green space due to development activities is considerable (up to 40%) and less than 10% of zone's green space remains. Ecosystem services are fragile, but still in medium to good condition. Environmental policies are to some extent reflected in development plans, as well as hazard maps in development activities.

Chennai is committed to participate in this campaign to address urban disaster risks and take decisive action to reduce these risks and enhance the resilience of the city. This two-year campaign shall help the Corporation of Chennai to facilitate the implementation of the Hyogo Framework for Action 2005-2015 at local level by investing in DRR actions to make the city safer to natural hazards.



MA. SUBRAMANIAN, B.A., L.L.B.,
MAYOR

CHENNAI CORPORATION
RIPON BUILDINGS
CHENNAI - 600 003

Date: 01.07.10

TO WHOMSOVER IT MAY CONCERN

This is to confirm that the attached nomination forms for the participation of Chennai Corporation with the active partner – University of Madras and other stakeholders in the "UN-ISDR World Disaster Reduction Campaign for 2010 - 11 – Making Cities Resilient" were signed by the Worshipful Mayor of Chennai, India.

Mayor

Encl: Nomination forms

Next Steps

The outcome of this study shall help the Corporation of Chennai to address the sectors where improvement is needed most to plan for the future. The aim should be to enhance the resilience by targeting those sectors which are least resilient. As a result, the CDRI serves as a planning tool for the Corporation of Chennai and also for the Chennai Metropolitan Development Agency (CMDA) to take into account impacts from climate-related disasters on the city into planning and policy decision-making processes. A word level analysis is planned in near future.

Key References

Chennai Metropolitan Development Authority (CMDA) (2008) Second Master Plan For Chennai Metropolitan Area, 2026. CMDA, Chennai.
Intergovernmental Panel on Climate Change (IPCC) (2007) 'Summary for Policymakers' In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press. Cambridge.

About the Organization

The Corporation of Chennai

The Corporation of Chennai (previously Madras) is the Oldest Municipal Institution in India established on 29th September 1688. The Madras Municipal Corporation Act, 1919 provides the basic statutory authority for the administration now. Over time the city has been growing in size and population and of today the number of territorial Divisions has grown from 30 in 1919 to 155 and the population of the city has gone up to approximately 5 million, likewise the area has increased from 27.6 sq.miles in 1921 to 176 sq/km.

The Corporation of Chennai has been taking earnest efforts to solve the multi-faced problems which have accompanied the rapid growth and expansion of the city with the specific focus of basic civic amenities to every citizen.

University of Madras

The University of Madras was established in the year 1857, which is the mother of almost all the Old Universities of Southern India. The University has been accredited by National Assessment and Accreditation Council (NAAC) with the five star rating first and latter with an A rating. The University Grants Commission (UGC) has recognized the University as one of the centres for potential of excellence in the Country. The Department of Applied Geology was established in the University of Madras in 1952 and has been functioning since then in the Guindy Campus. During the last six decades, the Department has contributed considerably in teaching, research and capacity building in the applied aspects of geosciences including in the fields of tsunami modeling, coastal environmental studies, integrated coastal zone management and disaster management.

Kyoto University

IEDM Laboratory of Kyoto University Graduate School of Global Environmental Studies targets to reduce the gap between knowledge and practice through pro-active field level, community based project implementation in the field of environment and disaster risk management. Key research areas are: climate change adaptation, urban risk reduction, environment and disaster education.

GCOE program of Kyoto University targets education and research excellence on Human Security Engineering in Asian Megacities, with focus to city governance, infrastructure management, health risk management and disaster risk management.

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