RESILIENT CHENNAI STRATEGY

KALEIDOSCOPE

My city through my eyes

RESILIENT CHENNAI
PIONEERED BY THE ROCKEFELLER FOUNDATION

100 RESILIENT CITIES

CHENNAI CITY RESILIENCE STRATEGY 2019
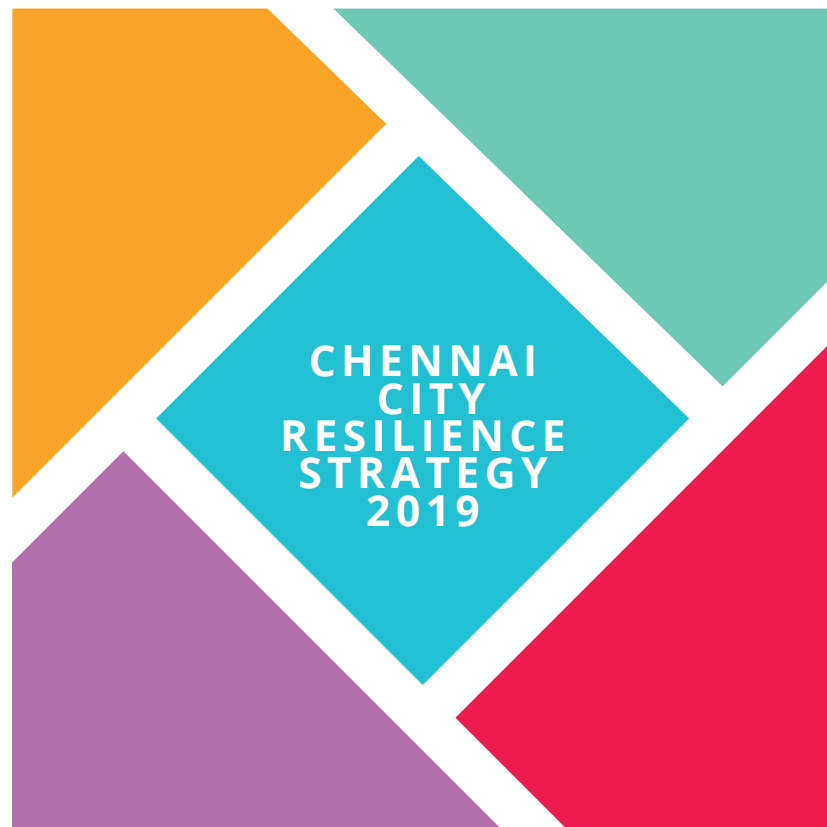
KALEIDOSCOPE

My city through my eyes

No single image or story captures the city of Chennai. Experiences overlap, refract and reflect to form an ever-changing collage of the city's struggles and triumphs.

Discover the city's many stories through the eyes of its people. Immigrants seeking work, students, industrialists, fisher folk, movie stars and scientists all living side by side. You will find today's Chennai is a kaleidoscope of traditional Madras and modern Chennai.

Classical and Contemporary, Rich and Poor, Acceptance and Aggression, Discipline and Disregard, Floods and Drought, Concrete and Greenery, all come together to give you a city with a history and a future.

This, then, is the path to building resilience in our city. When you plan for one, you plan for the other. When you make room for the river, you recharge ground water. When you resettle the poor, integrate them with the more affluent. When citizens talk of their rights, remind them of their responsibilities. Consolidate when you need to, decentralise where appropriate. Where there is blue, plan for green. Where there are silos, integrate.

As we move into the future, we need a city strategy that considers and respects these many truths, embracing diverse conditions and needs. A strategy that makes our city *enlightened, just, integrated.*

RESILIENT CHENNAI
PIONEERED BY THE ROCKEFELLER FOUNDATION

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100 RESILIENT CITIES

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PART A

PART B

Dear Reader,

I am pleased to present to you Chennai's Resilience Strategy on behalf of the city of Chennai. This comprehensive document is a result of a strong multi-stakeholder consultation process and has generated 86 actions and recommendations for us to collectively address as a society. We are sincerely grateful to all the citizens and experts from academia, the private sector, civil society and government, who have contributed to developing this robust resilience strategy. We have to now work towards the realization of this ambitious strategy.

We appreciate the Chief Resilience Officer Mr. Krishna Mohan Ramachandran and his team for strengthening the understanding of resilience throughout the city. The strategy process began with the Preliminary Resilience Assessment of the city, which my predecessor Dr. D. Karthikeyan, I.A.S. oversaw. He poignantly noted that,

> ❝ *The city of Chennai and the people of Chennai have shown remarkable resilience over the years. It is ingrained in the soul of our city.*"

Our people continue to remain some of the most resilient in the world as we collectively face the shocks and stresses posed by nature.

The resilience strategy identifies healthy and planned urbanization, and our water system, as two key priority areas and pillars. Some of our ongoing resilience building efforts such as water bodies restoration and decentralized composting units have been highlighted in this document, and I can assure you that we are making significant progress.

The Greater Chennai Corporation (GCC) has prioritized protecting and strengthening its green and blue assets to ensure that investing in resilience delivers for our future generations. GCC maintains 210 water bodies, and after the 2015 floods, we have taken up office and campus rainwater harvesting, restoration and rejuvenation of our traditional temple tanks, ponds and lakes, in order to recharge groundwater and accommodate flood water.

At present, the restoration work of around 52 water bodies has been taken up at a cost of Rs. 18.20 crores, and Villivakkam Tank (25 acres) is being restored for Rs. 16 crores utilizing funding from Chennai Smart City Ltd. We have signed MoUs with various NGOs and the private sector to restore 28 water bodies at a cost of Rs. 9.78 crores. The restoration and rejuvenation of 94 water bodies will be taken up in 2019-2020 at a cost of Rs. 60 crores. On completion of all the projects, around 1 TMC of water will be available to Chennai, and this will help increase the groundwater table in urban areas, and relieve water stagnation in various neighbourhoods.

In addition, the Honorable Late Chief Minister of Tamil Nadu, on the floor of the assembly during 2014, announced that the government would construct an Integrated Storm Water Drain network in extended areas of GCC under G.O. Ms. No. 1, MAWS dated 02.01.2015, at a cost of Rs. 4034 crores. We have nearly completed the Integrated Storm Water Drain network project covering a length of 405 km at a cost of Rs. 1261.70 crores funded by the World Bank in the Adyar and Coovum basins. GCC is currently raising funds for similar projects in Kosasthalaiyar and Kovalam basins. In addition, Rs. 500 crores have been spent to mitigate floods in the core Chennai city area since 2016. We are proactively taking steps to strengthen resilience in the city.

Related actions, some of which are outlined in the resilience strategy, can succeed if our citizens move from being observers to active citizenry. We are now witnessing a thriving civil society that is willing to partner with government to solve some of our society's greatest challenges such as solid waste management. After the 2015 floods, we have also observed a monumental increase in the number of volunteers who would like to help us with disaster relief efforts. Such partnerships and citizen efforts increase our confidence of a better future for all our citizens.

We recognize there are issues which require a deeper scientific understanding as highlighted in the strategy. For example, the strategy rightly highlights the need to be more sensitive towards climate change related risks as a threat to our city. To address this, we need to develop a better understanding of how global climate change may trigger sea level rise along our coast and how we may proactively minimize the negative implications of these processes to adapt to climate change. Therefore, to address such resilience challenges, I strongly believe there is tremendous potential for science and technology to inform our decision making.

Our goal is to make Chennai the most liveable city in the country and this resilience strategy will help us achieve that goal. We thank 100 Resilient Cities and the Rockefeller Foundation for supporting our city through this incredible journey, and most importantly, for building our understanding of resilience.

Sincerely,

Commissioner G. Prakash
Greater Chennai Corporation

On behalf of the entire 100 Resilient Cities (100RC) organization, I would like to extend my congratulations to the City of Chennai, Commissioner Mr. G. Prakash, Former Commissioner Dr. D. Karthikeyan and Chief Resilience Officer Mr. Krishna Mohan Ramachandran on the release of this great city's first ever Urban Resilience Strategy. This effort is the result of two years of tireless effort of leaders, stakeholders and community members across the city, but particular thanks are due to Deputy Commissioner (Works) Mr. M. Govinda Rao, Chief Engineer (Storm Water Drain, Special Projects and Bus Route Roads Departments) Mr. Nandakumar, and his team at the Control Room of Greater Chennai Corporation for their oversight of the strategy process and for contributing their expertise. At 100RC we always say building resilience requires a team effort and Chennai's CRO Krishna Mohan had a dedicated team working with him to lay the foundation for this progressive work so I would also like to extend my thanks not only to Krish, but his team as well. Thank you, Arjun Bhargava, Dr. Ashwin Mahalingam, Dr. Parama Roy, Akshaya Ayyangar, Tushar Thakkar, and Ashwin Chandrasekharan.

Working to build resilience in a city as complex and as dynamic as Chennai is a daunting challenge. Chennai is an historic city. It is a megacity in the most urbanized state in the world's most rapidly urbanizing country. Chennai is diverse, prone to flooding and droughts, has vast informal settlements and has outgrown much of its critical infrastructure. However, even in the face of these challenges, we have seen a commitment to resilience in Chennai that rivals any city in our network. This strategy is built on the foundation of a robust multi-stakeholder process that identified critical actions not only for government to take, but also for civil society and citizens to ensure that the whole city is working together to build a more resilient future. In Chennai's leadership we have also seen a strong desire to learn from peers and share knowledge around the world. So far, Chennai's resilience journey has included stops in New Delhi, Addis Ababa, New York and Singapore.

This strategy maps a path to healthy and planned urbanization, a water system that serves and protects the whole city, disaster readiness, and inclusion and equity for Chennai's most vulnerable communities. And while the strategy presents a holistic picture of what this great city can be, I would like to call out the work that Krish and his team have done in making sure this strategy reflects the needs of and gives a voice to Chennai's most vulnerable. This Resilience Strategy is world class and I am looking forward to seeing how it evolves in the years to come. This document, however, is just the start; the urgent and important task lies ahead in implementing these actions and I know that Chennai is committed to this change. I invite all of Chennai's citizens to continue to make your voices heard by working together to bring this work to life.

Sincerely,

Michael Berkowitz
President, 100 Resilient Cities

This is a defining moment in Chennai's 400-year-old history. We are the first among all of India's mega cities to have crafted a resilience strategy that puts forward a blue print to help our city adapt, change, nurture and grow, despite the stresses and shocks a thriving, rapidly urbanising city can encounter.

Our journey in Chennai began in 2014 and the process of building a Resilience Strategy gained traction in 2017. This involved deep engagement with over 3000 stakeholders via working group meetings, workshops, one-on-one interviews, online and offline surveys, and with students from 5 universities. Our Resilience Strategy consists of five pillars, 17 goals, and 86 distinct interventions. It is a high level and comprehensive document that addresses a range of resilience issues, with examples from the 100RC member cities and from within our own city that serve as inspiration to mitigate these challenges.

We have a vision of a city that revives our deep historical relationship with water and grows into its water basins and suburbs by protecting and preserving our water bodies as an integral and priceless part of our urban fabric. A city that embraces its vulnerable communities and treats them as key stakeholders in resilience building. A city whose leadership and governance have a 'big picture' view to make informed, coordinated, and more efficient decisions; where learnings are institutionalized and healthy engagement between and within stakeholder groups results in improved outcomes and greater impact. A cleaner, greener Chennai!

I would like to call out four projects that evolved from our strategy process which have the potential to transform our city. First, the Urban Horticulture project initiated with the University of British Columbia will now be scaled-up into a city-wide project and comes with a host of benefits for our city. Second, the Water as Leverage project, led by Mr. Henk Ovink, the Special Envoy for International Water Affairs from the Kingdom of Netherlands, has the potential to reshape our city's ability to absorb, store and manage our water. Third, an initiative to create an in-situ upgradation model for informal settlements close to a waterway in Chitra Nagar will make us a more inclusive city. Finally, the Data Observatory will help our leadership make better informed decisions.

While these and other projects in this Resilient Chennai Strategy have the potential to bring about transformative change in our city, I must end with a message that I have come to believe in more strongly than ever: that in order to bring about positive change and build a more resilient Chennai, we, as a people, must become more resilient ourselves; we need to meaningfully engage with civic issues, to believe that our voices do matter, to have a sense of ownership and responsibility towards our city. We must keep cynicism at bay and take small steps or make giant leaps towards a more resilient future.

Inclusive, environmentally sustainable, economically viable, and culturally vibrant. This is OUR Chennai. **Enlightened. Just. Integrated.**

Sincerely,

Krishna Mohan
Chief Resilience Officer (CRO), Chennai

From a cluster of fishing villages in the 16th Century to the fourth largest metropolitan area in India today, Chennai has come a long way. The city's economy boasts a GDP of $58 billion and a growth rate of 6%. Chennai's economy has diversified substantially over the past two decades. It now includes the automobile and Information Technology industries, the healthcare industry, financial services, post-secondary educational institutions and a manufacturing sector producing various types of hardware. The city is a key player in the state and national economies: it contributes 60% to Tamil Nadu's manufacturing sector and produces 60% of India's automotive exports. Furthermore, as India's 'software as a service' capital and the most preferred destination for medical tourists from within India and abroad, Chennai has achieved important global status.

This trajectory of development and diversification has made the city vibrant and cosmopolitan. However, it has also invited a range of challenges, including uneven development, which has aggravated risks faced by vulnerable communities, rapid and unplanned growth, which has resulted in water body encroachment, waste mismanagement and an increased impact of natural disasters. Compounding all of this is the nature of Chennai's governance system; the system tasked with addressing these myriad and interconnected challenges is characterized by multiple actors with overlapping and sometimes unclear mandates and jurisdictions.

executive summary

Chennai was selected in 2014 as one of the second cohort of cities for the 100 Resilient Cities (100RC) programme. Pioneered by The Rockefeller Foundation, the 100RC programme

> ❝ ...help(s) cities around the world become more resilient to the physical, social and economic challenges that are a growing part of the 21st century."

Chennai's partnership with 100RC has provided the opportunity to start addressing challenges in a holistic manner and incorporating resilience thinking[i] into the city's future development path.

A major flooding event in Chennai in 2015 added momentum to this development. It led to a new recognition among government, civil society and academia about the critical nature and extent of interconnectedness of the city's challenges. There was also a new awareness that crises like floods and droughts were becoming increasingly frequent. Thus, post 2015, Chennai began to actively address

i Resilience thinking in policy and projects help build "the capacity of individuals, communities, institutions, businesses and systems within a city to survive, adapt and grow, no matter what kinds of chronic stresses and acute shocks they experience."

Resilient Chennai Vision
Enlightened. Just. Integrated.

Our city leaders and citizens will think holistically, ecologically and with foresight, as well as act proactively and smartly to manage and respond to risks and vulnerabilities. We will leverage the linkages between urban, socio-cultural, economic and environmental development. We will be sensitive to the needs of those who are disadvantaged and will think and plan ahead of time to build a cleaner, greener, more liveable and inclusive city.

Enlightened: A city that revives our deep historical relationship with water and expands into our water basins and peri-urban areas by protecting and preserving our water bodies as an integral and priceless part of our urban fabric; where citizens take ownership and engage with civic issues to create public spaces that bring joy and pride, strengthening the city's vibrant cultural identity; a city that cultivates champions of change in schools and colleges by teaching our youth to respect the natural world, embrace diversity, live sustainably and believe that their voices can be heard and do matter.

Just: A city that embraces its vulnerable peoples and treats them as key stakeholders in resilience building, who contribute and benefit from resilience strategies; where participatory planning protects multiple interests and visions; a city designed to be equitable and inclusive, ensuring that the needs of all sections of society are met.

Integrated: A city whose leadership and governance have a 'big picture' view to make better informed, more efficient decisions; where learnings are institutionalized and healthy engagement between and within stakeholder groups results in streamlined, integrated systems leading to improved outcomes with greater impact.

Inclusive, environmentally sustainable, economically viable, and culturally vibrant. This is OUR Chennai...

Enlightened. Just. Integrated.

common city shocks and stresses with concerted and holistic efforts. For example, while the Sustainable Water Security Mission was launched in September 2015, it gained momentum only after the December 2015 floods. The mission aims at leveraging public, private, and civic resources to restore water bodies and meet the city's water demand by prioritizing activities such as recycling and rain water harvesting.

Chennai selected its Chief Resilience Officer, Mr. Krishna Mohan Ramachandran, in 2017, through a Memorandum of Understanding signed between the Greater Chennai Corporation and 100 Resilient Cities in 2017. His team leveraged this rising awareness and interest among city stakeholders to work with over 3,300 Chennai residents, experts, activists and government officials to develop this document, the Resilient Chennai Strategy.

This document offers a pathway for city leaders from government, civic and industrial sectors to collaborate and guide their organizations to ensure the future resilience of Chennai citizens and infrastructure, both natural and man-made, to respond to key shocks and stresses in the city.

The Resilient Strategy is driven by a collectively-defined vision to make Chennai *enlightened, just and integrated* through five missions that address the key challenge areas identified by stakeholders.

Each mission's goals will be achieved through a range of actions and recommendations, some of which are already under way, while some are being planned and others are still ideas inspired by 100RC network cities. With over 80 such interventions across five key thematic areas, the Resilient Chennai Strategy is an ambitious document that presents actionable, tangible and feasible initiatives, along with some relatively challenging, longer-term, transformative efforts to build Chennai's resilience.

With faith in Johann Wolfgang von Goethe's saying,

> " *What is not started today is never finished tomorrow,"*

the city of Chennai is ready to take the leap towards a resilient future.

HEALTHY & PLANNED URBANISATION

MISSION 1
Urbanising responsibly

GOAL 1.1 FOSTER RESILIENCE THINKING WITHIN THE URBAN PLANNING PARADIGM SO THAT AN INTEGRATED APPROACH IS USED TO ADDRESS ENVIRONMENTAL CONCERNS THROUGH POLICY AND DESIGN.

GOAL 1.2 ADDRESS SOLID WASTE RELATED CHALLENGES MORE EFFECTIVELY.

GOAL 1.3 ENCOURAGE A MORE MULTI-STAKEHOLDER DRIVEN URBAN PLANNING PROCESS.

GOAL 1.4 PROMOTE TRANSIT-ORIENTED DEVELOPMENT TO MAKE CHENNAI A WELL-CONNECTED, PEOPLE AND ENVIRONMENT-FRIENDLY CITY.

WATER SYSTEMS

MISSION 2
Carving a resilient future around our water resources

GOAL 2.1 FOSTER RESPONSIBLE WATER USAGE.

GOAL 2.2 GIVE PRIMACY TO WATER RELATED CHALLENGES IN URBAN DESIGN EFFORTS.

GOAL 2.3 ENSURE BETTER COORDINATED EFFORTS BETWEEN PUBLIC, PRIVATE AND CIVIC AGENCIES TO RESTORE AND PROTECT WATER BODIES (INCLUDING THE SURVIVING ERYS).

DISASTER PREPAREDNESS

MISSION 3
Making Chennai a prepared city

GOAL 3.1 LEVERAGE DATA AND TECHNOLOGY TO COPE WITH DISASTERS MORE EFFICIENTLY.

GOAL 3.2 SPECIFICALLY ADDRESS CHALLENGES FACED BY VULNERABLE GROUPS LIVING IN DISASTER PRONE AREAS.

GOAL 3.3 SUPPORT SMALL AND MEDIUM SCALE BUSINESSES THROUGH A COMBINATION OF ECONOMIC AND NON-ECONOMIC MEASURES TO HELP THEM COPE BETTER WITH DISASTERS.

GOAL 3.4 BUILD CAPACITY ACROSS GOVERNMENT & COMMUNITY TO BE BETTER PREPARED IN THE EVENT OF DISASTERS.

GOVERNANCE ECOSYSTEM

MISSION 4
Together, we lift Chennai

GOAL 4.1 IMPROVE EFFICIENCY TO HANDLE RESILIENCE CHALLENGES BY ENABLING KNOWLEDGE TRANSFER ACROSS GOVERNMENT AGENCIES.

GOAL 4.2 STRENGTHEN CURRENT PRACTICES OF ENFORCEMENT AND MONITORING.

GOAL 4.3 FOSTER AN ENVIRONMENT WHERE GOVERNMENT, CITIZENS AND MARKET INTERESTS CO-BUILD THE CITY'S RESILIENCE.

VULNERABLE COMMUNITIES

MISSION 5
Valuing the city's vulnerable

GOAL 5.1 BRING DIVERSE VULNERABLE COMMUNITIES INTO MAINSTREAM POLICY MAKING BY IDENTIFYING THE DIFFERENT GROUPS AND THEIR NEEDS.

GOAL 5.2 ENSURE THE INTEGRATION OF VULNERABLE GROUPS INTO THE URBAN FABRIC, WHILE MEETING BASIC NEEDS FOR ADEQUATE HOUSING.

GOAL 5.3 ENSURE A MORE HUMANE PROCESS OF PROXIMATE RESETTLEMENT OF INFORMAL SETTLERS WHEN NO OTHER OPTION EXISTS.

strategy structure

The strategy is divided into two parts:

© Adithya Anand - 'All aboard', Egmore Train Station

PART A

CHAPTER 01
**strategy
in a page**

overleaf ➤

HEALTHY & PLANNED URBANIZATION: URBANISING RESPONSIBLY

GOAL 1.1 FOSTER RESILIENCE THINKING WITHIN THE URBAN PLANNING PARADIGM SO THAT AN INTEGRATED APPROACH IS USED TO ADDRESS ENVIRONMENTAL CONCERNS THROUGH POLICY AND DESIGN. — **9 ACTIONS**

1. Climate Change Adaptation strategy
2. A strategy to protect green and blue assets in the Chennai Metropolitan Area
3. Special measures to protect Ennore Creek
4. Implementing a plantation strategy
5. Chennai Urban Horticulture programme
6. Hydrological mapping to support urban planning
7. Capacity building for planners and real estate developers to incorporate environment-friendly solutions into urban planning
8. Promote environmentally sustainable and disaster resilient building materials in real estate development projects
9. Common database for underground infrastructure

GOAL 1.2 ADDRESS SOLID WASTE RELATED CHALLENGES MORE EFFECTIVELY. — **6 ACTIONS**

10. Redesigning solid waste management (SWM) contracts
11. Extended Producer Responsibility (EPR) in Solid Waste Management (SWM)
12. Decentralised compost units
13. Targeted and sustained awareness programmes on waste management
14. Children as change agents
15. Economic measures for people to comply with source segregation

GOAL 1.3 ENCOURAGE A MORE MULTI-STAKEHOLDER DRIVEN URBAN PLANNING PROCESS. — **4 ACTIONS**

16. Strengthening public consultation process
17. Strengthening citizen representation in 'Ward Committees'
18. Participatory planning for the Chennai Metropolitan Area (CMA)
19. Participatory budgeting for part of Greater Chennai Corporation's (GCC) budget

GOAL 1.4 PROMOTE TRANSIT-ORIENTED DEVELOPMENT TO MAKE CHENNAI A WELL-CONNECTED, PEOPLE AND ENVIRONMENT-FRIENDLY CITY. — **5 ACTIONS**

20. Develop a comprehensive sustainable urban mobility plan
21. Scale up existing efforts to redesign roads to improve mobility for all
22. Promote use of public transportation through feeder services
23. Incentivise "clean" transport
24. Embedding green infrastructure in road networks

WATER SYSTEMS: CARVING A RESILIENT FUTURE AROUND OUR WATER RESOURCES

GOAL 2.1 FOSTER RESPONSIBLE WATER USAGE. — **6 ACTIONS**

25. Rise to recycle water—creating awareness around water recycling
26. Water recycling directive for domestic and industrial use
27. Decentralised water treatment systems (DEWATS)
28. Install water meters to monitor water consumption
29. Monitor water flow and leakage through electromagnetic flow meters
30. Strengthen and monitor rainwater harvesting systems

GOAL 2.2 GIVE PRIMACY TO WATER RELATED CHALLENGES IN URBAN DESIGN EFFORTS. — **5 ACTIONS**

31. Capacity building on water-centric design
32. Pilot project showcasing water-sensitive design
33. Web-based platform on water-centric urban design
34. Buffering the Chennai coast by using natural infrastructure
35. Green storm water drains

GOAL 2.3 ENSURE BETTER COORDINATED EFFORTS BETWEEN PUBLIC, PRIVATE AND CIVIC AGENCIES TO RESTORE AND PROTECT WATER BODIES (INCLUDING THE SURVIVING ERYS). — **3 ACTIONS**

36. Water restoration dashboard
37. A consortium for integrated restoration and protection of water bodies and water ways.
38. Lake restoration—A guide book

DISASTER PREPAREDNESS: MAKING CHENNAI A PREPARED CITY

GOAL 3.1 LEVERAGE DATA AND TECHNOLOGY TO COPE WITH DISASTERS MORE EFFICIENTLY. — **3 ACTIONS**

39. Multi-hazard data collection and mapping
40. Detailed flood monitoring and forecasting
41. Early warning systems for forecasting extreme events

GOAL 3.2 SPECIFICALLY ADDRESS CHALLENGES FACED BY VULNERABLE GROUPS LIVING IN DISASTER PRONE AREAS. — **3 ACTIONS**

42. Disaster response plan for vulnerable communities
43. Strengthening capacity of vulnerable communities to cope with disasters
44. Emergency supply of food and drinking water

GOAL 3.3 SUPPORT SMALL AND MEDIUM SCALE BUSINESSES THROUGH A COMBINATION OF ECONOMIC AND NON-ECONOMIC MEASURES TO HELP THEM COPE BETTER WITH DISASTERS. — **4 ACTIONS**

45. Single window system for Micro, Small and Medium Enterprise (MSME) relief
46. Strengthening insurance support by offering specific disaster insurance
47. Assistance from banks
48. Collective aid for MSMEs by MSMEs

GOAL 3.4 BUILD CAPACITY ACROSS GOVERNMENT & COMMUNITY TO BE BETTER PREPARED IN THE EVENT OF DISASTERS. — **5 ACTIONS**

49. Engage with community-led organisations to act as first responders
50. Disaster warning announcement system
51. Prepare Chennai—a campaign for awareness on disaster preparedness
52. Capacity building and equipping disaster response force
53. Mapping existing community infrastructure and creating new investments where needed

GOVERNANCE ECOSYSTEM: TOGETHER, WE LIFT CHENNAI

GOAL 4.1 IMPROVE EFFICIENCY TO HANDLE RESILIENCE CHALLENGES BY ENABLING KNOWLEDGE TRANSFER ACROSS GOVERNMENT AGENCIES. — **4 ACTIONS**

54. Create an urban data observatory for better governance
55. Strengthen the role of Chennai Metropolitan Development Authority (CMDA) as a facilitator of government coordination
56. Set up digital display boards for better communication
57. Scorecards for evaluation

GOAL 4.2 STRENGTHEN CURRENT PRACTICES OF ENFORCEMENT AND MONITORING. — **5 ACTIONS**

58. Dedicated fund for SWM monitoring, Operation & Maintenance (O&M)
59. Decentralised enforcement cell for SWM and RWH
60. Economic measures for citizen compliance
61. Invest in technology and data for monitoring water management laws
62. Link project funding to impact assessments

GOAL 4.3 FOSTER AN ENVIRONMENT WHERE GOVERNMENT, CITIZENS AND MARKET INTERESTS CO-BUILD THE CITY'S RESILIENCE. — **11 ACTIONS**

63. Strengthen the "Namma Chennai" app
64. Strengthen "open governance" data portal
65. Better communication between government, corporate actors and citizens to tap Corporate Social Responsibility (CSR) funding
66. Student stewardship programme
67. Civic leadership programme
68. Incentives and competitions to induce citizen responsibility
69. Adoption programme
70. Creating awareness around civic issues
71. Introducing community service in school curricula
72. Platform for collective-action best practices
73. Expand reach of Joint Secretary Programme to build government capacity

VULNERABLE COMMUNITIES: VALUING THE CITY'S VULNERABLE

GOAL 5.1 BRING DIVERSE VULNERABLE COMMUNITIES INTO MAINSTREAM POLICY MAKING BY IDENTIFYING THE DIFFERENT GROUPS AND THEIR NEEDS. — **3 ACTIONS**

74. Resource centre on the invisible to inform policy
75. Awareness drive on programmes for the vulnerable
76. Strengthen the Urban Homeless programme

GOAL 5.2 ENSURE THE INTEGRATION OF VULNERABLE GROUPS INTO THE URBAN FABRIC, WHILE MEETING BASIC NEEDS FOR ADEQUATE HOUSING. — **6 ACTIONS**

77. Regularisation and in-situ upgradation of informally-built housing stock wherever possible
78. Augmenting land availability for affordable housing in the city
79. Flexible tenure security arrangements
80. Community-led planning for informal settlements
81. A city-wide, slum-free Chennai action plan
82. Flexible affordable housing policy

GOAL 5.3 ENSURE A MORE HUMANE PROCESS OF PROXIMATE RESETTLEMENT OF INFORMAL SETTLERS WHEN NO OTHER OPTION EXISTS. — **4 ACTIONS**

83. Resettlement and rehabilitation policy
84. Reviving the Sites and Services model
85. Case-based resettlement action plan
86. Case-specific resettlement advisory body for monitoring resettlement efforts

Top: © Adithya Anand – Barbershop, Parry's Corner; Bottom: © Kals Pics – "Laughter", Royapuram;

Top: © Aravindan Ganesan – Handloom weaving house, Thirumazhisai; Bottom: © Kals Pics – Eid-ul-fitr, Khana Bagh, Triplicane;

Top: © Joe Ravi/Wiki - Santhome Basilica interior; Bottom: © Adithya Anand – "Who's going to feed me now?";

© Aravindan Ganesan - "Playtime", Elliot's Beach

CHAPTER 02
unpacking resilience

Originally a topic of academic research in the 1970s, the concept of resilience has since taken hold in policy and popular discourse, particularly since the beginning of the millennium. Resilience is largely applied to the context of environmental disruptions as a way of thinking about how system equilibrium can be maintained in the face of ecological disasters—or, as Wagner and Breil (2013) suggest, how communities

> 66 *... withstand stress, survive, adapt, and bounce back from a crisis or disaster and rapidly move on[1]".*

In fact, the term resilience originates from the Latin word *resilio,* which means "to bounce back"[2]. A review of the concept of urban resilience by Meerow *et al.* (2016) highlights this predominant (and arguably narrow) understanding of resilience as a city's or community's ability to cope with major shocks and recover quickly, with all its social, economic, and political systems returning to their usual functioning[3]. Increasingly, however, scientists also recognize the need to think of resilience in terms of the transformative capacity of people/communities

to bring about change for the better—rather than just reproducing a status quo. Resilience here need not imply a response to disasters or disturbances, but rather a continual effort towards change for the better (see *Table 1* for a range of definitions of resilience).

TABLE 1: DEFINITIONS OF RESILIENCE *(Meerow et al, 2016)[4]*

Authors	Definitions
Pickett, et al. (2004)[5]	". . . the ability of a system to adjust in the face of changing conditions."
Campanella (2006)[6]	". . . the capacity of a city to rebound from destruction."
Ahern (2011)[7]	". . . the capacity of systems to reorganize and recover from change and disturbance without changing to other states . . . systems that are "safe to fail"."
Lamond and Proverbs (2009)[8]	". . . encompasses the idea that towns and cities should be able to recover quickly from major and minor disasters."
Coaffee (2013)[9]	". . . the capacity to withstand and rebound from disruptive challenges . . ."
Chelleri (2012)[10]	". . . should be framed within the resilience (system persistence), transition (system incremental change) and transformation (system reconfiguration) views."

RESILIENCE FOR 100 RESILIENT CITIES (100RC)

The 100 Resilient Cities (100RC) program conceptualizes resilience using a broader (going beyond environmental risks), deeper (being inclusive), and longer term (focusing equally on immediate and future concerns) lens. By saying that *"(w)e help cities around the world become more resilient to the physical, social, and economic challenges that are a growing part of the 21st century,"* 100RC acknowledges that building resilience should not be limited to addressing environmental shocks and stresses.

Consequently, 100RC defines resilience as *"the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow, no matter what kinds of chronic stresses and acute shocks they experience."* By explicitly accommodating chronic stresses and shocks within the scope of resilience, 100RC highlights the need to think about all the possible challenges cities face, both in the short and the long term, whether they be one-time events (such as floods,

earthquakes, or terror attacks) or ongoing stresses (such as water shortage, climate change, encroachment, or racial inequity). For 100RC,

> 66 *(C)ity resilience is about making a city better, in both good times and bad, for the benefit of all its citizens, particularly the poor and vulnerable."*

This highlights resilience as not just a response to major shocks or negative events or as limited to bouncing back to the status quo. Rather, it is about growing, transforming, and improving, for the benefit of all. Building the resilience capacity of weaker and disadvantaged sections of the citizenry is specifically highlighted and runs through most 100RC city strategies.
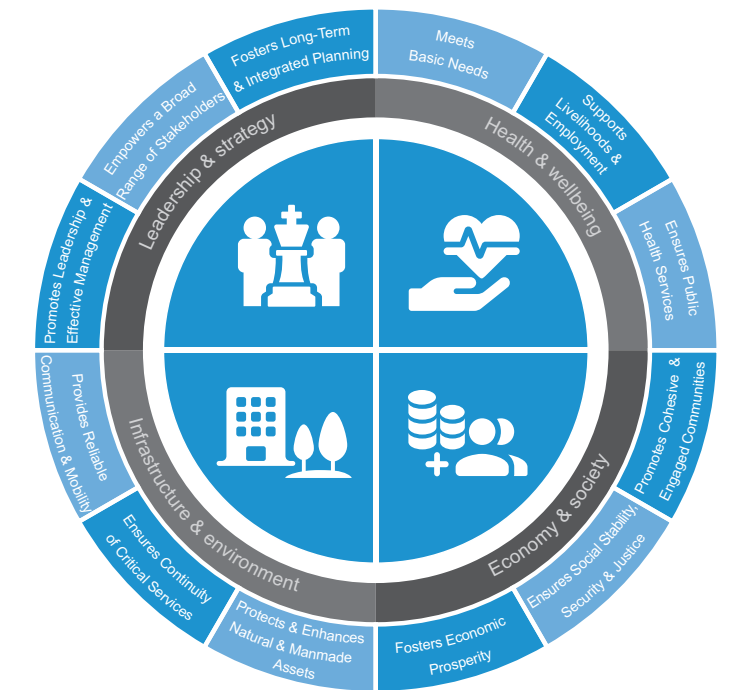
Figure 1: 100RC's City Resilience Framework

Chennai's resilience strategy is inspired by this deeper, broader, and longer-term conceptualization of resilience. The City Resilience Framework (CRF), developed by Arup[ii] and the Rockefeller Foundation,

ii Arup is an independent firm headquartered in London which provides engineering, design, planning, project management and consulting services for all aspects of the built environment. The firm is also a strategy partner for 100 Resilient Cities.

also guides the Chennai resilience strategy to operationalize a broader resilience thinking that goes beyond disaster preparedness and recovery and includes health and wellbeing, economy and society, infrastructure and environment, and leadership and strategy as key dimensions of resilience (see *Figure 1*).

These dimensions are further divided into 12 drivers (for e.g. meeting basic needs, fostering economic prosperity, and empowering a broad range of stakeholders) to help the city assess the implications of shocks and stresses. The CRF also provides a framework to assess how specific resilience-building actions may strengthen the four areas of focus and the 12 city resilience drivers. Therefore, the Resilient Chennai Strategy assesses the resilience value of each strategy action using the CRF.

WHAT DOES RESILIENCE MEAN TO CHENNAI CITIZENS?

When Chennai citizens, government officials, and representatives of the private, academic and non-profit sectors were asked to describe Chennai as a resilient city, responses were varied. Overall, however, they echoed a sentiment of accommodating the broader, deeper, and long-term lens of resilience. Based on a common understanding of the socio-political and ecological concerns of the city, these responses also offered some additional insight into what resilience building should mean specifically in the context of Chennai. For instance, one running thematic emphasis was on the **need to be proactive and have foresight, both in terms of thinking and action**, including around urban planning, water systems management, and in terms of dealing with vulnerable communities. Another key theme that cut across stakeholders' characterization of resilience-building in the context of Chennai was the **need for greater coordination and collaboration within government and across government and non-government partners.**

Stakeholder responses were coded to reflect broader thematic goals and represented in the form of a word cloud (see *Figure 3*).

< Figure 2: Index Cards from working group workshop

Figure 3: Word cloud illustrating stakeholder vision for resilient Chennai

RESILIENT CHENNAI VISION

The Resilient Chennai Vision is thus a reflection of 100RC's deeper, broader, and longer-term lens and Chennai residents' call for a proactive, long-sighted, inclusive, and well-coordinated approach to dealing with city shocks, and, more importantly, the many stresses that aggravate the scale and impact of such shocks (e.g.: the scale of floods aggravated by challenges around rampant urbanization, encroachment, and solid waste management).

The vision for Chennai in the new future is *'Enlightened. Just. Integrated.'* This means city leaders and citizens think holistically, ecologically, and with foresight, as well as act proactively and smartly to manage and respond to risks and vulnerabilities. They recognize linkages between urban, socio-cultural, economic, and environmental development, are sensitive to the needs of those who are disadvantaged, and think and plan ahead of time to build city capacity for dealing with vulnerabilities. Chennai will continue to grow and will do so by leveraging its strengths, rather than compromising its environment, and thereby its citizens' future.

CHAPTER 03

madras to chennai: history & context

From a cluster of fishing villages to the fourth largest metropolitan area in India

Human settlements have dotted the present day Chennai region since ancient times. This is evidenced in archaeological material from the Palaeolithic and

What's in a name?

Madras became Chennai in 1996 when cities and addresses across India selected non-anglicized names to replace those assigned to them during the British occupation. It is said that the name 'Chennai' originates from Chennapattinam, a region in King Chandragiri's empire that was conquered by the British. 'Madras', in turn, is said to originate from Madraspattinam, a fishing village just north of the British-built Fort St. George. As the Fort St. George area expanded to absorb nearby villages, the developing town came to be known as Madraspattinam and eventually Madras to the British.

Source: The Environs of Madras, Published 1816, Barry Lawrence Ruderman Antique Maps

Tondiarpet
Royapuram
Black Town
Fort St. George
Chintadripet
Island Grounds
Triplicane
Mylapore

Figure 4: Historical map of Madras (1816)

Iron ages, as well as ancient manuscripts and temple inscriptions from the Pallava and Chola periods[11,12]. However, Chennai's journey to the city it is today began with the advent of colonization: the Portuguese in 1522, the Dutch in 1612, and the British in 1639[13,14]. By this description, the city is about 400 years old.

On August 22, 1639, a local *Nayak*[iii] ruler turned over a tract of land to the East India Company for building a factory and warehouse for trading purposes. The land consisted primarily of fishing settlements and was located near the northern Coromandel coast[15]. In 1640, the British built Fort St. George which became the anchor of this growing colonial city. By the 18th century, the British had conquered areas covering present-day Tamil Nadu, Andhra Pradesh, and Karnataka to form the Madras Presidency, with the emergent city of Madras as its capital.

In 1688, Madras was declared the first Municipal Corporation in the British Commonwealth outside of Britain. Over the next 200 years, Madras urbanized and added a range of infrastructure, including railways (in 1856), water supply (in 1872), a sewage system (in 1907), electric lighting (in 1910), and electrified meter gauge railway (in 1928).

iii The Nayaks were a Telugu speaking royalty who ruled a large part of South India, including current areas of North Tamil Nadu, between 1529 and 1736.

An 18th century sketch of Fort St. George | Source: British Library/Wiki

Between the 1900s and the 1940s, Madras grew from a city of 70 sq. km with 540,000 people to a sprawling 80 sq. km with 860,000 people. The rate of urbanization in Madras was significant, particularly when compared with that of its local Tamil Nadu counterparts[iv], and, more broadly, those across South India[16,17]. This picked up additional pace after India's independence in 1947[18], when city boundaries expanded to 129 sq. km to accommodate an annual population growth rate of 2% between 1951 to 1961 and of 3.51% between 1961 and 1971[19]. In 1978, the Madras city boundary was once again expanded to cover 176 sq. km as a means of managing continuing growth[20].

iv In 1969, the Madras Presidency was renamed the state of Tamil Nadu.

circa. 150 BCE–200 CE

Records of Sangam literature of Tamil Nadu show that **tank irrigation and river water was used for paddy cultivation**

9th century CE

Early medieval Chola and Pallava kingdoms in Tamil Nadu, **continued to harvest rain water through building of tanks**. Rulers, such as King Rajendra Chola, (1012-1044) also laid down the basic principles of management of earthworks.

1011–1037 CE

Chola ruler Rajendra Chola I is believed to have built the **Veeranam tank**, the largest in South Arcot district of Tamil Nadu, and a source of water for Madras.
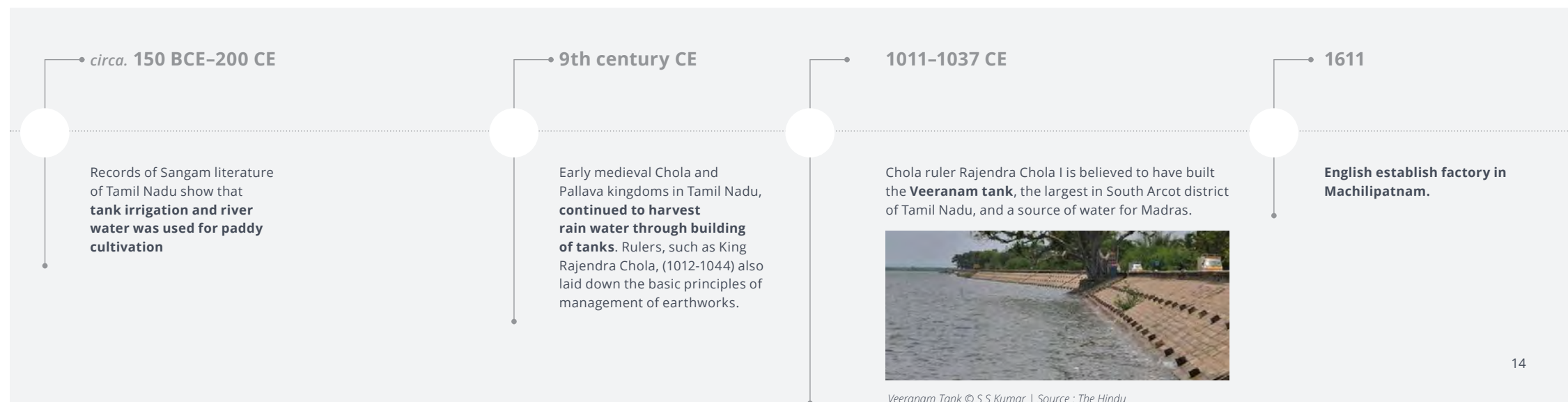
Veeranam Tank © S S Kumar | Source : The Hindu

1611

English establish factory in Machilipatnam.

$58 billion GDP (PPP)
4th largest economy
~6% growth rate

40% of India's automobile sector housed in Chennai
~70 of India's automobile exports

SaaS (software as service) capital of India
>$500m revenue earned by SaaS industry

3.5m (1971) - **8.6m** (2011) Growth
1.6m Migrants

91% Literacy rate (highest among top 10 most populous cities in India)

40% of India's medical tourists come to Chennai every year

Figure 5: Snap shot of sector performances in Chennai
Source: MSME (2013)[21], Babu (2018)[22], The Times of India, (2013)[23]

In 2011, the city area (which was now named Greater Chennai Corporation area) was expanded a third time to 426 sq.km.

According to the census, the city housed 8.6 million people in 2011, making it India's fourth largest metropolitan city and the 36th largest metropolitan city in the world.

While under British rule, Chennai city grew into a major urban centre and naval base. Post-independence from Britain, it continued to grow primarily as a hub for manufacturing industries. Today, Chennai's economy has expanded substantially into a service and knowledge economy, while continuing to support thriving automobile and Information Technology (IT) industries, which are complemented by the healthcare industry, financial services, post-secondary educational institutions and manufacturing of various types of hardware[24]. The city's vibrant economy is qualified by a Gross Domestic Product (GDP) of United States Dollar (USD) 58 billion and a 6% growth rate[25]. Chennai has successfully positioned itself as a key player in the state's and the country's economies by producing 60% of India's automotive exports[26] and by being the largest revenue generator in the 'software as a service' (SaaS) sector by already earning over USD 500 million in revenue so far[27].

Top: © @seeveeaar - Infosys, Mahindra World City; Bottom: Renault Nissan Plant, Oragadam | Source: REDACT, Medium

1639

British East India Company receive a plot of land near north Coromandel coast (just south of a small fishing village called *Madraspattinam*) from Nayak rulers to build a warehouse or factory for trading purposes. In 1644 Fort St. George was completed, which eventually became the core of the colonial city.

Fort St. George, 1890 | Source: The Hindu Archives

1688

Madras Municipal Corporation forms –the first municipal corporation in the British Commonwealth outside Britain.

1856

First railway line opens from Royapuram to Arcot The development in Royapuram opened up settlements in low-lying areas.

From ecologically driven to economically conscious

Development in Madras early on was largely guided by topographical and hydrological constraints. In other words, communities understood and respected the environmental realities of their surroundings and moulded development accordingly. For instance, to mitigate the risk of flooding, they concentrated their settlements in more elevated areas[28,29]. Also, they seemed particularly ingenious in their handling of local water resources. Recognizing the seasonal uncertainties of water supply, early settlers built an *ery* system which, till date, remains a fascinating example of an efficient engineering and management solution to Chennai's water problems. Typically, *erys* consisted of interconnected water bodies/tanks created primarily to ensure water was available to all for irrigation, but also to help in conservation, aquifer recharge, and flood mitigation during times of heavy rainfall[30]. These *erys* were managed by a committee (known as *Ery Variyam*), which was constituted by villagers, and were maintained using a dedicated percentage of the gross produce of each village[31].

This collective or communal resource management system was typical of pre-colonial times when large tracts of land were also collectively owned[32]. The *poromboke* system of land-use classification, which dates back to the medieval era, designated grasslands, groves, water bodies, and village forests as shared-use spaces (the term *porom* means "outside")[33]. The distinction between public and private was unclear and land as a key economic resource did not factor into decision-making processes until British dominance[34].
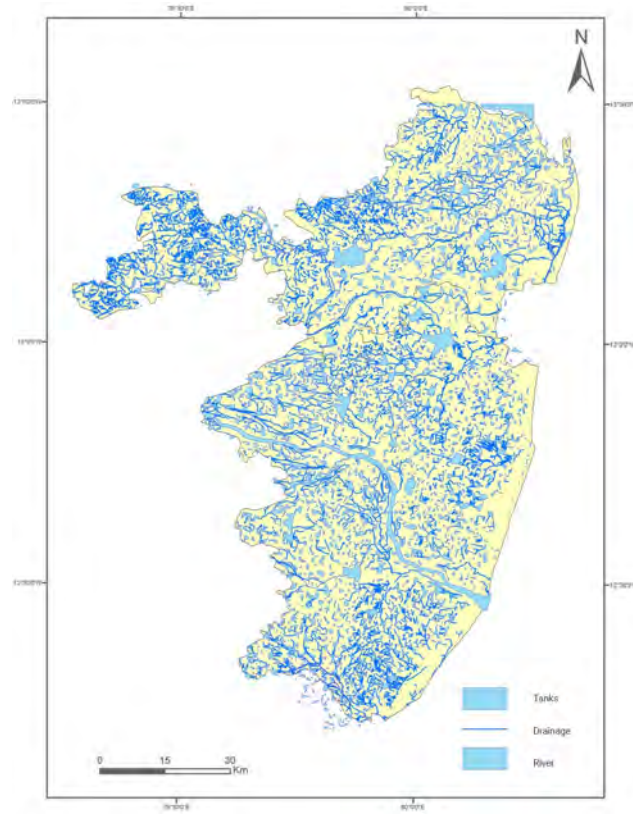
Figure 6: Kanchipuram and Thiruvallur district tanks and their supply channels
Source: Madras Institute of Development Studies

1857

The Madras University is instituted

Senate House, University of Madras, 1890
Source: The Hindu Archives

1872

Protected water supply for Madras is ensured.

1876

Extension of the Buckingham canal through Madras begins.

Buckingham Canal, 1961 | Source: The Hindu Archives

© Vasistan Shakkaravarthi - Pallikaranai Marsh

© Shanmugam Saravanan - Greater Flamingos, Pallikaranai Marsh

Later, following the introduction of western-influenced distinctions between private and public, with a particular focus on the monetary/economic value of land, *poromboke* areas such as wetlands became demarcated as "wastelands", a differentiation method that continues well into the twentieth century[35], and one that puts ecologically relevant landscapes at risk of rampant development and encroachment.

The traditional *ery* system has also lost its relevance in today's urbanized Chennai. A growing population and economy, combined with a booming real estate market, mean that Chennai's water bodies including its *erys* have been encroached upon or reclassified for housing, and in some cases for commercial and industrial developments. Surviving *erys* are poorly maintained for a number of reasons: during the period of British rule, the communal resource management system broke down when a transition to centralized water management structures (such as dams and canals) and agencies (such as the Public Works Department (PWD)) were made. The focus on large engineering interventions to

manage city water flow is apparent in the prioritization of artificial storm water drainage (SWD) systems over traditional tanks. In addition, the eventual proliferation of unregulated private bore wells and a transition to a non-agricultural economy has rendered the *ery* less important as a source of water to citizens.

The colonial period also triggered an approach to urban development that oriented the city towards suburbanization by implementing sprawling road and transportation networks[36]. The 1862 British-built Royapuram Railway Station is a clear manifestation of this strategy: it induced people to move northwards and settle down in the low-lying Royapuram neighbourhood where a timber industry had developed. The Royapuram railway line also cut through the ecologically sensitive swamp lands of Perambur in North Chennai. Thus, people started settling around transportation networks, in areas that were traditionally uninhabited[37].

The suburban expansion and development trend into ecologically vulnerable areas continued post-

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1895

Inauguration of first tram line in the city (*existed till 1953*).

A tram running | Source: The Hindu Archives

1907

Inauguration of main sewerage system in the city.

1910

Electric lighting inauguration in the city.

1925

Mid-Day Meal Programme introduced for disadvantaged children in Madras Municipal Corporation.

1937-1938

First phase of the Tamil Language Movement begins when the Congress Party is elected to form the State Government at Madras Presidency in the first Provincial Election held in British India, and issued an order in April 1938 making Hindi language teaching compulsory in all the secondary schools of the province.

1947

India gains independence from British rule.

Independence Day Commemorative Stamp, 1947 | Source: IndianPostageStamps.gov.in

1950s

Second phase of Anti-Hindi agitation –a temporary solution was designed whereby English was to remain the official language for fifteen years while Hindi would be promoted as national language so English could be phased out.

20

independence, and has especially been aggravated since India's economy was liberalized in the early 1990s. For instance, the development of Chennai's IT corridor in the late 1990s along the Old Mahabalipuram Road, which was supported by a strategic Government of Tamil Nadu (GoTN) move to leverage IT sector growth for economic development, is an example of the city's encroachment into ecologically sensitive areas—in this case around the Pallikaranai wetland. Originally spread over 6,000 hectares in the 1960s, this wetland shrank dramatically over several decades by approximately 90%. The result is a compromised ability to perform its natural role as sink for excess water during heavy rainfall, meaning that surrounding areas, including Chennai's newly developed IT corridor, are at risk from perpetual flooding. Recently, the Tamil Nadu government has begun to recognize the ecological importance of this area, responding in part to the tireless efforts of Care Earth, a local non-profit organization which calls for the protection and restoration of ecological resources. In 2007, about 317 hectares of swamp land in Pallikaranai was declared a Reserved Forest by the GoTN.

From traditional to cosmopolitan

Irrespective of all the development, most locals agree that Chennai has always been and still remains a traditional city—one deeply rooted in its Tamil identity, its religions, its cultures, and its art forms.

The fierceness with which Anti-Hindi agitation unfolded in the late 1930s highlights Tamilians' pride and attachment to their Tamil identity and fear of 'Hindi imperialism' that has dominated since before India's independence[38]. The movement began as opposition to the introduction of compulsory teaching of the Hindi language in Madras Presidency schools in 1937. The agitation lasted three years and involved fasts, conferences, marches, demonstrations, and protests. The movement gained momentum again post-independence, while India's constitution was being drafted, as intense discussions prevailed regarding Hindi as India's official language. Around the 1950s, in response to relentless opposition from the South, a temporary solution was designed whereby English was to remain India's official language for fifteen years, while Hindi would be promoted as a national language so that English could be phased out. However, as Rahman says

> 66 *(T)his only created a ticking time bomb that exploded with bloody violence when the time ran out" (2014)[39].*

In 1965, it took another round of bloody protests by Tamil nationalists to finally thwart the idea of making Hindi India's official language. Even today, locals prefer to speak with non-Tamil speaking visitors in English rather than Hindi.

1958

First Industrial Estate in the country is established in Guindy.

1968

Anti-Hindi Agitations in Tamil Nadu protests and finally thwarts the possibility of inclusion of Hindi as the official language of India.

Students at an Anti-Hindi rally, 1965 | Source: The Hindu Archives

1969

The Madras Presidency is renamed as the state of Tamil Nadu.

1970s

TNHB's "*Ery* Schemes" allows defunct lakes to be filled in to accommodate housing schemes.
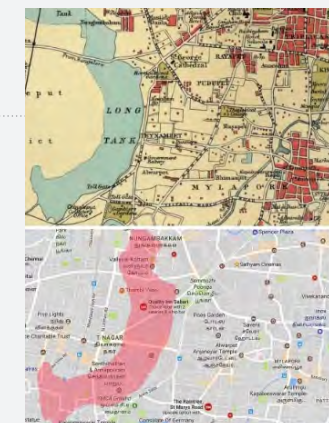
Nungambakkam Long Tank encroachment Source: Top: S.Muthiah, The Hindu | Bottom: Sriram.V, dsal.uchicago.edu

1978

Madras proper expands from 129 sq. km to 176 sq. km.

1996

Madras is renamed 'Chennai'.

Another example of the deep-rooted nature of Chennai culture and identity is the continued interest and importance placed on the arts (particularly the performing arts of music and dance). This includes classical art forms of Carnatic music and Bharathanatyam, as well as other forms of music such as *villupattu*, *gaana*, Tamil *sufi* music, film music, and folk dances such as *paraiattam* and *therukoothu* (theatre).

Several temples in the city including the Thiyagarajaswamy temple in Thiruvottriyur, the Kapaleeshwarar temple in Mylapore, and the Parthasarathy temple in Thiruvallikeni, were centres of music and dance, with numerous *tevarams* (verses on Lord Shiva), *pasurams* (verses on Lord Vishnu), and Carnatic music compositions on the presiding deities.

While music and dance have now largely moved out of temples to auditoria, they continue to be an intrinsic part of the Chennai city identity. The Margazhi Music and Dance Festival, which is held in the months of December and January, is one of the largest music festivals in the world with around 1,500 performances spread across the city and only evening performances ticketed. Complementing this festival is the Chennai Kalai Theru Vizha, which showcases multiple art forms through performances across less explored and understood parts of the city (such as North Chennai) with the intent of "equalizing spaces, cultures, communities, and the arts"[40]. In 2017, these efforts resulted in Chennai

being included in UNESCO's list of 'creative cities' for its contribution to music.

Tied inexorably to Chennai's culture is the Madras tiffin. The triumvirate of Tamil Nadu fast food —*idly*, *dosa* and *vadai*— is available on every street at prices within the means of all citizens. Heaped around these is a host of dishes whose fragrances and flavours are uniquely South Indian, not the least of which is a frothy cup of hot filter *kaapi* (coffee).

No story of the Tamil identity is complete without the story of the Chennai Super Kings, better known as CSK, led by the indomitable *Thala* Dhoni (as of 2019). In a culture where film stars have been embraced with blind faith and revered, Dhoni and his CSK team are no longer cricketers playing a game. They are gladiators fighting for and bringing pride to the Tamils with their winning ways. Across the length and breadth of this cricket crazy nation, CSK have put the Tamils firmly and truly on top, bringing with them a sense of honour and belonging that has seldom been felt or seen in recent times.

Nor is it complete without discussing the *Jallikattu* protests: In 2017, the city witnessed strong protests against a Supreme Court order banning the state's traditional bull-taming sport *Jallikattu*. The largely peaceful demonstrations on Marina Beach and at Tidel Park Junction (on the IT Corridor) were predominantly

Late 1990s - Early 2000s

Economic liberalization and the IT corridor development takes place along the Old Mahabalipuram Road.

IT Corridor © Prakash K V

2001

Rainwater Harvesting Movement launches.

2004

Boxing Day Tsunami Following an earthquake off the Indonesian coast (9.1 on the Richter scale), a massive tsunami strikes Chennai and surrounding areas wreaking tremendous havoc to livelihood and infrastructure.

2008

The Second Master Plan for Chennai Metropolitan Area (2026) launches.

24

organised on social media by IT professionals, students, and others who turned it into a celebration of Tamil pride[41]. The movement was significant for two reasons: a) it represented the power of social media and consequently the adeptness of the city's young people with newer, modern technology to orchestrate a city-wide movement; and b) the increase in white collar employees, signalling a slow but steady change from the 'traditional' to the 'cosmopolitan'.

Chennai's journey from traditional to cosmopolitan coincided with significant economic changes that were triggered by emerging new industries in IT, IT-enabled services, and business process outsourcing industries— all of which attracted a new labour force that largely included skilled middle-income men from outside the state. Migration trends from the Economic Survey of India 2016-2017 reveal that 'Delhi, Maharashtra, and Tamil Nadu attract large swathes of migrants from the Hindi speaking heartland of Uttar Pradesh, Bihar, and Madhya Pradesh and the North East. In fact, net railway passenger inflows into Chennai district are among the highest in the state (see *Figure 7*).

Migrants from these states do not all work in the IT sector; some also come to join the construction workforce while many come to the city to study and generally in search of better living standards. And they bring with them their culture and traditions. Associations such as the Zomi Christian Fellowship, which looks after the
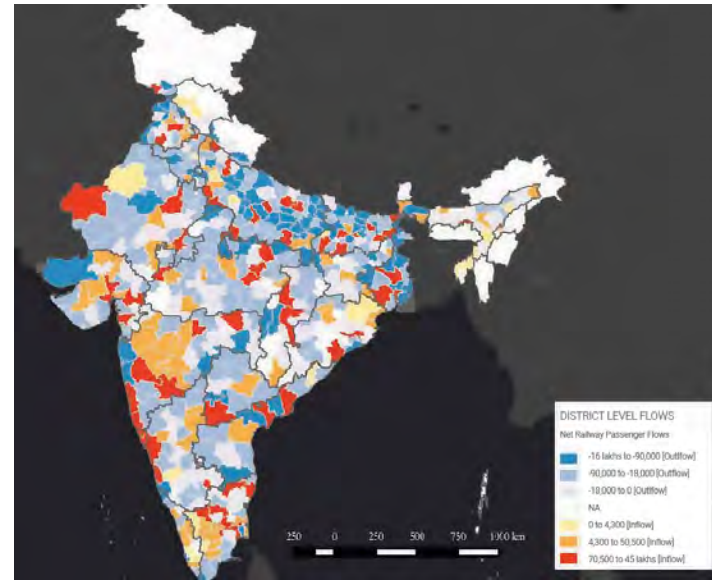
Figure 7: District-wise heat map of railway passenger inflows
Source: Ministry of Finance (2017)[42]

welfare of Manipuris, Chennai Mizo Welfare Association, and Neoliberal Ethos Centre help members adjust to Chennai city life, as well as organise cross-cultural events and activities[43]. While these organizations cater to relatively newer migrants, Gujarati and Rajasthani traders make up some of Chennai's earlier migrants; they came to the city in the 1600s to do business with the East Indian Company. Predominantly money lenders, these communities settled around Mint Street, an area that came to be known as Sowcarpet (derived from *sowcars*, or money lenders)[44]. Even today, this area is unique in Chennai for its Rajasthani and Gujarati sweets, crafts, and fashions.

Top: Chennai Super Kings cricket fans | Source: BCCI; Bottom: © Arun Ramanan - Hot idli, vada, dosa, Perambur

2009
Construction of Metro Rail system begins.

Chennai Metro | Source: CMRL

2011
Chennai expands to cover 426sq. km with a population of 4.6 million.

2015
Chennai floods.
Unprecedented rainfall during the NE monsoon leads to devastating floods causing 470 deaths and displacing lakhs.

Aerial view of Chennai flooded | Source: PTI

2017
Chennai included in **UNESCO's list of 'creative cities'** for its contribution to music; pro-jallikattu protests against a Supreme Court order banning the state's traditional bull-taming sport.

Chennai cosmopolitanism is also the result of the city's large automobile industry, which attracts citizens from foreign countries including South Korea, Germany, USA, France, and Japan to work in their respective automobile companies, which include Hyundai, Daimler, BMW, Ford, Renault, and Mitsubishi. Expatriates from these countries have set up their own cultural centres, including the Inko Centre (India Korean Cultural Centre), the Goethe Institute, and the Alliance Française, all of which hold various activities, classes, and cultural events throughout the year.

Further, over the years, the city has also attracted a steady inflow of medical tourists from other Indian states and countries (East African countries and Bangaladesh, in particular). According to a study by the Confederation of Indian Industries (CII), Chennai attracts nearly 40% of India's medical tourists, with 200 foreign patients coming to the city for treatment every day[45].

S. Muthiah concludes his book "Madras Rediscovered" with the following words:

> " *Madras is the past that's also catching up with the present, where the Bharata Natyam dancer is as much at home on the Music Academy's stage as she is in the discos that are an established part of today's entertainment scene or the sambhar and curd rice connoisseur at home is the gourmand in fine dining spaces that offer a plethora of international cuisine. But for all the change, the traditions of a conservative past and memories of glorious yesterdays remain an intrinsic part of the fabric of a city of today drawing up great plans for tomorrow" (2018: 545).*

Top: © Ashish Parmar - GoMadras Electronic Music Festival | Source: GoMadras.in; Bottom: © Kals Pics - Jallikattu, Rajakkalpatti

CHENNAI'S RESILIENCE NARRATIVE

South East view of Fort St. George, 1797 | Source: Engraved by Thomas Daniell, Oriental Scenery

Government House, Madras, 1913 | Source: Messrs. Nicholas & Co, Ilustrated Guide to the South Indian Railway

Construction of the Gemini Flyover, 1972 | Source: The Hindu Archives

Kathipara Junction | © Pratik Gupte / Wiki

PRE-COLONIAL PERIOD
2nd century CE to 1639

During this period, a communal system of resource management was typical. The *poromboke* system of land use classification, dating back to the medieval era, designated grasslands, groves, waterbodies and village forests as shared-use spaces. The traditional *erys* (interconnected waterbodies/ tanks created as effective means of water distribution, conservation, and flood mitigation) were also managed collectively by village communities.

COLONIAL PERIOD
1688 – 1947

With colonial rule, land and other resources began to be distinguished as public and private, primarily based on property ownership rights and with particular focus on the monetary/economic value. Hence, *poromboke* areas such as wetlands began to be demarcated as "wastelands", a practice that continued until recently, putting these ecologically relevant landscapes at risk of rampant development and encroachment. Development and expansion into low-lying areas and ecologically sensitive zones began with almost 3,482 waterbodies being transferred to built-up areas during this time.

POST INDEPENDENCE
1947 – 2015

The trend in rampant growth, often at the cost of environmental sustainability continued, and even accelerated with the economic liberalization in the 1990s and the IT sector development in particular. While the 2004 Tsunami was a wake-up call for the city to begin thinking about its resilience to future shocks, the 2015 floods managed to raise wider awareness regarding the human contribution to such natural occurrences. As an activist explained, the "2015 flood was in the making for decades," as the city built over and violated the natural ecosystem in pursuit of growth and development.

POST 2015 FLOODS
2015 – present

Recognizing the inter-dependencies of the city's development and the environmental shocks and stresses, especially related to water, the city has begun to focus on restoring its waterbodies and removing encroachments, both for environmental protection and public safety. Multi-lateral/bilateral funding agencies are investing in the water sector to build the city's capacity to meet citizens' water demand and to reduce the city's vulnerability to floods and droughts. While the GoTN is contemplating eight-fold expansion of the metropolitan area to accommodate Chennai's growth, it is emphasizing the need to plan this growth in an integrated fashion linking economic, social, and environmental thinking.

CHAPTER 04

chennai's resilience challenges & opportunities

© Adithya Anand - Kolam contestant, Mylapore Festival 2016
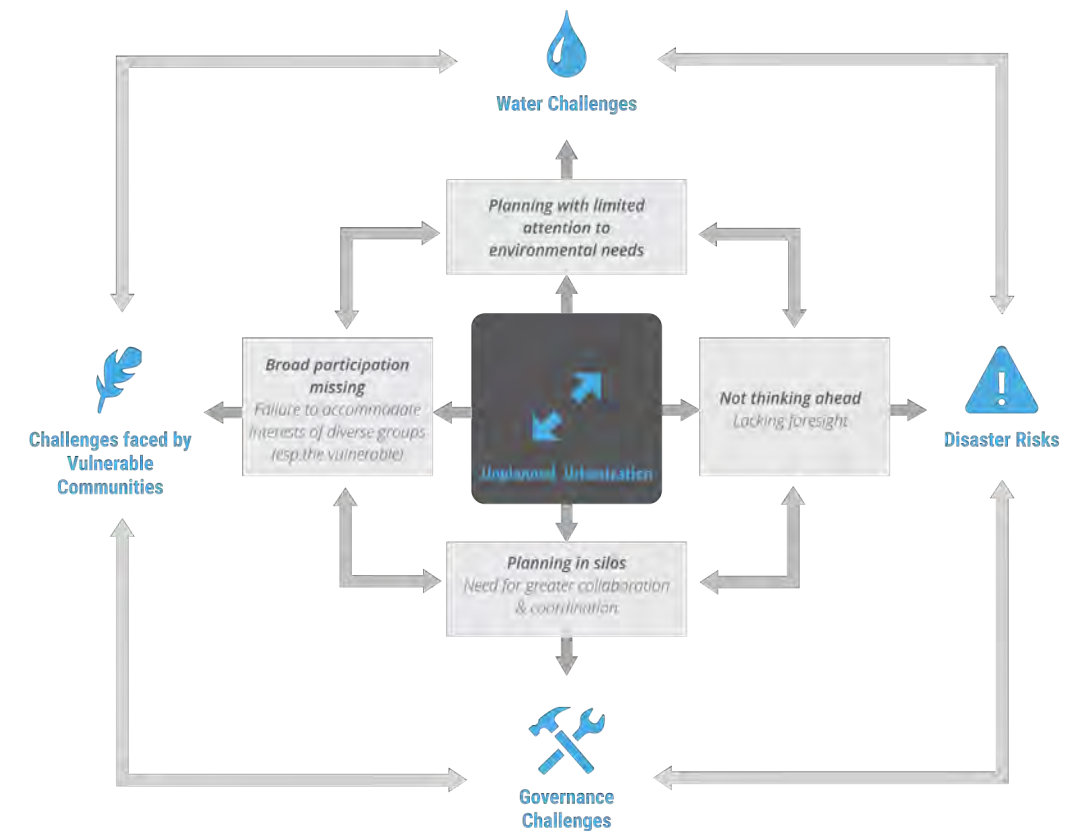
Figure 8: Unplanned and unhealthy urbanization: the anchor in Chennai's resilience challenges story

From a cluster of 16th century fishing villages to the fourth largest metropolitan city and economy in India, recognized for its world class medical facilities and software services, Chennai has come a long way. Like all other rapidly expanding metropolitan cities, Chennai also has its share of resilience challenges: the city frequently endures shocks such as floods and cyclones, while coping with chronic stresses such as droughts, poor waste management, encroachment, traffic congestion, and pollution. Drawing on stakeholder feedback on Chennai's resilience challenges, five areas stand out:

⊗ *rapid and unplanned urbanization;*

⊗ *poor water systems;*

⊗ *disaster risks;*

⊗ *poor governance ecosystem;*

⊗ *and disadvantaged vulnerable communities.*

While each of these areas is intricately connected with the other, **the overall story of Chennai's resilience challenges does appear to be firmly anchored in the process by which it has urbanized: a process that has been rampant, unplanned, and unhealthy.**

Figure 8 indicates how the various limitations of Chennai's urbanization process link to its resilience challenges. For instance, limited attention to environmental resources and future risks in urban planning have led to water related challenges and aggravated disaster risks. These issues have been further worsened by planning that has occurred in silos, which has led to governance challenges across all urban and environmental management sectors. Similarly, limited multi-stakeholder participation in planning has led to impact on the city's poor and other vulnerable groups who are exposed to higher risks on all fronts.

CHENNAI'S UNPLANNED AND UNHEALTHY URBANISATION TREND

A description of Chennai's urbanisation trend helps portray the gamut of the city's socio-environmental challenges and their inter-linkages. Driven by population growth, economic transition, and development, the city has been experiencing urban land use expansion at an unprecedented rate. A 2009 study[46] assigned Chennai 37th place in the list of largest urban areas in the world (see *Figure 9* for decadal growth rate and population increase in Chennai). To accommodate the rapidly increasing population, the Greater Chennai Corporation (GCC) expanded its jurisdiction to 426 sq. km in 2011, prior to which it covered an area of 174 sq. km. Currently, the state government is considering a further expansion of the Chennai Metropolitan Area (CMA) to nearly eight times its current size (from 1,189 sq. km to 8,878 sq. km).

While there have been master plans to shape the growth, these have not been effective or well thought through, aggravating the natural and man-made shocks and stresses the city experiences, including floods,
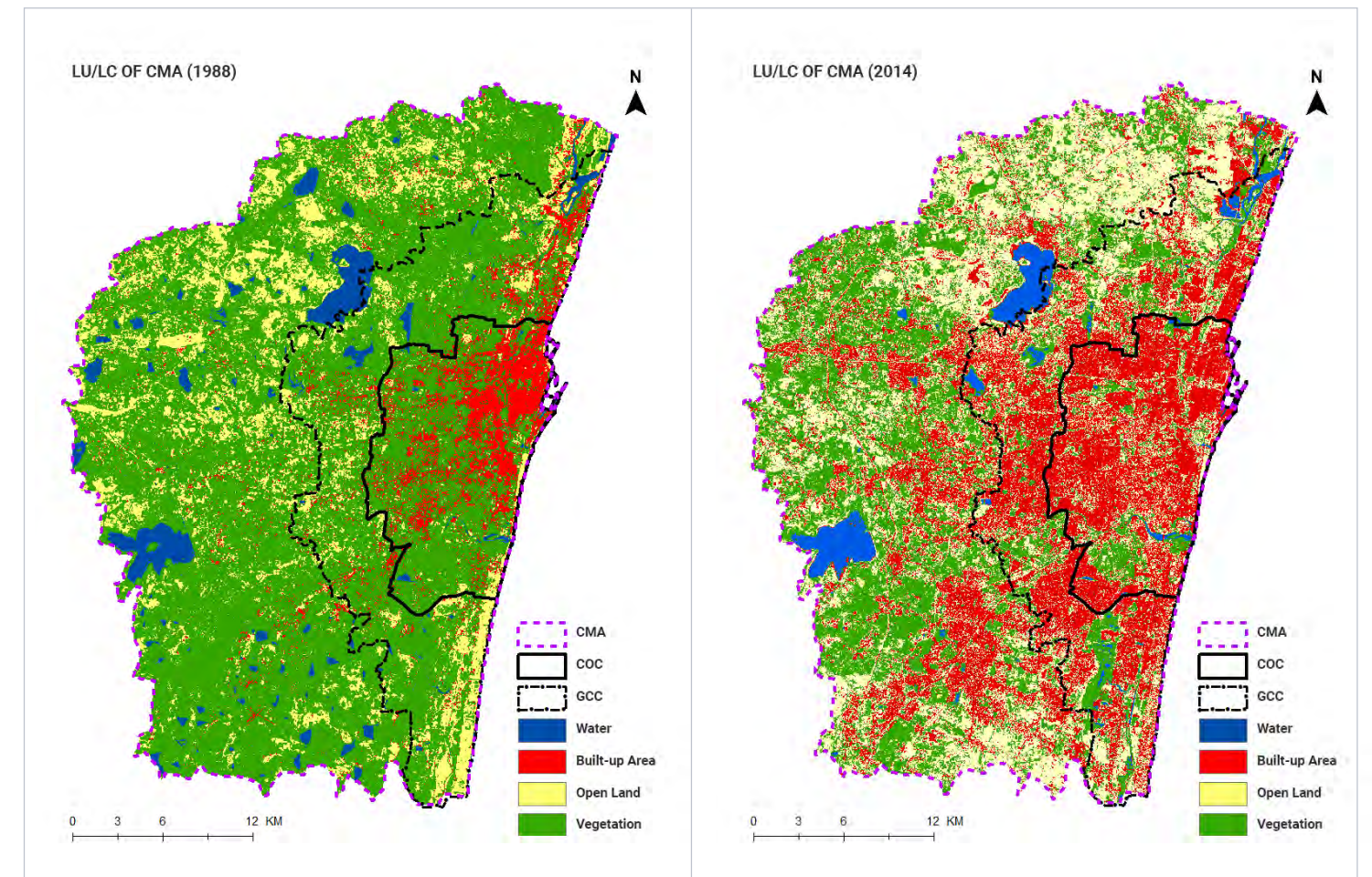
Figure 10: Land use change in the Chennai Metropolitan Area | *Source: Author's own*

POPULATION GROWTH
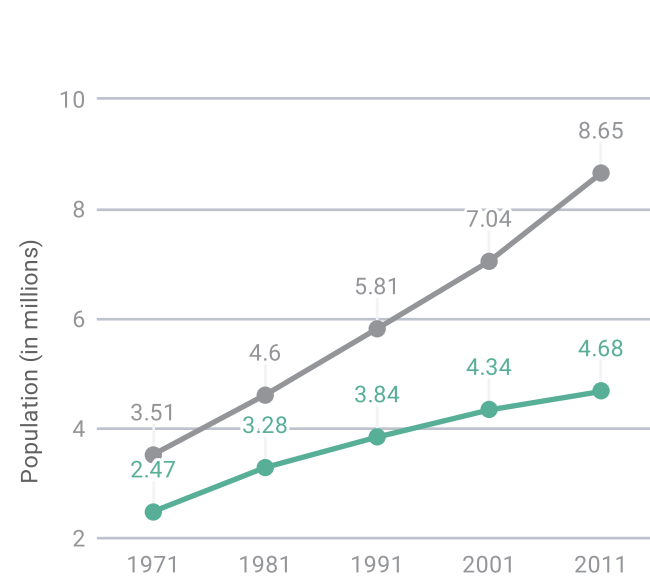
DECADAL GROWTH RATE IN PERCENTAGE
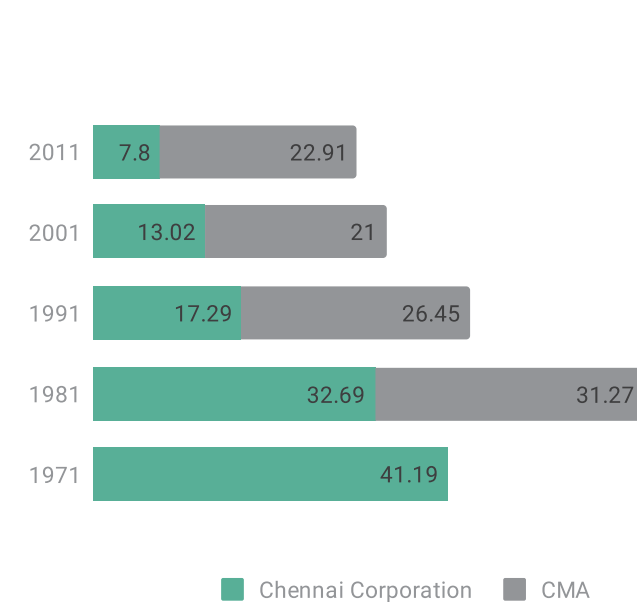
Figure 9: Population statistics

pollution, and encroachment. Prior to 1975, Chennai city did not have a comprehensive master plan[47,48,v]. As the city needed to accommodate more people and the need for associated infrastructure increased, natural areas were constructed upon, without attention to the functions of those ecosystems or to the long-term impact of losing them, including the impact of losing their function in mitigating city disaster risks (see *Figure 10* for CMA land use change).

The 1970s and 1980s saw 'development of lakes' through the "*Ery* Schemes", whereby the Tamil Nadu Housing Board (TNHB) filled up dry lakes in order to accommodate housing schemes in Ambattur and Mogappair. These schemes, which were funded by the World Bank, also included the construction of markets and the development of bus stands[49]. In the 2000s, several slums were relocated from within the city to its outer limits on the banks of the Pallikaranai Marsh in Perumbakkam and Semmancheri. Accompanying these changes were land re-classifications which further affected fragile ecosystems including the Ennore creek, which was earmarked for the development of hazardous waste industries. Further, expansion of the Kamaraj Port into Chennai's salt pans and Ennore creek led to the dumping of fly ash in the area by TANGEDCO, the Tamil Nadu Government Electricity Generation and Distribution Company. Data on land-reclassification from 2008 to 2017 also indicates that 250.576 hectares of agricultural land were converted to accommodate residential and other development—which accounts for 42.64% of total land use conversion in Chennai[50] (see *Figure 11*).

v Prior to that, General Town Planning Scheme (1957), Madras Interim Plan (1967), Madras Metropolitan Plan (1971-1991), and Madras Urban Development Project (1974) were a few of the schemes that governed urban planning in the city.

FREQUENCY OF AGRICULTURE LAND CONVERSION

N

Agriculture
Frequency

● 1
● 2
● 3
● 4
● 5
● 8
● 13
● 14

☐ Corporation of
Chennai
▫▫▫ Greater Chennai
Corporation (GCC)
⋯ Chennai
Metropolitan Area

0 3.75 7.5   15
km

EXTENT OF AGRICULTURE LAND CONVERSION

N

Agriculture
Extent (Ha.)

● 0.105 -1.555
● 1.556 - 4.775
● 4.7776 - 7.605
● 7.606 - 19.423
● 19.242 - 29.665

☐ Corporation of
Chennai
▫▫▫ Greater Chennai
Corporation (GCC)
⋯ Chennai
Metropolitan Area

0 3.75 7.5   15
km

Figure 11: Agriculture and land use conversion | *Source: Roy et al., 2018[51]*

> "*Since we do not have flood mapping in the area, whenever planning permission comes to build a building or layout of land, we refer the case to PWD's WRD... In the 2015 flood we did not have adequate manpower, time, and could not access majority of areas. So, with limited staff, we could not map out the impact.*"
>
> *-- CMDA Interview, 17 Oct 2018*

This land conversion highlights not just the loss of agricultural and natural land that serves important ecological functions, but also means a loss of livelihood for farmers. Without adequate safeguards, such land-use conversion will pose increasing threat to food security, as well as to farmer livelihoods in areas around the city, because land price increases will force them to sell their agricultural land to real estate developers.

Development on or too close to lakes and rivers has led to a loss of water bodies and encroachment on flood plains. This has compromised the ecosystem balance that the traditional *ery* system maintained as a flood mitigating mechanism, and exposed communities, especially the poor living along waterways, to regular flood risk[52,53], which is not just limited to episodes of heavy rainfall; flooding occurs around Chennai following brief episodes of rainfall as well.

Urban planning needs to integrate information on environmental shocks and stresses and/or measures to address them more pro actively. In fact, reliable multi-hazard maps are still unavailable to inform planning. Flood prone areas were marked only post the December, 2015 flooding event. Environmental shocks and stresses such as floods or climate change and associated sea-level rise are generally not recognised as key or urgent issues that need to be considered in urban planning discussions. Even as mean sea levels are projected to rise between 0.19m and 1.2m[54] over the next few decades, major infrastructure development along the coast continues, including desalination plants, ports, and industry. This highlights a need to raise awareness around the urgency to plan for a climate adaptive city. Similarly, protecting the city's blue and green infrastructure for long-term sustainability also needs to be prioritized in the city's planning paradigm.

Informed and environmentally responsible planning, by using sustainable building practices, could improve the ability of structures to withstand floods or earthquakes. Porous pavements can improve groundwater recharge while also reducing surface run-off during flooding events. Thus, by adopting a proactive and integrated approach to urban planning, the city can mainstream environmental thinking into urban development and better address Chennai's socio-environmental shocks and stresses.

Urban planning has also been unsuccessful in tackling the city's solid waste and sanitation issues effectively. An early 100RC survey indicates solid waste management (SWM) and sewage as high impact challenges. Several experts across government and non-government agencies agree that mismanaged solid waste was one factor that contributed to major flooding in 2015, when

© Resilient Chennai – Development along the Muttukadu Backwaters, Chennai suburbs

RESILIENCE OPPORTUNITY

Solid waste management (SWM)

Citizens have also made efforts to manage solid waste within their communities. Resident Welfare Associations (RWAs) such as the one in Manali, segregate 100% of their waste due to active participation from the residents. With greater support — both technical and political — from the GCC, these RWAs and others could do even better at SWM.

waste choked SWD and waterways, causing large-scale inundation. In fact, in the aftermath of the floods, the GCC had to remove 1.32 million tonnes of garbage that was strewn across the city, which amounts to almost 25 days' worth of waste[55]. The issue of solid waste in Chennai is an outcome of collective neglect and mismanagement—by both government and citizens— and therefore needs strict action on everyone's part. However, recent developments such as steps taken by the GCC to redefine solid waste management vendor contracts and to ban the manufacture, sale, and use of plastics indicate intent to tackle the issue more seriously.

Chennai citizens also point to traffic as a key challenge in an early Resilient Chennai survey[vi, 56]. The root cause of this issue is poor planning, road infrastructure problems, and inadequate public transportation services, and is especially problematic in peri-urban areas. A 2018 Centre for Science and Environment report states that Chennai citizens have the longest daily commutes. As a result, the city ranks second among all Indian metros in overall energy consumption and carbon emissions. The study also reveals that Chennai has the highest number of two-wheelers among all metro cities[57].

Middle-class dependence on private vehicles (including motor bikes), which contributes to traffic, pollution, and climate change in the long run, is largely a function of insufficient last-mile connectivity in the public transport system[58]. Another cause is insufficient pedestrian or non-motorized vehicle friendly urban planning. Neighbourhoods in the core city area are

not pedestrian-friendly, and do not accommodate concerns related to non-motorized vehicles. A lack of dedicated spaces for vendors, pedestrians, parking, etc., lead to congested, unsafe, and unwalkable city spaces. Chennai ranks low among Asian cities in terms of walkability: one 2011 index gives it an average of 40 out of 100[59]. However, Chennai did win a Sustainia Award in 2015 for efforts to improve sustainable transport. The award was presented by the Danish think tank Sustainia and recognizes a comprehensive approach to improving sustainable transport across the world.

Sustainable transport systems require state-of-the-art public transportation that is accessible, affordable, convenient, safe, and green. Chennai's public transport system is considered one of the best in the country with four modes of transport: buses, metro rail, sub-urban railway and the mass-rapid transport system. However, Chennai residents prefer buses to other forms of public transport. In 2015-16, Chennai's buses carried approximately 1,300 passengers per bus per day, which is the highest number in the country[60]. Yet the city's bus fleet is one of the oldest in the country[61], which increases the risk of accidents, and makes access difficult for disabled and elderly passengers, since older buses are higher up off the ground and do not include extendable steps. The government has worked to improve access and recently (in January, 2019) introduced 56 new buses which are relatively disabled-friendly. While physical accessibility on buses is critical to improve ridership, ensuring affordability is equally important. Passenger counts fell sharply from 4.6m to 3.3m in 2018 as a result of a fare hike[62].

RESILIENCE OPPORTUNITY

2015 Sustainia Award

Chennai was awarded for its effort to retrofit over 75 km of walk-able streets and the redesign of an additional 60 km. The award also recognized Chennai's support for cycling, which it demonstrated by implementing a Public Bicycle Sharing (PBS) system with 5,000 cycles.

Such hikes impact vulnerable communities in particular, including those who have been resettled into peri-urban areas, far away from their work places[63].

Finally, limited coordination, collaboration, and inclusivity in urban planning processes pose a major threat, particularly to vulnerable citizens. The Tamil Nadu (TN) Vision 2023, the Second Master Plan, and the city development plan (submitted under Jawaharlal Nehru National Urban Renewal Mission (JNNURM)), all highlight the importance of broad stakeholder engagement in planning and decision-making processes. However, experts point to the limitations of the commonly used public hearing and consultation mechanisms to truly include multiple voices[64]. For instance, a 7.5-km elevated beach expressway was proposed in 2008 as a solution to the problem of congestion in the city. It would have extended from Marina Beach to the East Coast Road (ECR) in Kottivakkam. Further, the proposed expressway would cut through ecologically sensitive areas such as the Adyar estuary and beaches along the east coast which provide nesting sites for the endangered Olive Ridley turtles. It would have also run through coastal fishing villages and displaced more than 100,000 people[65],[66]. Chennai's fisher folk have been successful at thwarting some of these government designs, arguing that they pose livelihoods-related concerns. However, the same communities have been unable to stop private parties from grabbing large portions of coastal "*poromboke*" lands for urban development. This illustrates why broader stakeholder involvement in decision-making processes is crucial to protect varied interests.

Overall, development pressure and a prioritization of immediate needs and economic aspirations predominate planning in Chennai and this has taken a toll in terms of sustainable city growth as well as on the needs of the vulnerable. What is lacking is holistic planning that is sensitive to economic, ecological, and social needs.

© Vinoth Chandar - Broken Bridge, Adyar Estuary; In the background, construction on the banks of the Adyar, 2013.

CHENNAI'S WATER SYSTEMS AT RISK
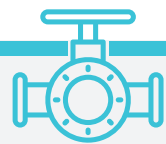
The Chennai Metropolitan Water Supply and Sewage Board (CMWSSB) have the capacity to supply 830 million litres a day (MLD) through its piped network. However, the actual amount supplied is lower. For example, just 650 MLD was supplied in February, 2018. This is not just below capacity but also far below the supply benchmark of 135 litres per capita per day (lpcd)[67].

Chennai water bodies well exemplify the city's problematic urbanization trajectory. The development of roads, houses, and industries over and in close proximity to lakes and rivers has, on the one hand, compromised the city's ability to meet its water needs, and on the other, exposed citizens to frequent flooding. Flooding risk has further been aggravated by solid waste and sewage dumping into water bodies. This paradoxical situation involving either too much or too little water, experts believe, results from a failure during planning to consider the water system holistically. Thus, in designing city SWDs, the focus, until recently, has been on the single purpose of alleviating the impact of floods, while ignoring the fact that drains can play equally important twin roles in a) directing water to drain into reservoirs so it can be stored for later use, and b) allowing it to filter into the ground to recharge depleting aquifers.

As in most Indian cities, Chennai's piped water supply is at present intermittent, and available for just a few hours a day (or on alternate days), irrespective of the amount of rainfall. Households and commercial/industrial parties therefore depend heavily on a private water market, or on own bore wells that they themselves sink—both of which lead to over exploitation of ground water.

City water shortages and an anticipated increase in water demand have pushed Chennai to invest in desalination plants. Investments are likely for two new plants: one with a capacity of 150 MLD in Nemmeli and another with a capacity of 400 MLD in Perur[68]. Despite high financial and environmental costs, desalination plants present an immediate solution to water scarcity. Following the 2015 floods, more attention is also being paid to restoring and protecting water bodies as a means to enhancing future supply (for example, the Sustainable Water Security Mission). However, ecologically restoring waterways and water bodies is a complex solution that requires addressing a range of issues including solid waste and sewage disposal, and legal and illegal encroachments.

Interestingly, water experts across government and non-government institutions highlight the importance of demand management more than source augmentation or supply side solutions[vii]. This is in line with India's 2012 National Water Policy, which advocates for a demand driven approach to water efficiency and states that "recycling and reuse of water should be the general norm and water pricing should ensure its efficient use, and reward conservation"[69].

Resilience building in Chennai includes a need for water conservation. Metering to measure consumption and effective pricing are the most direct ways to manage demand and encourage users to conserve water[70,71].

However, the extent of water metering in Chennai today is less than 10%[72]. This dearth of water meters not only makes consumption-based pricing impossible, but also has implications for another demand management technique: reducing non-revenue water (NRW) or water

RESILIENCE OPPORTUNITY

Sustainable Water Security Mission

The Mission was formed in September 2015, through a *suo motu* announcement in the legislative assembly with the aim of protecting and restoring Chennai's waterbodies and to meet Chennai's growing drinking water needs by implementing various projects to,

a. Restore and rejuvenate waterbodies in and around Chennai;
b. Expand and strengthen rainwater harvesting across the city;
c. Promote grey-water recycling and reuse.

GCC and CMWSSB are the nodal/coordinating agencies for implementing the mission.

Chennai Smart City Ltd. T.Nagar Piping Infrastructure

Chennai Smart City Ltd. is exploring options to revamp the existing water piping infrastructure in T-Nagar. This can address issues with NRW by reducing the quantity of water leakages.
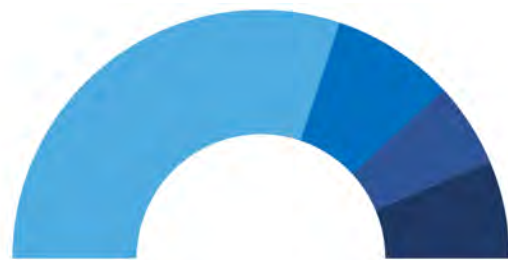
- Reasonably priced (60.23%)
- Too high (16.02%)
- Too low (11%)
- Very cheap (12.74%)

Figure 12: Current citizen opinion on water charges (2018)

Water Pricing

In a recent survey conducted by the 100RC team with residents from across the city, 60% of the 518 respondents said that water is reasonably priced. 51% of 543 respondents are willing to pay a higher price for water, if it is 24x7 and of higher quality. Respondents also showed their support (72%) for government policy on water meters and a consumption-based tariff.

https://resilientchennai.com/water-survey

> " Water metering is difficult to implement, especially in India, because water pricing tends to be a political decision."
>
> -- CMWSSB Interview, 2018

lost due to bad piping infrastructure, theft, and illegal water usage[73]. On average, non-revenue water (NRW) accounts for around 20% of water produced in Chennai[74]. Also, effective pricing is extremely difficult to implement in Indian households, as they are accustomed to paying extremely low tariffs for water, and are averse to water metering and consumption-based pricing[75]. Any small change in price thus requires public approval to avoid political costs associated with the changes. A pilot attempt to introduce metering in Anna Nagar in 2008 had to be abandoned for several reasons, including already existing water quality and water pressure related issues, logistical issues in fixing water meters, and political blow-back as a result of the substantially higher monthly water tariffs[76],[77].

Like efficient pricing, recycling waste water in the Indian context also presents multiple challenges. One relates to institutionalizing recycling and reuse in the existing centralized structure, where less than 30% of sewage from households is actually collected[78]. The other relates to popular acceptance. In Chennai, cultural rejection due to the so-called "yuck factor" of using recycled sewage is often mentioned as a primary obstacle to mandating recycling water at the household level, although a recent survey conducted by the Resilient Chennai team proved the contrary – that citizens are willing to support government policy on recycling for household purposes.

Compared with waste water recycling, Chennai has been more successful at implementing rain water harvesting (RWH) as a measure to conserve fresh water at the household level. However, a recent review of the city's RWH system reveals that RWH implementation

© Cynthia van Elk | Water as Leverage - A young boy carrying a water can

Water Recycling

In a recent survey with Chennai residents, more than 55% of respondents were willing to consider using waste water recycled by the government for domestic purposes in future. While describing the reason for their decision to use or not use recycled waste water only ~11% chose the 'yuck factor', contradicting what is often believed to be the primary detriment to recycling.

https://resilientchennai.com/water-survey
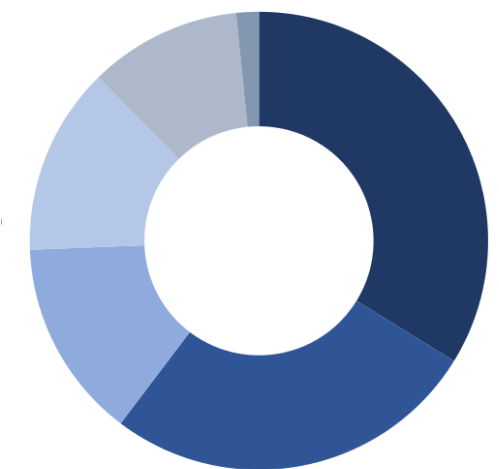
- Feel good that I am conserving water (33.79%)
- Space (13.27%)
- O&M (26.53%)
- Yuck' factor
- Price (14.06%)
- Other (mostly trust issues) (1.59%)

Figure 13: Factors influencing decision to recycle water

was actually rushed, and the systems were poor and malfunctioning. Currently, around 50% of RWH structures are believed to be functional and the ordinance is not being monitored or enforced effectively[79].

Another barrier to conserving fresh water is the poor monitoring and enforcement of restrictions on groundwater extraction by end-users, as result of which the city's groundwater table is depleting between 10 cm and 20 cm every year, approximately[80]. The 1987 Chennai Metropolitan Area Groundwater (Regulation) Act obligates obtaining permission and licenses to sink wells, and to extract or use or transport groundwater. The rules do not apply to domestic users. However, monitoring and enforcement of this regulation is poor. Since illegal ground water extractors face no consequences, hardly any new permit requests have been received or permissions granted by CMWSSB since 1996 (CMWSSB, interview, 2018).

In sum, the current state of Chennai's water system is inadequate and inefficient due to poor public management and planning as well as a lack of civic responsibility. This poor state of water systems also explains why the two most frequently experienced disasters in Chennai (those that are natural but aggravated by man-made processes) are water-related: floods and droughts.

⊕ **RESILIENCE OPPORTUNITY**

Rainwater Harvesting and Groundwater

Water levels in the groundwater table increased by almost 50% as a result of RWH between November 2004 and December 2007.

CHENNAI CITY AVG. WATER LEVELS BEFORE RWH

CHENNAI CITY AVG. WATER LEVELS AFTER RWH

5.37
5.81
6.83
4.85
4.30
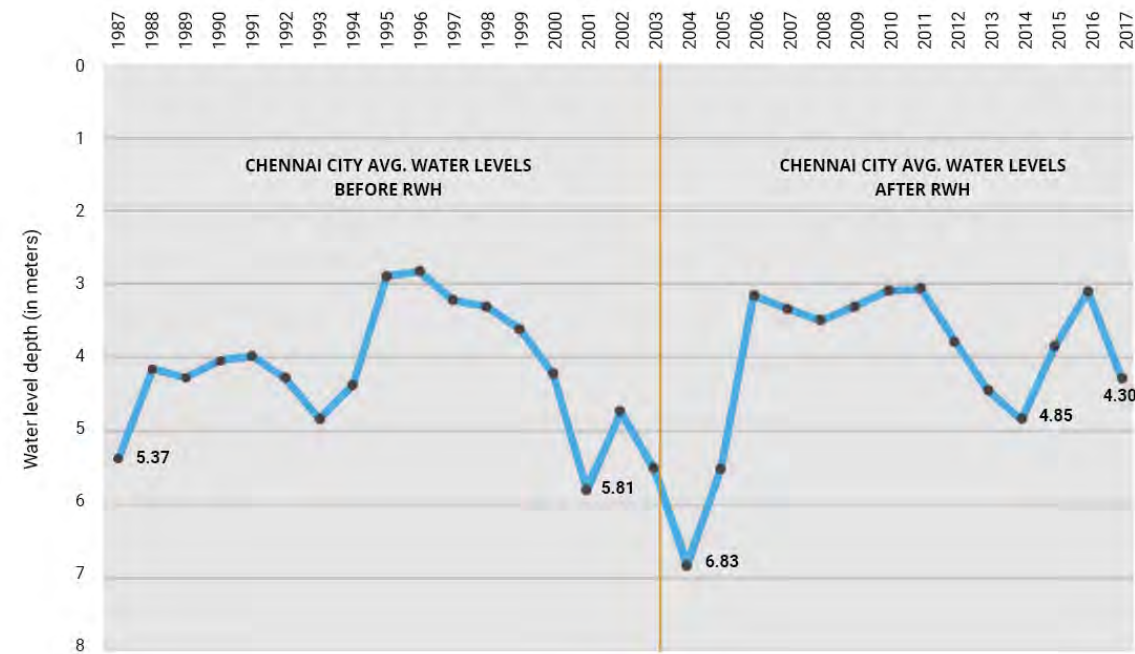
Figure 14: Average groundwater levels in Chennai city before and after Rain Water Harvesting
Source | CMWSSB Interview September 2018

Top: © Veethika/Wiki – Aerial view of Chennai during the November 2015 Floods; Bottom: © Niranj Vaidyanathan – Parched land at Pallikaranai Marsh, April 2015

DISASTER MANAGEMENT REGIME

In addition to floods and droughts, Chennai is also at risk of earthquakes (according to the National Centre for Seismology, Ministry of Earth Sciences, the city is classified under Zone III[viii]) and the related risk of tsunamis. Nuclear accidents are another risk due to Chennai's proximity to Kalpakkam Nuclear Power Station.

As a coastal city at a low elevation (averaging 6.7 meters above sea-level) with three rivers flowing through it, Chennai has always been vulnerable to storm surges and floods during times of heavy rainfall. However, climate change related sea-level rise (projected to be 1.3mm per year along India's east coast)[81], intensified cyclones, and changing rainfall patterns seem to have exposed Chennai to frequent droughts and higher flooding risk from both the coastal and the inland sides[82] (see *Figure 15*). Interestingly, while Chennai floods attract more attention from government, citizens, and the media, the city is actually more prone to droughts.

[viii] *Earthquake prone areas of Indian have been categorized into four seismic zones – II, III, IV, V by the Bureau of Indian Standards, under the guidance of the Ministry of Earth Science, Zone V is seismically the most active while Zone II is the least active.*

CLIMATE PROJECTIONS FOR TAMIL NADU

DECLINE IN PRECIPITATION BUT INCREASE IN EXTREME EVENTS

- Seasonal mean rainfall likely to reduce in South Asia
- More extremes in precipitation events in East, South and South-East Asia
- Increased risk of flooding (Hijoka et. al 2014)

RISING SEAS AND RIVERS

- Increase in mean sea level between 0.19m and 1.2m along the coast of Tamil Nadu
- More extremes in precipitation events in East, South and South-East Asia
- Increased risk of flooding (ISRO 2012; DoE 2015)

INCREASING TEMPERATURES

- Surface air temperatures projected to increase 1.6 °C - 2.1 °C
- Increase in lowest and highest extreme temperatures (MoEF 2010; DoE 2015)

Figure 15: Climate projections for Tamil Nadu [83, 84, 85, 86]

CHENNAI DISASTER TIMELINE (1985 - 2017)

● CYCLONE ● FLOOD ● TSUNAMI ● DROUGHT

1985

FLOODS

Crossing near Nellore, Andhra Pradesh, with a maximum wind speed of 80-90 km/hr, the 1985 cyclone triggered heavy rains. Chennai received 650 mm in 3 days and 900 mm in total. It was one of the greatest flood events in Chennai's history as the rains caused the Adyar river to flood with a water flow of 1784.16 m3/s (63,000 cusecs) and submerged the encroached flood plains.

Marmalong Bridge, Saidapet submerged, 1985 | Source: Hindu Archives

1996

Chennai received more than 700 mm of rainfall over three continuous days. It also registered a record-breaking high (at that time) of 17.4 cm in 24 hours (surpassed by the 2005 floods). The heavy rainfall caused flooded roads, electricity was cut off and people were marooned at home for more than three days.

FLOODS

1998

FLOODS

Chennai received incessant rain during this year. It is recorded as one of the few catastrophic floods which caused heavy damages. The flood submerged some of the residential colonies along the flood plain of Adyar river.

Residents around a water tank, 2003 | Source: Hindu Archives

2000

2004

The state and city experienced a rainfall deficit over three years: 2000, 2001 and 2002. There were no improvements in ground water levels till September 2005, resulting in drinking water scarcity in Chennai and other parts of the state. The droughts were so severe that domestic water supply through pipelines was stopped in Chennai, with the city switching to mobile supply. Water supply was restored in 2005 after heavy rains.

DROUGHT

Water from quarries to reduce impact of drought

In a special drought measure, CMWSSB's Special Drought Team identified abandoned quarries around the city with stored rain water to meet the city's water demand*. Twenty quarries at Sikkarayapuram near Mangadu in Kanchipuram district were identified as water sources after conducting feasibility and water quality tests. Pipes were laid to convey the water from the quarries to Chembarambakkam water treatment plant for appropriate treatment and then supplied for distribution*. Approximately 3000 million litres was withdrawn from the quarries which benefitted nearly 0.4 million people in Mogappair, Alandur, Valasarawakkam, Porur, Ramapuram, Nandambakkam and adjacent areas**. CMWSSB identified additional quarries in Erumaiyur, Nanmangalam, Pammal, Pallavaram, Thiruneermalai, and Nallambakkam for feasibility studies**.

CMWSSB Press Release No. 40/2017, dated 08.06.2017
*** CMWSSB Press Release No. 57/2018, dated 08.10.2018*

The state government declared a 'hydrological drought' for 24 districts including Chennai, and its neighbouring districts of Kanchipuram and Thiruvallur in March 2019, as the reservoirs that supply water to the city are currently at, approximately 10% capacity due to a rainfall deficit of 55% in the 2018 North East Monsoon[87]. It is projected that, instead of the usual 650 MLD (which itself is below Chennai's needed 850MLD), water supply could reduce further in June[88, 89].

These events and their impact on citizens and infrastructure are further aggravated by human processes such as rapid urbanization, which disturbs natural land and waterscapes; lack of integrated urban development planning that takes environmental concerns into consideration; institutional fragmentation in water and floods management; and limited foresight in considering future risks such as climate change/sea-level rise and incorporating disaster response plans into development plans. Thus, while many insist that the December, 2015 flooding event was caused by record-breaking rainfall, the scale of devastation was in fact enhanced by man-made decisions and processes (see Table 2).

© REUTERS/Stringer – Policemen remove tree uprooted by strong winds, Cyclone Vardah, 12 Dec 2016

BOXING DAY TSUNAMI

2004

A series of high and long sea waves hit the coast of India's southern peninsular on 26th December 2004. The sea waves were caused by an earthquake of 9.0 magnitude originating off the west coast of Great Sumatra (3.29°N and 95.94°E), Indonesia with a focal depth of 30 km. While the earthquake did not cause any damage to the mainland of India, it triggered a massive tsunami that impacted the entire south eastern coast.

Coastal communities in Chennai were inundated with waves up to 30m high. The tsunami caused severe damage to 25 kuppams in 4 coastal revenue villages, affected 73,000 people and resulted in evacuation of 30,000. Around 206 human lives were lost, 9 injured and 17,000 houses damaged, apart from other property. The government undertook immediate relief measures to assist families that lost family members and who were homeless.

Aerial view of Marina Beach during the Tsunami | Source: PTI

2005

FLOODS

The city and state received unprecedented heavy rains during the northeast monsoon from November-December. Chennai city received 35% more than the normal average rainfall. This resulted in flooding throughout the city and its suburbs. It was reported that 16 human lives were lost, 2525 huts - damaged completely and 47996 huts - partially damaged. During the months of November-December city life was disrupted multiple times due to several spells of heavy rainfall. The city was back to normalcy only after 10 days from the last spell of rainfall on 4th December 2005. The state government estimated Rs.13684.16 Cr for relief and restoration work for the entire state.

CYCLONE FANOOS

Cyclonic storm 'Fanoos' made landfall as a deep depression near Vedaranyam, on December 10th, 2005. Wind speeds reached a maximum of 50-60 km/hr. Damage was not significant in Chennai because the cyclone weakened on landfall to a deep depression and later, a low pressure.

CYCLONE OGNI

2006

Cyclonic storm 'Ogni' crossed Chennai's coast on October 28th, 2006 and made landfall near Andhra Pradesh with a wind speed of 65 km/hr. Chennai received 300mm rainfall in two days and 500 mm of rainfall in total during the cyclone. Parts of the city were flooded for 4-5 days due to heavy rain.

Anna Salai flooded | © SR Ragunathan, Source: The Hindu

TABLE 2: LOSSES DUE TO 2015 FLOODS

SECTORS	EXTENT OF LOSS
People	Approx. 470 lives lost in the state
Housing	1.8 million displaced
Slum tenements (TNSCB)	0.49 million homes destroyed/ damaged (throughout state)
Critical infrastructure	Of the 101,000 total tenements, most were damaged because they were located in low-lying areas
Economic	22 electric sub-stations and other critical infrastructure such as airports, power stations damaged
	8th most expensive natural disaster in 2015, globally
	INR 50,000 – INR 1,00,000 Cr[ix] economic loss
	INR 15,000 Cr loss from industrial production
	INR 1,700 Cr loss to MSMEs

Source; Ministry of Home Affairs 2016[90], Idicheria et al., 2016.[91]

[ix] 1 lakh = 0.1 million; 1 Cr = 10 million

As such, the devastating floods inundated the entire city including the airport, major train stations, and roads—disconnecting the city and marooning citizens without supply of food, water, medicines, and electricity for days. The floods also had particular impact on the newly developed residential and commercial areas along Chennai's southerly IT corridor, which is situated on and near the Pallikaranai Marshland.

It took more than a week to restore normalcy and essential services, and over a month to carry out relief measures. Among the most affected were the poor and vulnerable, living in informal settlements along waterways or in public tenements located in flood prone areas, and the small business enterprises. Many small businesses were affected to such an extent that they were unable to restart their work[92].

Post floods in 2015, a strong realization emerged among Chennai-ites about the need for consistent efforts to remain prepared for such events, with special attention required for the needs of the poor, and those who live in vulnerable and risk-prone areas. While environmentally conscious planning can mitigate the risk of disasters, the

⊕ **RESILIENCE OPPORTUNITY**

The Tamil Nadu State Disaster Management Perspective Plan 2018-2030 (TNSDMP)

The Tamil Nadu State Disaster Management Perspective Plan 2018–2030 attempts to integrate disaster risk into policy-making and planning. It envisions "building a safe and disaster resistant Tamil Nadu through a systems approach, inclusive development, and mainstreaming disaster risk concerns into the development ethos of the State." It is based on the Sendai framework's multi-hazard approach and accordingly includes a list of districts that are vulnerable to different disasters from natural to chemical, biological, nuclear, and radiological. It also provides much needed information regarding vulnerable areas at a district level and a preparedness strategy for specific disasters.

city also needs to be prepared to respond to disasters. Such preparedness involves building community capacity to cope with disasters while also strengthening government ability to provide relief to citizens in an effective, coordinated, and humane fashion. Currently there is a gap in terms of a standard operating procedure and systematic communication to help communities during and post disaster events. Furthermore, gaps in technical/scientific and sociological data available on different types of disaster risks, their spatial character, most vulnerable communities, nature of vulnerability etc. limit the city's ability to remain prepared.

Backed by the National Disaster Management Act, 2005, GoTN established the state's Disaster Management Authority. Today, a dedicated department of Disaster Management within the Revenue Administration reviews and coordinates efforts related to preparedness, relief work, and capacity building.

While a tsunami in 2004 initiated development of a TN disaster response regime, it has recently gained momentum. In 2017 the GCC published a Disaster

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CYCLONE JAL

Severe cyclonic storm 'Jal' crossed the coast between Chennai and Nellore, Andhra Pradesh on November 7th, 2010. The maximum wind speed recorded was 60-70 km/hr in Chennai and the city received an average rainfall of 70mm. Only a few places in Chennai were impacted with flooding and power disruption. However, around 10,000 families living in low lying areas in the city were moved to safer locations.

2010

An informal settlement under water | Source: The Hindu

Fisherman's hut inundated | Source: UNI PHOTO

CYCLONE NILAM

Severe cyclonic storm 'Nilam' hit the south-east coast at Mamallapuram, about 60 km south of Chennai, on October 31, 2012. The maximum wind speed was nearly 100 km/hr. Chennai received 120mm rainfall during the cyclone. Nearly 4000 people were evacuated. The cyclone uprooted several trees, damaged electric poles and traffic signal posts and disrupted telecommunication services in some parts of the city. The city returned to normalcy within a day.

2012

Cyclonic storm 'Nisha' crossed the Tamil Nadu coast close Karaikal with a wind speed of 75 km/hr on November 27th, 2008. Chennai city and its suburbs received heavy rainfall of about 400 mm in 4 days from 25 Nov - 28 Nov 2008. Throughout the state, at least 180 people lost their lives, over 20 lakh people were displaced and nearly 40 lakh were affected. Several lakh hectares of crops and public infrastructure worth several hundred crores were damaged. The extent of damage in the city included severe inundation of residential colonies and subways, and clogging of storm water drainage systems. Further, 15000 cusecs of water were released from Chembarambakkam reservoir, adding to the flooding in the city. Inundation in the city and its suburbs lasted for more than one week.

Very severe cyclone 'Thane' made landfall on December 30, 2011 about 150 km southeast of Chennai between Cuddalore and Puducherry. A wind speed of 140 km/hr was recorded during this period. The cyclone uprooted several trees, caused coastal inundation of 500 mts along Marina beach, damaging many fishing boats. Disruptions in traffic on East Coast Road and flight and train services took place for several hours and displaced thousands of people. While no human lives were lost in the city, it was reported that 46 people died across other districts in the state.

2011

A family watches the cyclone on Elliot's Beach | © M Karunakaran, Source: The Hindu

Tanker 'Pratibha Cauvery' ran aground on Elliot's Beach during the cyclone | © V Ganesan Source: The Hindu

2008

CYCLONE NISHA

CYCLONE THANE

Management Plan that discusses how to manage flooding, required mandatory maintenance works for various infrastructures, and post-event measures including information on relief centres. This document also includes a disaster management plan for each zone, with each plan providing maps of roads that are prone to inundation and that were inundated during the 2015 floods.

In 2018, the State Disaster Management Perspective Plan was prepared; it focuses on pre-disaster activities and takes a multi-hazard approach. Many city officials agree that the city plan which was updated in 2018 following the publication of the State Disaster Management Perspective Plan needs to be better aligned with the latter in terms of adopting a multi-hazard approach to deal with disasters that may be climate induced, geo-physical, biological, chemical, or industrial. Even amongst climate-induced disasters, in addition to focusing on floods, it also needs to recognize risks related to droughts and storm surges.

Despite these plans, effective implementation remains challenged by institutional gaps relating to a lack of

communication and coordination (for example between the Meteorological and Hydrological departments)[93], and unclear demarcation of roles and responsibilities across departments and jurisdictions.

Fragmented governance structures with limited coordination thus remain a critical and an overarching resilience challenge.

© Kannan Muthuraman - Boys play in the floodwaters on Marina Beach, 2015

Residents filling water, Mylapore | © HK Rajashekar, Source: IndiaTodayImages.com

2015

FLOODS

The city of Chennai and its suburbs recorded multiple torrential rainfall events during the annual north-easter in November-December 2015 that caused severe flooding throughout the city. The maximum rainfall recorded was 319.60mm which is the highest ever record on a single day. The floods claimed approximately 470 lives and destroyed 4.92 lakh houses in the entire state. While Confederation of Indian Industry (CII) and Assocham valued economic losses at Rs. 15,000 Cr, the state government estimated Rs.25,912.45 Cr for relief and restoration. It took more than a week to restore normalcy of essential services. 100% electricity supply was restored only after two weeks and relief and restoration work continued during the entire month of December.

Three consecutive rain-deficit years 2011, 2012 and 2013 and the delayed onset of the south west monsoon in 2014 created a drought-like situation in several parts of the State. Chennai managed its water supply without reducing the quantity supplied by augmenting through sources such as the desalination plants and the Veeranam lake. The city received normal rainfall during the northeast monsoon 2014 bringing an end to the drought.

2011

2014

DROUGHT

Aerial view of Chennai during the floods | Source: PTI

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Tree uprooted by Cyclone Vardah | Source: AFP

2016

Vardah, a tropical cyclonic storm and the most severe in two decades, made landfall on the coast of Chennai on December 12th, 2016. The city and its suburbs were lashed by strong gusty winds with a speed of more than 140 km/hr. The average rainfall recorded was 119.10 mm. An estimated 12 people lost their lives while 13,578 people were affected by the storm. Industries estimated a loss of $1 billion (Rs. 6749 Cr). GCC's disaster report assessment further recorded that immense damage was caused to avenue trees, roads, street lights, electricity installations and storm water drains. The state government estimated INR 22,573 Cr for relief and restoration work. Water and electricity supply was restored to normal levels within a week, but it took longer to restore telecom services, remove all uprooted trees and clear road blocks.

CYCLONE VARDAH

DROUGHT

Chennai city and surrounding areas have faced monsoon deficits from 2016 through 2018. The rainfall deficit in 2016 was 62% over the state of TN, while in 2018, deficit ranged between 19% and 59%. This has led the State government to declare a drought in Chennai, Kanchipuram and Thiruvallur in March 2019. All four reservoirs supplying water to Chennai have almost dried up. Sources such as Veeranam lake and stone quarries from Kanchipuram and Thiruvallur district are being used to augment supply. The State government sanctioned Rs. 40 Cr to CMWSSB to combat water shortage. A large part of this was used to arrange for drinking water supply through lorries, drilling of new bore wells, and hiring of agricultural wells.

2016

2019

Water tanker strike | © M Karunakaran, Source: The Hindu

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GOVERNANCE IN SILOS

Chennai's governance structure is, at present, characterized by multiple agencies with overlapping responsibilities and jurisdictions and unclear role assignments. For instance, while CMWSSB uses reservoirs/tanks to supply water to Chennai citizens, these tanks are owned by PWD which means CMWSSB depends on PWD to clean/desilt these reservoirs efficiently. Further, old village revenue maps —available with the PWD— show that all water bodies and natural drainage channels were not incorporated into the Second Master Plan, which is the primary planning document for the Chennai Metropolitan Area (CMA). Instead, the Second Master Plan includes maps that mark substantial sections of these water bodies and natural channels for "other uses", which in turn makes it difficult to protect them.

These examples highlight the degree of, and need for coordination and collaboration between agencies to enable efficient water management in the city. In the absence of strong institutional mechanisms to support such coordination this becomes a major challenge.

Besides limited inter- and intra-agency interaction and data sharing, Chennai's fragmented institutional structure is also characterized by frequent change in leadership. For instance, the Managing Director position at CMWSSB has been held by seven bureaucrats since 2011. The frequent transfer of Indian Administrative Service (IAS) officials to different portfolios affects continuity and compromises long-term planning within agencies. In addition, a predominance of para-statal[x] agencies, and the continued state-level presence

in urban decision making on a significant scale, also poses limits on empowering local-level governance structures, which are expected to be more committed to local needs.

Another key challenge for Chennai relates to the current system's capacity to enforce and monitor rules and regulations. While the GoTN and the GCC have enacted several regulations relevant to managing urban development and protecting environmental resources and human lives, the extent to which these are implemented needs to be strengthened. Some crucial but poorly enforced regulations include the Solid Waste Management Rules, 2016, the Amendments to Section 215 (a) of the Tamil Nadu District Municipalities Act, 1920, and the Building Rules, 1972 (which makes it

x Para-statal agencies are usually set up at the state level and tasked with a specific purpose/area of municipal governance (such as water and/or sanitation) and wield considerable influence in urban governance, thus superseding local authorities in most cases.

Water body marked as 'institutional use'

Figure 16: Water body marked as institutional land in the Second Master Plan

Source: Cadastral Map, Department of Land and Survey Settlement, CMDA Land Use Map, Google Satellite Imagery

mandatory for all buildings to provide RWH structures), the Coastal Regulation Zone Notification, 2011, and the Chennai Metropolitan Area (CMA) Groundwater (Regulation) Act, 1987 (amendment made in 2002). As these regulations are not sufficiently enforced, the city faces certain perennial problems including poorly managed waste disposal, pollution, water body encroachment, groundwater resource over-extraction, and a loss of biodiversity. Public departments, in turn, face enforcement and regular monitoring challenges in terms of capacity, finance, and human resources.

In any case, irrespective of resource availability, government alone cannot run a city effectively without strong collaboration from public agencies, private entities, and citizens. While Chennai has several well-established industrial, academic, non-profit, and technical institutions, interaction across these, and between them and the public, remains limited[94]. Engaging the public in decision-making processes has also been relatively weak. For instance, public consultations, the most common institutional mechanism through which citizens are invited to engage with the state, is more often than not used as a platform for providing feedback or grievance redressal, rather than active participation in decision-making processes[95]. Partly due to lack of time and partly to avoid major contestations, such consultations are in fact

organized but not sufficiently advertised, and often held in locations that are hard for relevant stakeholders to access. For instance, a public consultation for restoring the Buckingham Canal was scheduled for a weekday, with one day's notice. The consultation was attended by around 30 people, most of whom were government officials. The remaining attendees were a few college students from nearby colleges who reportedly were asked to join at the last moment to increase the crowd size[96].

While the 73rd and 74th Constitutional Amendment Acts of 1992 and 1993 provides constitutional status to grassroot institutions, the rural Grama Sabha and urban Ward Committees were constituted for the involvement of people in governance processes[97]. Even though the 73rd Amendment Act gave concrete shape to the Grama Sabha, the Ward Committee was left to the state to design for themselves[98]. The GCC formed Ward Committees under the Chennai City Municipal Corporation Act, 1919 which was amended in the year 2010 to allow for the formation of Ward Committees at the zonal level, rather than at the ward level, with members consisting of elected representatives—or ward councillors—for particular zones, and a Chairman who was elected by the ward councillors within each zone. As such, these Ward Committees do not include any Residential Welfare Associations (RWAs), non-profit

organizations, or citizens in general, but are populated instead by executive members. This does not automatically guarantee devolution of power to the people.

Such institutional limitations pose major roadblocks for citizens who want to take control of or engage with city decision-making processes. Also, another major roadblock relates to citizen awareness, responsibility, willingness, and trust that they can make a difference. Irrespective of public efforts, building resilience is bound to be challenging in a city of 8.65 million people without their support or involvement.

In a citizen survey of 478 respondents conducted by Resilient Chennai, 66% vouched that there was ample scope for citizens to engage with government and 93% said there is a need for citizens to engage with government, and showed interest in learning about the city's functions, civic issues, and in contributing. However, almost 60% of survey respondents said they do not actually interact with government at all. Respondents who do interact do so mostly through local organizations and RWAs. Many were unaware of available avenues for engaging with government such as telephone helplines, online portals, and the Namma Chennai mobile app, which can be used for lodging complaints and seeking redressal. Survey results showed that about 84% of the 478 respondents do not use the Namma Chennai app.

Furthermore, 77% of respondents did not interact with ward or zonal level staff, and a similar percentage of them, about 75%, were not part of any social media group

RESILIENCE OPPORTUNITY

Civic Engagement

A large potential exists within Chennai in the form of a growing student population, an active battalion of RWAs (although they predominantly represent the middle-class), and non-profit organizations. Some of them specifically voice the needs of vulnerable groups, such as Information and Resource Centre for the Deprived Urban Communities (IRCDUC), *Pen Urimai Iyyakkam,* and the North Chennai Christian Network. Potential also exists among corporations who can make Corporate Social Responsibility (CSR) contributions. This potential is not fully tapped but will need to be, to ensure future resilience in Chennai's governance system. Facilitating mechanisms are needed for these groups to come together, share, co-plan, and co-benefit alongside public agencies.

Fort St. George, Seat of Tamil Nadu Government; Source: DC/File
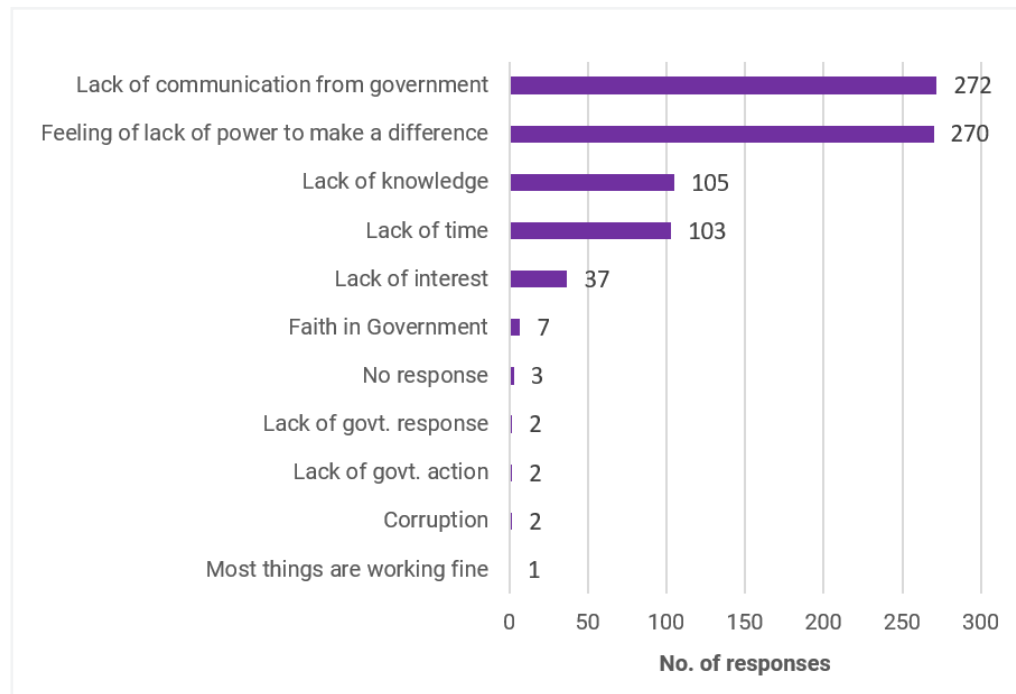
Figure 17: Reasons for citizens not engaging with the government | *Source: Resilient Chennai Citizen Survey, 2018*

discussing/addressing local civic issues. Respondents picked "feeling of lack of power to make a difference" and "lack of communication from government" as the two primary reasons for not being more involved with government (See *Figure 17*). This highlights the need for raising awareness, using positive and negative incentives, and building trust amongst citizens so that they are more proactive and responsible. Efforts to leverage different forms of public-private collaborations between government agencies, citizens, and corporate representatives are critical for optimizing efforts to build a city's resilience.

Special attention is also needed to incorporate the voice of the nearly 30% vulnerable citizens living in informal settlements across the city as it is this population that faces the greatest brunt of a city's resilience challenges, whether relating to urbanisation, water crises, disasters, or the city's governance.

Top: © PlaneMad/Wiki - Public Works Department; Bottom: © Kilpauk Water Works | Source CMWSSB

UNEQUAL IMPLICATIONS FOR CHENNAI'S VULNERABLE COMMUNITIES

© Cynthia van Elk | Water as Leverage - Nochikuppam, TNSCB tenements along Marina Beach

Madras/Chennai has historically been known as a city of slums. Rather than a negative characterization, this image suggests that the city has, since its early days, been shaped by a strong presence and defiant inclusion of low-caste migrants into its urban form. While economically weaker sections contribute significantly to Chennai's economy, they remain vulnerable to and invisible in city planning and governance. Chennai's urban land-use development and water resource management-related limitations affect the city's poor and disadvantaged the most; or instance, by failing to provide affordable housing options within the current city fabric, or by forcing them to shoulder a greater burden of ecological shocks like floods by relocating them to distant locations.

Chennai housing demand, as estimated by the Second Master Plan for the year 2016, is around 659,479 units. Of this, Economically Weaker Section (EWS) and Low-Income Group (LIG) together (at 65% of the total demand) account for 428,662 units. While the state alone cannot meet this demand, the government has offered 50% additional Floor Space Index (FSI) for builders constructing low-income housing projects and has mandated that developments on properties exceeding one hectare should reserve 10 per cent of the developed land for LIG and EWS dwelling units. However, these measures have not yielded enough positive results.

As such, failure to provide adequate affordable housing options for the city's diverse poor groups (including migrants, the physically or mentally disabled, older people, transgender populations, etc.) has forced them to live in informal settlements or slums. Nearly 20% of the Tamil Nadu Slum Clearance Board (TNSCB) notified slums are situated along the low-cost but disaster-prone flood plains around Chennai's lakes and river banks accounting for the 'untenable' slums—slums unfit for habitation and hence marked for relocation[99] (see *Table 3* for slum population growth).

The range of vulnerabilities faced by these weaker sections of Chennai society goes far beyond the risk of floods to include insecurity of tenure, susceptibility

TABLE 3 : SLUM POPULATION GROWTH IN THE CITY

YEAR	NO. OF SLUM DWELLERS	NO. OF SLUMS
1961	97,851 families	548
2001	178,000 families	1431
2011	329,827 families	1999
2014	304,980 families	1131[xi]

Source: CMDA 2008, Census of India[100]

to evictions, lack of access to basic services, job insecurity, unhealthy living conditions, etc.

Chennai's current vision of a slum-free city has evolved to predominantly become a programme of formalizing informal city housing through large-scale, often involuntary, relocation of slum-dwellers or other vulnerable residents to resettlement colonies, often located on ecologically fragile land in peripheral areas of the city. For instance, the Semmancheri resettlement colony on the IT Corridor houses people who were:

a. affected by the 2004 tsunami,
b. living along the banks of the Cooum river and
c. displaced as a result of Mass Rapid Transit System (MRTS) station construction[101] .

Such resettlement drives have ended up cutting the poor out of Chennai's urban fabric and segregating them into disjointed pockets with limited access to basic facilities such as water and sanitation, schools, and healthcare. Ironically, while many Semmancheri residents were relocated to the colony to reduce their vulnerability to floods, they were badly affected by the 2015 floods, since Semmancheri is situated in a low-lying area.

This resettlement model has been found to undermine the resilience of low-income and vulnerable urban households along many axes, not just on the ecological one. Many of the informal settlements typically tend to be old and well settled, since squatting on "*poromboke*" or un-assessed common lands along river or lake

xi This row represents the population of only 1131 slums out of the total 2173 slums.

RESILIENCE OPPORTUNITY

Winners Bakery

The Winners Bakery is an initiative which provides youngsters from disadvantaged backgrounds a chance for a real career, even if they are unable to afford a formal education or were forced to drop out of school. The Bakery also provides employment and training to the differently abled.

Started in 2005 by the Chennai Culinary Institute and the Rotary Club of Madras East, in association with the GCC, Winners Bakery runs a rigorous 6-month training programme in baking and confectionery making. Trainees receive a stipend during this period, with food and transportation expenses taken care of. Upon completing the course, they go on to seek gainful employment either at the bakery, or elsewhere. Around 120 students have completed the course till date.

At the bakery, the team bakes 60 kgs of cakes, 43 other bakery items and 55 confectionery products daily. The bakery has received widespread acclaim and enjoys an ever increasing customer base because of its quality, charm, and profound act of giving back to society by supporting GCC's education initiatives over the years to the tune of more than INR 2.5 million, with proceeds generated through sales.

RESILIENCE OPPORTUNITY

The value of 'Sites and Services' (S&S) model

S&S projects were implemented in Chennai between 1977 and 1988 by the Tamil Nadu Housing Board (TNHB) under the Madras Urban Development Projects (MUDP) I and II, and funded by the World Bank. This approach to housing formalisation provided small plots with tenure security, adequate infrastructure, and low-interest credit to households, allowing them to invest in improving their own housing. The schemes catered to a mixed socio-economic group and made significant advances in providing affordable shelter to large numbers of the urban poor, covering over 76,000 slum households over 10 years.

Today, many S&S sites in Chennai are solidly built, vibrant and dynamic lower middle-class neighbourhoods where residential spaces are closely enmeshed with livelihood spaces such as shops, saloons, and workshops and with community infrastructure such as schools, temples, and meeting halls. These sites (e.g. Arumbakkam, Villivakkam, and Maduravoyal) have emerged as some of the most successful models of housing formalisation, yielding resilient and sustainable urban neighbourhoods which have offered their residents strong opportunities for social and economic mobility over a relatively short period of time.

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banks was a common strategy by which migrant laborers found shelter in Chennai from its early days. Given the long history of these settlements within the current urban form, most of them are well-established spaces, well connected to jobs, healthcare, and educational opportunities, where families have invested over time and have a well-supported social network. In many cases, communities have successfully negotiated with authorities to obtain amenities such as water supplies (street or in-house piped), roads, street lights, and household electricity connections. Uprooting these communities, particularly when they are resettled in peri-urban locations, disconnects them at once from income sources, education opportunities, and family healthcare, subjecting them to a sense of extreme disempowerment, loss, and neglect.

Resettling families in cases where communities of origin were not well established with access to basic amenities is debilitating as well, because the new homes are typically in distant areas, have poor access to public transportation, and have limited alternative job opportunities. Furthermore, the process of eviction is particularly harsh on those evicted. Families are often informed too late or misinformed about their relocation site. There is very minimal involvement of those to be resettled in the resettlement and/or eviction planning process.

However, TNSCB recognizes the pitfalls of this approach and is reconsidering the MUDP 'Sites and Services' model as a more effective and socially responsible approach to dealing with informal settlements.

Both with in-situ redevelopment and resettlement efforts, households have been subjected to vertical resettlement into high rise buildings. However, this model has also raised major concerns among beneficiaries, as residents feel their need for more common space, access to water tanks, working lifts etc., are not met.

While challenges and needs relating to low income communities, especially those living in informal settlements, are better understood, these communities represent only a sub-section, and often a better-off section of vulnerable groups in the city. Other segments of the population, including those classified by their occupation (migrant workers, manual scavengers, families involved in sex work), their gender (destitute women and transgender), their age (elderly, children and youth), their disability, or their caste are also highly vulnerable. This is owing not only to their condition, but because less information is available about them and the barriers they face in accessing services such as water, sanitation, health care, education, and housing. Collectively, these urban residents may never even find their way into a slum or may remain invisible, yet there are isolated examples of efforts to address their needs.

Therefore, much effort is needed to identify these relatively more invisible groups, and gather comprehensive data that can inform planning for resilience of vulnerable populations in Chennai.

Overall, while Chennai faces several resilience challenges with respect to its people, environment, development, and management, opportunities also remain tucked away within these challenges. The resilience opportunities highlighted in this section indicate, based on current trends, what Chennai can learn from the past, or do, to build its resilience.

THE FUTURE OF CHENNAI'S RESILIENCE CHALLENGES

In January 2018, the Government of Tamil Nadu proposed to expand the Chennai Metropolitan Area (CMA) eight-fold from the current 1189 sq. km to 8,878 sq. km. This proposal, if implemented, would make Chennai the largest metropolitan area in the country after New Delhi, urbanizing 1,709 villages in the adjoining Kanchipuram and Tiruvallur districts[102]. According to the Chennai Metropolitan Development Authority (CMDA), this proposed expansion was spurred by anticipated population growth. This, in turn, necessitates better infrastructure, distribution of physical city growth, and land utilization in Tiruvallur and Kanchipuram districts, if the city wants to attract investment and experience balanced urban development.

However, the Chennai public has expressed concern over this proposal, particularly in light of existing challenges relating to the city's urbanization process, governance, and environment, and specifically water systems that unfairly affect the city's poor and disadvantaged. In April 2018, three public consultative meetings were held in Tiruvallur, Kanchipuram, and Chennai where citizens consistently raised concern about the city's ability to cope with current challenges and how these would manifest in an area (potentially) eight times the current size. While the expansion is described as just a statement of intent of the government (CMDA interview 2018) that is yet to be finalized, it is imperative that Chennai's resilience building efforts begin to acknowledge the possibility of expansion and

prepare accordingly. The city of Chennai can turn this into an opportunity by:

i. Carrying out transparent and exhaustive consultations and deliberation among all stakeholders about the proposed expansion plans in order to arrive at an acceptable formula;
ii. Ensuring access to basic services such as water, sanitation, and solid waste management;
iii. Engaging in urban planning that has a clear strategy and mission, and development plans that lay out ecologically sensitive areas, protect agricultural lands (to the extent possible), and identify heritage structures, as well as include well planned transport corridors, housing for vulnerable communities, disaster mitigation and management plans, and so on; and
iv. Establishing clarity in the roles of institutions such as the CMDA, TNSCB, Housing and Urban Development Department, Urban Local Bodies (ULBs) such as corporations, municipalities, Town and Village Panchayats, the Revenue Department, PWD, Highways, etc., and well-designed means of interaction between these agencies in order to ensure effective inter-departmental coordination.

Implementation of this resilience strategy would be an essential step in this direction.
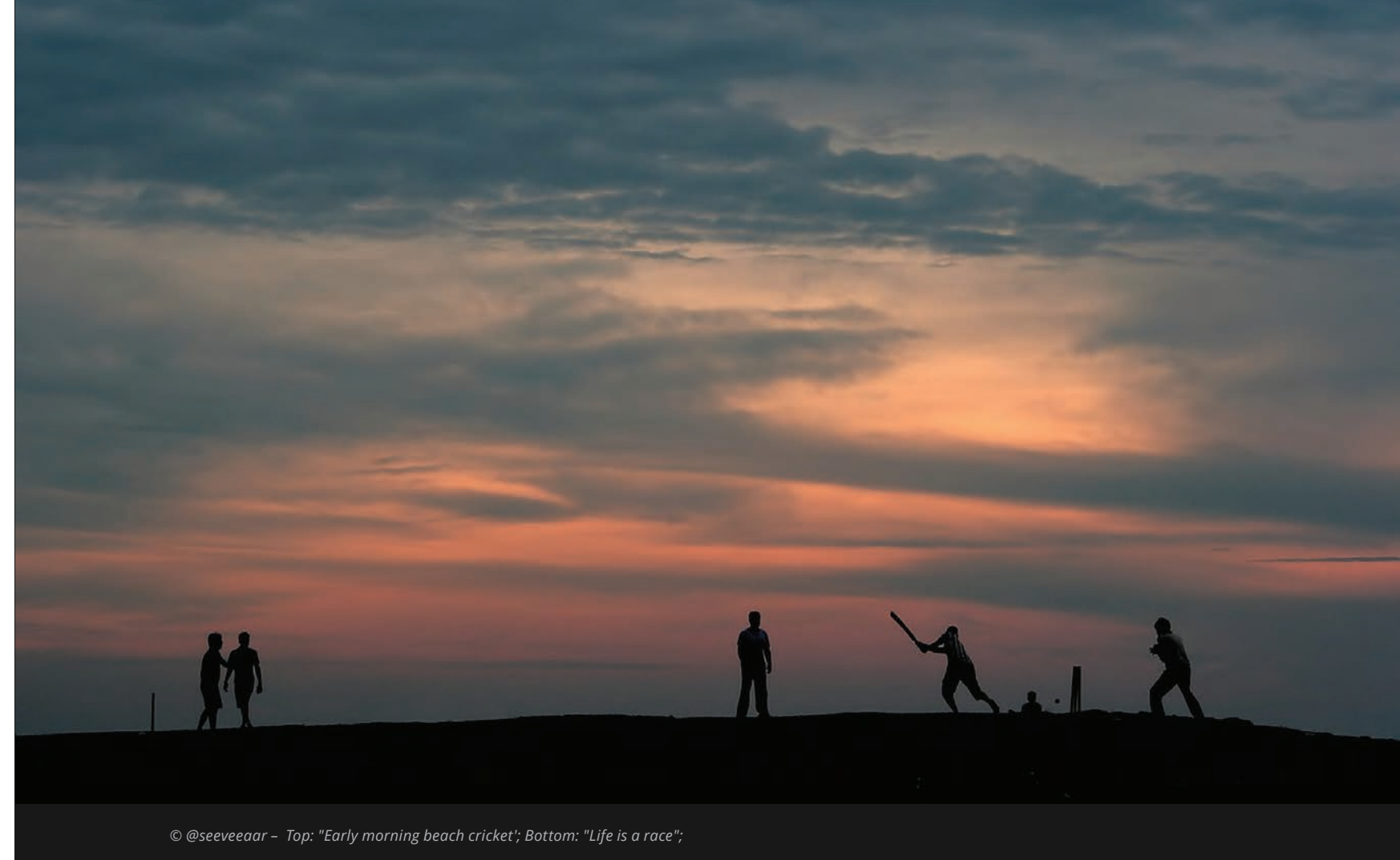
© @seeveeaar – Top: "Early morning beach cricket"; Bottom: "Life is a race";

PART B

developing the Resilient Chennai strategy

The 100 Resilient Cities process has been used to develop the Resilient Chennai Strategy.

WHAT?

This strategy proposes pathways to ensure resilience of Chennai's people and infrastructure, both natural and man-made, to reduce the impact of, and respond and readjust to current and future disasters and stresses.

FOR WHOM?

This is a leadership document to help city leaders from public, private and civic domains to collaborate and guide their organisations to respond to the key shocks, stresses and challenges of Chennai over a 5-year horizon. This strategy has built on the experiences and knowledge of multiple stakeholders from government, non-government, academic, civic, and private agencies and has been designed to be aligned to existing state, metropolitan, and city policy and planning documents. As such, this is a resilience strategy of Chennai leadership, by Chennai leadership, for Chennai leadership to work in partnership with citizens, government, and the private sector to translate strategy into action.

HOW?

This strategy has prioritised: integrated understanding of problems and solutions; multiple stakeholder involvement/co-owned strategy; and a multi-criteria driven approach to assess relevant solutions to resilience challenges.

Integrated **understanding of problems and solutions:** The resilience challenges and solutions are examined and understood in an integrated manner so the complex interlinkages of various shocks and stresses, natural as well as man-made, are taken into consideration.

Co-owned **prioritization of challenges and solutions:** Multiple stakeholders have collectively formulated resilience challenges and identified potential solutions ensuring that the strategy is co-owned by citizens and city's leaders from various sectors.

Multi-criteria driven **approach to finalize strategy:** Final set of proposed interventions have been selected based on multiple criteria, such as a) the nature of the intervention (infrastructure, policy, capacity building etc); b) alignment with current policies at local, state, and national scale; c) stakeholder priority and d) potential for cross-cutting implications to address multiple resilience challenges. As such, the actions presented in this strategy cover a wide range of suggestions that is capable of offering a holistic approach to build Chennai's resilience.

© Nagesh Jayaraman, Cyclist in Cyclone, Chennai
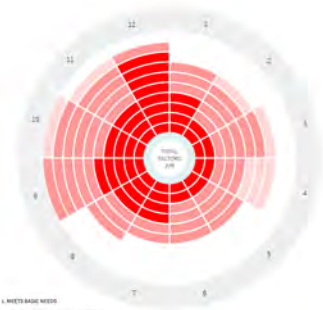
Perception of resilience strengths and weaknesses by stakeholders in Chennai

Average rating, participants rated from 1 (not a challenge) to 5 (most important challenge)

| | 2.50 | 3.00 | 3.50 | 4.00 | 4.50 | 5.00 |

GARBAGE
ENCROACHMENT
WATER
SEWAGE
TRAFFIC
DISASTER
HOUSING
UNEMPLOYMENT
LIQUOR
TRANSPORT
ELECTRICITY
SOCIAL DISHARMONY
EPIDEMICS
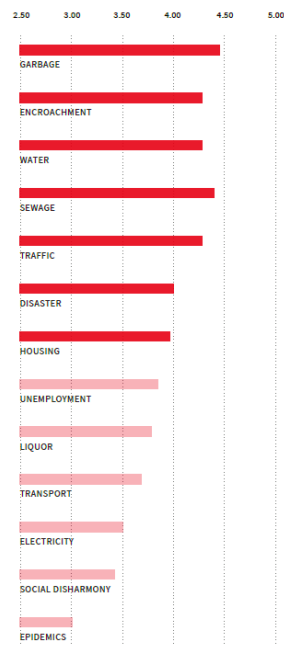
Results from the Citizens Perception Survey

Resilient Chennai
Summit on Urban Flooding
WORKSHOP SUMMARY REPORT

PHASE I: Preliminary Resilience Assessment

2014 — Selection

Chennai was selected as part of the second cohort of cities to join the 100 Resilient Cities (100RC) network.

JULY 2015 — Agenda Setting Workshop (ASW)

Through presentations and discussions, the workshop supported participating stakeholders "to achieve a common understanding of the definition of resilience for Chennai, prioritize shocks and stresses that are important to the city, identify 'drivers of resilience' along 100RC's multi-dimensional City Resilience Framework in which Chennai either excels or requires improvement, brainstorm key stakeholders who are critical for the process of building a resilience strategy, and envision Chennai's future Chief Resilience Officer."

JANUARY 2016 — Urban Flood Summit

The summit engaged a diverse range of international and local experts to share best practices and identify high-impact solutions.

JULY 2017 — Chief Resilience Officer (CRO)

The Greater Chennai Corporation, in partnership with 100 Resilient Cities, appointed a Chief Resilience Officer for the city.

PRELIMINARY RESILIENCE ASSESSMENT

FEBRUARY 2018 — Preliminary Resilience Assessment (PRA)

The PRA marks the completion of Phase I work. It is a result of inputs from the agenda-setting workshop (ASW), citizen survey, working group meetings, expert survey and interviews. Thus the document provides an overview of the learnings from Phase I and highlights priority areas (known as 'discovery areas') for further investigation during Phase II. These include, 'Water Systems, Metro Governance, Civic Engagement, Vulnerable and Low-Income Groups, Healthy and Planned Urbanization and Financing Urban Resilience'.

Engaged over 25 city leaders (i.e. corporate, government, civil society, and academia) to understand city's strengths and weaknesses

Engaged 4 city champions from different stakeholder groups to validate our findings and hypotheses

Expert Survey

Expert interviews

Citizen Survey

Working group

Engaged over 1800 citizens from across the city including over 500 from vulnerable communities to understand the city's major shocks & stresses

Engaged over 40 technical experts in the area of water, disaster management, civic engagement, informal settlements & unplanned growth

DECEMBER 2017 — Citizen Survey, Working Group, Expert Survey and Interviews

To arrive at the PRA, the CRO and his team engaged a broad range of stakeholders from civil society, industries, academia, and government agencies through multiple means.

PHASE II: Strategy Development - Deep Dive

Scope of Work

Phase II started with the preparation of a Scope of Work. Five out of the six Discovery Areas (DAs) were chosen for in-depth assessment, including Healthy Urbanisation, Water Systems, Governance Ecosystem, Vulnerable Communities, and Civic Engagement. Working Group members and Leads for each discovery area were identified and contacted to initiate Phase II work.

Citizen Survey: Namma Chennai – Water & Civic Engagement

The Water Survey engaged more than 600 citizens from across the city including over 85 citizens from informal settlements and different socio-economic backgrounds. Through electronic questionnaires and face to face interviews, the survey ascertained consumer willingness to utilize recycled waste water for domestic purposes and the extent and impact of RWH systems.

The Civic Engagement Survey conducted in a similar manner engaged more than 500 citizens in the city including over 75 citizens from informal settlements. The survey's intent was to gauge civic consciousness and engagement with governance processes.

Discovery Area Reports

The five DA reports presented the result of extensive secondary research, expert interviews, citizen survey for water and civic engagement and working group workshops. The secondary research included comprehensive compilation and analysis of existing research on current status, challenges and the list of interventions/actions to build resilience for the discovery areas. To validate the findings of secondary research and gather additional insights interviews were conducted with multiple government departments, civic and academic experts. The citizen surveys and working group workshops also provided relevant findings for fleshing out the DA reports.

These DA reports are the foundation of the Resilient Chennai Strategy.

Healthy & Planned Urbanisation Workshop

Informal Settlements Workshop

Metro Governance Workshop

Water Systems Workshop
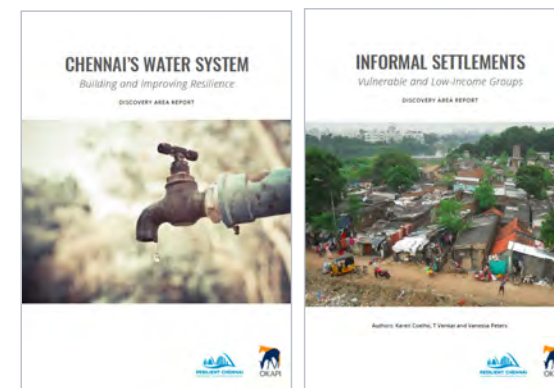
Working Group Meetings and Interviews

Working group meetings specific to the five DAs were conducted. Participants included diverse groups of technical experts, government officials, academicians and civil society representatives. These workshops were intended to engage in a brain-storming exercise to map out the relevant challenges related to each discovery area and discuss ways of addressing these challenges through technical, research-based, regulatory, and/or infrastructural interventions. The workshops also included a session on Opportunity Assessment were participants prioritized the interventions/actions appropriate for building resilience in each DA.

In addition, several one-to-one interviews were conducted with experienced government officials, academic experts, and civic leaders to gain deeper understanding of each DA and related challenges and potential solutions.

SEP - DEC
2018

Opportunity Assessment Tool (OAT)

The Opportunity Assessment Tool is a 100RC tool to assess and prioritise the actions and interventions for building resilience based on multiple criteria (e.g. contribution to CRF, ability to address various shocks and stresses, funding availability, timeframe for implementation etc). Resilient Chennai Strategy Actions, initially identified through DA work, was further assessed based on the OAT. To ensure a participatory process, working group workshop participants were asked to use a concise version of the OAT to help shortlist the Resilient Chennai Strategy Actions.

JAN - JUN
2019

Development of Chennai Resilience Strategy

The development of the city resilience strategy started after prioritizing the challenges and opportunities. The strategy underpins Chennai's overall vision, mission, goals and actions for building resilience. It also showcases the ongoing resilient efforts across Chennai while presenting concept notes to provide well-thought out ideas for future implementation.

MAY - JUN
2019

Peer Review

While the strategy is a reflection of opinions and insights of Chennai citizens, technical experts, civic leaders, and government officials, the Resilient Chennai team conducted a second level of engagement: First, by conducting one-to-one interviews specifically with government officials with the power to incorporate the strategy in policy and action, and secondly, by letting experts from different sectors peer-review the strategy document before formalization.

Vulnerability Assessment in Perumbakkam:
Ongoing community engagement
April 2019

Urban Horticulture: Rooftop vegetable garden
maintained by Tamil Nadu Corporation for
Development of Women (TNCDW)

Forging Ahead

Phase III of the 100RC programme aims to institutionalize resilience building within the city and implement initiatives to gain momentum in the city's resilience building process. Resilient Chennai has forged ahead to facilitate/initiate a number of Resilience Actions in collaboration with government, civic, corporate, and academic partners during the strategy development process. These include:

1. Water as Leverage programme
2. Chennai Urban Horticulture programme
3. Chennai Data Observatory
4. Advisory Consortium for co-building resilient resettlement process
5. Vulnerability Assessment in Perumbakkam
6. Public Service Announcements (PSA)
7. Trashonomics – Taking trash to schools
8. Chennai Against Plastics

CHAPTER 06
learnings from the 100RC network

New York City, United States

Berkeley, United States

Norfolk, United States

New Orleans, United States

Mexico City, Mexico

Medellin, Columbia

Quito, Ecuador

Rio de Janeiro, Brazil

Rotterdam, The Netherlands

Athens, Greece

Byblos, Lebanon

Ramallah, Palestine

Amman, Jordan

Resilient
CHENNAI

Singapore City, Singapore

Semarang, Indonesia

● ROUND ONE CITIES
● ROUND TWO CITIES
● ROUND THREE CITIES

NEW ORLEANS
UNITED STATES

Resilient water management & Healthy urbanisation

The city has developed a **comprehensive urban water management plan** that presents sustainable strategies for managing water and waste water resources, and flood risks, in a holistic fashion; It is also implementing **green infrastructure demonstration projects** to show how underutilized public spaces can be used to manage/detain stormwater.

Resilient vulnerable communities

In order to improve **access to safe and affordable housing,** the city launched an **integrated housing policy** to include public housing developments to be redeveloped as mixed-income communities and improve surrounding areas. The city has also revised its **comprehensive zoning ordinance** for the inclusion of affordable housing.

PG 218

MEDELLIN
COLUMBIA

Disaster preparedness

The city has formulated a **community risk management** process, empowering the community to use risk prevention technologies and techniques, and an early-warning system to reduce their risks to disaster.

Resilient vulnerable communities

Medellin's **Proyecto Urbano Integrado** (PUI) urban project upgrading model is popular as it takes a comprehensive city-wide approach to slum improvement.

PG 156

PG 178

RAMALLAH
PALESTINE

Coordination in governance

A **long-term roadmap** is being designed by Ramallah to guide the working relationships of various agencies and **improve regional collaboration** to build a collectively-planned city.

Data and technology for governance

The city is planning to develop a **centralized data system** with a comprehensive inventory of data that will support **evidence-based decisions** and promote accountability and transparency in governance.

SEMARANG
INDONESIA

Disaster preparedness

Semarang has developed a **flood early warning system** that requires **effective coordination** between key stakeholders across governmental departments and sectors, including the planning, water resources, meteorological and disaster management agencies.

BYBLOS
LEBANON

Healthy urbanisation

The city is developing a comprehensive **greening strategy** for protecting and restoring existing green open spaces, limiting urban sprawl, and providing context for the city's future planning.

PG 118

PG 136

SINGAPORE CITY
SINGAPORE

Healthy urbanisation & transportation system

The second **Land Transport Master Plan (2013)** is a long-term plan that aims at making public transport the primary public choice of transportation in Singapore.

QUITO
ECUADOR

Healthy urbanisation

In its metropolitan plan for development and land management, Quito introduced a **policy to protect the ecological area** by demarcating precise boundaries between urban territory and protected territories.

ATHENS
GREECE

Data and technology for governance and Disaster management

The city has introduced up-to-date technologies for **real-time monitoring** of extreme events.

Participatory governance

The city is also planning to create an **open data policy** to become more transparent and accountable, and encourage more citizen involvement in city governance.

MEXICO CITY
MEXICO

Coordination in governance

Mexico City plans to create a resilience baseline using a **scorecard** (ARISE initiative). This will enable the city's government departments to be evaluated based on the institution's capacity to coordinate.

Data and technology for governance

Command, Control, Communications, Computer Intelligence, Integration (C4I4) surveillance center is the most modern surveillance center opened by the city under the urban security programme.

Healthy urbanisation and Water-sensitive planning

The city is working to improve its flood-prevention capacity using **innovative water-sensitive green and blue urban design solutions.**

NEW YORK CITY
UNITED STATES

Resilient vulnerable communities

New York is implementing a **ten-year housing plan** that addresses affordable, high-quality housing coupled with robust infrastructure and neighbourhood services.

Climate adaptation

In response to Hurricane Sandy, New York prepared the most expensive **climate action plan** in 2013. This presents a strategy for the city to build back, and recommendations to adapt the city to the projected impacts of climate change.

RIO DE JANEIRO
BRAZIL

Disaster preparedness & Healthy urbanization

Rio is involved in an effort to develop **multi-hazard assessment maps** using computational models, real-time sensing, and Big Data to evaluate potential risks and guide urban development.

NORFOLK
UNITED STATES

Community outreach and awareness

In Norfolk, the **city outreach programme** has appointed a **dedicated officer** to coordinate the programme. This person regularly interacts with residents by visiting them at home, in public places, and sponsored events in the neighbourhoods to discuss important issues and hear their concerns.

AMMAN
JORDAN

Healthy urbanisation & Transportation system

The city is developing an **integrated mobility plan** to address traffic congestion, the increase in private car use, lack of mass transport and safe pedestrian infrastructure. It is also creating a **walkability map** to promote walkability.

Community outreach and awareness

The city is launching an **awareness campaign targeting school students** to address key issues of the future including climate change, resource consumption and public behaviour.

BERKELEY
UNITED STATES

Healthy urbanisation & Water-sensitive planning

The city is implementing **multi-purpose Green Infrastructure** (GI) projects to mitigate floods, protect ecosystems, remove pollutants, beautify neighborhoods, and enable the capture and use of stormwater for other purposes.

ROTTERDAM
THE NETHERLANDS

Climate adaptation

Rotterdam's **climate adaptation strategy** developed in the year 2013 is an inspiration to many cities across the world.

Healthy urbanisation

The city is also creating a **platform to host information on underground infrastructure** location, state, and more, to help various departments managing these resources to cooperate and coordinate for integrated planning.

reading the strategy & actions

RESILIENT CHENNAI

ONE VISION

To make chennai

Enlightened. Just. Integrated.

	Healthy & Planned Urbanisation	Water Systems	Disaster Preparedness	Governance Ecosystem	Vulnerable Communities
5 PILLARS	*MISSION 1* Urbanising responsibly	*MISSION 2* Carving a resilient future around our water resources	*MISSION 3* Making Chennai a prepared city	*MISSION 4* Together, we lift Chennai	*MISSION 5* Valuing the city's vulnerable
17 GOALS	4 GOALS	3 GOALS	4 GOALS	3 GOALS	3 GOALS
86 ACTIONS	24 ACTIONS	14 ACTIONS	15 ACTIONS	20 ACTIONS	13 ACTIONS

© Thangaraj Kumaravel's Marina Beach at sunset

ACTION TYPOLOGY

Actions are distinguished as Flagship Actions, Supporting Actions, or Recommendations in this strategy document.

FLAGSHIP ACTION

Four specific actions in this strategy have been identified as flagship actions for the following reasons:

1. These are concrete projects that showcase the city's strong inclination to build resilience in partnership with the Resilient Chennai Office. These actions either have the backing from relevant government departments or have the support of multiple civic and private partners;

2. These actions are capable of addressing several of the challenges the city faces simultaneously;

3. Discussion and planning for these projects are already underway;

4. Given stakeholder interest, these projects are the priority resilience-building actions, Chennai Resilience Office intends to support;

SUPPORTING ACTION

These projects/programmes have been described as supporting actions because they:

1. Are relatively more tangible in nature (outcome is in the form of policy, strategy, infrastructure, programme);

2. May already have some momentum on the ground that needs strengthening or upscaling, or are similar to other ongoing efforts in Chennai or elsewhere;

3. Are likely to be done in a shorter time frame;

4. Are relatively more feasible to implement in light of easily identifiable potential lead agencies.

RECOMMENDATION

These are strategies/measures/programmes that:

1. Can help Chennai better cope with shocks and stresses, but might be relatively less tangible, and more aspirational;

2. Are likely to be more time consuming;

3. Need greater collaboration and must be taken up by multiple agencies/sectors;

4. Might need heavy political lifting;

HOW TO READ AN ACTION

ACTION TIMEFRAME & STATUS

Timeframes for implementation:

Short Term *(1-2 years)*   Long Term *(2+ years)*

Status of the project:

New/Proposed   Ongoing   Piloted

ACTION NUMBER & ACTION TYPE

The Action Number helps to quickly identify an action; Action Types are:

(Background Colour)

- ● ★ Flagship Action
- ○ 👐 Supporting Action
- ○ 💡 Recommendation

ACTION TITLE

KEY PLAYERS

Organizations that can potentially facilitate and initiate the action.

RESILIENCE LINKAGES

CRF Resilience Drivers that the action helps address.

🏛	Leadership & Strategy	👥	Economy & Society
🏙	Infrastructure & Environment	🤲	Health & Wellbeing

RESILIENCE CO-BENEFIT

Linkages to other pillars and/or goals in the Chennai strategy.

(Action Theme Colour)

- 🟢 ↗ Healthy & Planned Urbanisation
- 🔵 💧 Water Systems
- 🔴 ⚠ Disaster Preparedness
- 🟣 🛠 Governance Ecosystem
- 🟠 🍃 Vulnerable Communities

VULNERABLE COMMUNITIES

VALUING THE CITY'S VULNERABLE

GOAL 5.3

85 💡

Reviving the Sites & Services Model

TIMEFRAME Short term	STATUS Piloted *(Needs scaling up)*

The Sites and Services model implemented under MUDP I & II offered many advantages. For instance, providing beneficiaries with plots of land that they can develop according to their needs, providing space to set up small businesses and catering to mixed socio-economic groups. The city can consider reviving this programme. Under the revived project, the resettlement sites should be developed not more than 5 km from the city, and should contain associated services such as roads, drainage and individual water supply and sewage connections. The objective of the model would be to ensure that resettled sites are well integrated into the urban fabric and include mixed-class neighbourhoods; have a flexible built form more suited to the needs of low-income households; integrate livelihood activities and spaces into the residential neighbourhood and allow for strong and self-sustaining resident associations to be built.

KEY PLAYERS

HUD, TNSCB, TNHB

RESILIENCE LINKAGES

Empowers a broad range of stakeholders; Fosters long term & integrated planning;

Meets basic needs; Supports livelihoods & employment;

Ensures social stability, security and justice;

RESILIENCE CO-BENEFIT

This effort would be critical to help make Chennai a more equitable city (Healthy Urbanising – Goal X)

RESILIENCE GOAL, MISSION, PILLAR

The goal, mission and pillar that the action is aligned to.

© Sarathy Selvamani - Fishermen prepping nets

CHAPTER 08
resilience actions

RESILIENCE PILLAR 1: HEALTHY & PLANNED URBANIZATION

© Mahindra World City – Green township, Special Economic Zone

Development, population growth and economic transition in Chennai have led to an unprecedented level of urban land use expansion. Chennai was assigned 37th place in a 2009 list of the largest urban areas in the world[103]. This growth has occurred mostly with very little foresight or planning, and, as a result, natural and man-made shocks and stresses are much aggravated. It is clear that unplanned and unhealthy urbanisation processes, as characterized by siloed actions within and across public agencies, poor public and private collaboration and limited levels of civic involvement, remain at the heart of Chennai's resilience challenges. As such, the encroachment of, and public and private development along floodplains and water bodies have contributed significantly to the city's water problems while specifically exposing lower-income communities who live in these areas to high-impact disasters such as the 2015 floods. Thus, Chennai's water related difficulties, disasters, governance related limitations, and the challenges faced specifically by vulnerable communities, all remain interlinked to the issue of urbanisation.

A recent expression of intent by the government to expand the Chennai Metropolitan Area (CMA) to 8,800 sq. km. has understandably stirred debate among government and non-governmental stakeholders who emphasize a need to first reflect on and learn from past experience. As Chennai expands further, some of the key challenges of past planning efforts, e.g., the failure to integrate environmental and long-term thinking into urban planning and the limited involvement of communities, especially those from weaker sections, into decision-making processes must be addressed in order to build city resilience. Also, as Chennai aspires to becoming a world-class city with high quality services, infrastructure and quality of living, the city must also focus on becoming a clean, well-maintained and well-connected, people-friendly city.

MISSION 1: Urbanising responsibly

A key Chennai resilience mission is to urbanise responsibly. Future growth needs to build city resilience to limit and respond to shocks and stresses such as floods, droughts, solid waste problems or encroachment. In order to do this, the city needs to pay urgent attention to scientific as well as socially and environmentally responsible planning. The following four goals will help achieve this mission:

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

GOAL 1.1 FOSTER RESILIENCE THINKING WITHIN THE URBAN PLANNING PARADIGM SO THAT AN INTEGRATED APPROACH IS USED TO ADDRESS ENVIRONMENTAL CONCERNS THROUGH POLICY AND DESIGN.

9 ACTIONS

Historically, urban land and water resources were managed collaboratively, with careful attention paid to environmental conditions and limitations. Villages and communities pooled together land and water resources and managed them collectively as "commons" for various purposes[104]. However, this has changed drastically since colonial times, with a rising pressure of population and economic development that continues till today. Integrating environmental realities into urban planning in the current context is challenging because of multiple agencies with multiple visions for the city that predominate Chennai's governance scene. These visions, which translate into policies, need to incorporate environmental concerns such as the need to adapt to climate change and mitigate risks of sea-level rise, cyclones, and floods so that the city can be more resilient and better able to withstand, manage and reduce its vulnerabilities.

Mainstreaming environmental concerns into policies and programmes involves integrating key elements of adaptation (*e.g., protecting wetlands that are natural defences along the coast or building flood embankments*) in early stages of planning and implementation. Here, urban design can play a critical role; a number of design features that reduce energy and water consumption (*e.g., solar panels, use of sustainable building material, rainwater harvesting (RWH)*) as well as programmes to encourage tree planting (as a means to reducing the urban heat island effect), and to improve citizen safety and well-being, can help make the city more resilient to long-term shocks and stresses.

LINKS TO NATIONAL/ LOCAL POLICIES/ GOALS

The Environment (Protection) Act, 1986

National Mission on Sustainable Habitat, 2011

National Action Plan on Climate Change, 2008

Tamil Nadu State Action Plan on Climate Change, 2015

Tamil Nadu Sustainable Water Security Mission

Tamil Nadu Town and Country Planning Act 1971

CMDA Second Master Plan 2006 to 2026

LINKS TO INTERNATIONAL POLICIES/ GOALS

01

Climate Change Adaptation strategy

TIMEFRAME
Long term

STATUS
New / Proposed

Chennai city has a disaster management plan that discusses how to manage and respond to events such as floods, earthquakes, cyclones and tsunamis. As a disaster management plan, the scope of the document is restricted to disaster preparedness and response. A more comprehensive action plan or strategy is required to help the city adapt to climate change, which manifests over a longer period of time. Therefore, the city will consider developing a climate change adaptation strategy which aims to make Chennai resilient to climate threats and hazards by reducing exposure, pooling resources, transferring and sharing risks, increasing capacity to cope and by responding effectively to unforeseen events. This strategy will be based on the draft Tamil Nadu State Action Plan on Climate Change currently being prepared by the Government of Tamil Nadu in consultation with GIZ[xii]. Some potential elements of the strategy, as informed by UNFCCC[105], include:

a. Identifying critical climate change risks and their potential impact for the CMA, including sea level rise, storm surges, coastal erosion, heat waves and drought;

b. Setting a target to reduce carbon emissions based on India's Intended Nationally Determined Contribution (INDC), as communicated for the Paris Agreement, 2016;

c. Employing different methods of adaptation that go beyond capital-intensive engineering and technological solutions such as flood levees and seawalls to include ecosystem-based institutional and social measures, including coastal and wetlands maintenance and restoration (e.g. building up beaches, using sand dunes and planting natural buffers), integrated coastal zone management, community-based adaptation (CBA), and social protection schemes;

d. Protecting city water bodies and increasing city vegetation. This would entail recognizing the critical role CMA water bodies play in climate adaptation;

e. Prioritising adaptation efforts where vulnerabilities are highest, such as in fishing villages, low-income settlements, low-lying areas, areas where access to water, sanitation, energy, health care, education and other services is poor;

f. Integrating climate change risks into long-term and short-term development projects and into urban planning through innovative measures, including the redesign of metrics used to evaluate detailed project reports (DPRs) of infrastructure projects, retrofitting buildings to improve water and energy efficiency and creation of water squares, infiltration zones and green roofs;

g. Capacity building of planners, citizens and the private sector so that they may understand climate risks, effectively use available information to develop, monitor and evaluate appropriate adaptation actions at the local level;

h. Enabling better disaster preparedness and response through improved early warning systems, contingency planning and integrated response.

xii Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH or GIZ is a German Development Agency that works on sustainable, economic, ecological and social development.

KEY PLAYERS

TN Climate Change Cell, Environment and Forests Department, Revenue and Disaster Management Department, GCC, Centre for Climate Change Adaptation, Anna University, IIT Madras, GIZ

RESILIENCE LINKAGES

Promotes leadership & effective management;

Fosters long term & integrated planning;

Supports livelihoods & employment;

Protects & enhances natural & man-made assets;

Ensures continuity of critical services;

RESILIENCE CO-BENEFITS

While the climate adaptation strategy can indirectly help achieve all the resilient missions specified in this document, it can directly drive efforts to prioritise water challenges in urban planning and design efforts (**Water Systems – Goal 2.1**) and make Chennai a prepared city (**Disaster Preparedness – Pillar 3**).

100RC INSPIRATION:
Rotterdam, Netherlands

Rotterdam stands out as an inspirational example for its comprehensive climate change adaption strategy. While the Rotterdam Climate Proof (2008) and the Rotterdam Climate Change Adaptation Strategy (2013) highlighted the importance of adaptation strategies for building city's resilience towards future risks, its scope is further strengthened via the Rotterdam Climate Initiative (RCI), which aims at reducing carbon emissions by 50% and making the city 100% climate proof by 2025. RCI also stands out as an instance of effective collaboration of multiple agencies (the Port of Rotterdam, the City of Rotterdam, port and industries' association Deltalinqs, and the DCMR Environmental Protection Agency) to build city's resilience.

Rotterdam is proactively tackling both the causes and the consequences of climate change and placing climate adaption at the centre of all city projects by a) strengthening the system of flood, storm water surge and sea-level rise defences; b) adapting the urban space to combine its three functions: 'sponge' (water squares, infiltration zones and green spaces), protection (dykes and coastal protection) and damage control (evacuation routes, water-resistant buildings and floating structures); c) increasing city resilience through integrated planning; and d) developing the opportunities that climate change brings, such as strengthening the economy, improving quality of life, and increasing biodiversity.

Taking responsibility for resilient planning and financing the city has already implemented a series of effective and some new solutions. These include extra water storage facilities in new buildings, water squares, green roofs, a knowledge centre for building floating buildings, and flood proofing of buildings and their surroundings.

02

A strategy to protect green & blue assets in the Chennai Metropolitan Area (CMA)

TIMEFRAME
Long term

STATUS
New / Proposed

KEY PLAYERS

CMDA, CRRT, DTCP, Forest Department, PWD, Revenue Department, GCC, EFI, Care Earth, TNC, Tamil Nadu Coastal Zone Management Authority (TNCZMA), Coastal Resource Centre[xvii]

RESILIENCE LINKAGES

Fosters long term & integrated planning;
Promotes leadership & effective management;

Ensures continuity of critical services;
Protects & enhances natural & man-made assets;

RESILIENCE CO-BENEFITS

This strategy would help place water challenges at the centre of urban design (**Water Systems - Goal 2.2**).

To ensure that sensitive land in the peri-urban areas of Chennai and the expanded CMA is protected, and that development there is environmentally sustainable, a targeted strategy to protect ecologically vulnerable zones and agricultural land will be extremely crucial. This could be part of the CMDA's proposed Strategic Regional Plan, and could essentially do the following:

a. Identify and map all ecologically vulnerable and agricultural zones, including coastal lands;

b. Mark buffer or no-development zones for these areas;

c. Enable the government to buy back environmentally sensitive private land through Transferable Development Rights (TDRs)[xiii];

d. Assigning 10% open space reserve (OSR)[xiv] areas for plots less than 10,000 square meters (sqm). Currently, for the first 3000 sqm OSR is not required while for plots of 3000 – 10,000 sqm, developers need not reserve 10% land if they pay a compensation to the government for the land;

e. Encourage citizens to play a more active role in monitoring development by checking the land classification for plots using the survey number on the land records website[xv];

f. Restrict ribbon development[xvi] along highways by enforcing the 2001 Tamil Nadu Highways Act;

g. Protect sensitive coastal land by creating more awareness about existing rules and regulations that aim to protect the coast, including the Coastal Regulation Zone Notification 2018;

h. Evaluate current land reclassification processes to understand their implications in terms of protecting green and blue spaces.

The strategy development process could potentially involve extensive collaboration between government bodies including the Directorate of Town and Country Planning (DTCP), Chennai Rivers Restoration Trust (CRRT), Housing and Urban Development (HUD) Department, Public Works Department (PWD) and Environment and Forests Department, and non-government agencies such as Care Earth, The Nature Conservancy (TNC) and Environmentalist Foundation of India (EFI), with the CMDA performing a lead agency role that spearheads the process.

xiii According to the Draft Tamil Nadu Combined Development Regulation and Building Rules 2018, TDR currently applies only for cases where private land is required for traffic or transport development, including road widening and other urban infrastructure projects like water supply, sewage, electricity, drainage, etc.

xiv OSR land is reserved for developing parks, playgrounds, recreational facilities for public use.

xv Refer: http://eservices.tn.gov.in/eservicesnew/land/areg.html?lan=en

xvi Ribbon development refers to building houses and commercial establishments along highways, which, if unchecked, can lead to urban sprawl.

xvii Chennai's Coastal Resource Centre aims to combat unsustainable development and provide sustained support to increase resilience of coastal communities by using democratic spaces for dissent and proactive engagement.

03

Special measures to protect Ennore creek

TIMEFRAME
Short term

STATUS
New / Proposed

Ennore in north Chennai is an area dotted with ecologically fragile water bodies and wetlands. It also hosts several fishing villages, industries and thermal power stations. Over the years, the Ennore creek has been polluted by industrial effluents and fly ash affecting the natural ecosystem and the livelihoods of local fishermen, dependent on it. Special measures are therefore required to protect the creek and the neighbouring communities by working with the Forest Department, local communities and the Coastal Resource Centre[xviii]. These measures would include recognising the creek as an ecologically vulnerable site, and then creating a dedicated body, to restore and protect it. This body could be similar in structure to the Conservation Authority of Pallikaranai marshland, or could exist as a dedicated wing possibly within the CRRT.

KEY PLAYERS

Forest Department, PWD, CRRT, Coastal Resource Centre, Indo-German Centre for Sustainability (IGCS), IIT Madras, local Resident Welfare Associations

xviii The Coastal Resource Centre has been particularly active in garnering public and private support to save and restore the creek and is working closely with the local fishing community.

RESILIENCE LINKAGES

Fosters long term & integrated planning;

Protects & enhances natural & man-made assets;

RESILIENCE CO-BENEFITS

Restoring and protecting Ennore creek resonates with water sensitive planning (**Water Systems - Goal 2.2**) and showcases the need to bring in varied stakeholders into the process of planning and taking responsibility for city's resources (**Healthy Urbanisation - Goal 1.3**).

CHENNAI INSPIRATION:
Ennore Creek Restoration

Sustained efforts from the local fishing communities, Coastal Resource Centre, Chennai city-based activists, civil society and the media have resulted in significant awareness creation on the plight of Ennore's extremely sensitive and valuable ecosystem. These efforts have also triggered some corrective measures from the state government: The Commissionerate of Revenue Administration, Disaster Management and Mitigation Department has been undertaking flood prevention and dredging work in the creek during the pre-monsoon period, while the district administration has worked toward removing ongoing encroachments and blockage of the backwater. Further, the Government of Tamil Nadu has initiated an ecological restoration process of the creek and the Ministry of Environment, Forest and Climate Change, Government of India, has prohibited setting up of any new industrial establishments within the wetland. While this is a start, more decisive and concrete protection measures are needed to protect and restore the eco-system.

04

Implementing a plantation strategy

TIMEFRAME
Short term

STATUS
Ongoing
(Needs strengthening)

Chennai has developed a comprehensive greening strategy to increase the city's green cover. It includes detailed descriptions of appropriate species and locations in wards and zones to plant these species. This strategy can be strengthened further by discussing Chennai's existing green cover (as compared with that in other Indian cities) and by introducing regularly updated, zone-wise green cover goals and community-based monitoring. For this, the green cover will need to be monitored every five years, and the strategy will have to be updated according to the new goals.

KEY PLAYERS

GCC, Tamil Nadu Urban Infrastructure Financial Services Limited (TNUIFSL), Department of Horticulture and Plantation Crops, Care Earth

RESILIENCE LINKAGES

Fosters long term & integrated planning;

Promotes cohesive & engaged communities;

Protects & enhances natural & man-made assets;

RESILIENCE CO-BENEFITS

A green strategy will support water-sensitive urban planning (**Water Systems – Goal 2.2**) and will encourage citizen participation, responsibility and ownership of city resources (**Governance Ecosystem – Goal 4.3**).

CHENNAI INSPIRATION:
Plantation Strategy

In 2018, Greater Chennai Corporation (GCC) and Chennai Rivers Restoration Trust (CRRT) adopted the plantation strategy prepared by Care Earth Trust and Infrastructure Management and Advisory Services Private Limited. The strategy envisages a) planting of select species of trees within the GCC jurisdiction over the next five years along roads, on GCC premises and land, burial grounds, waterbodies, parks and vacant areas, and b) planting shrubs in medians to enhance green cover in the city. Currently, GCC has planted 23,000 saplings in different locations of Chennai city and Tamil Nadu Forest Department has planted 17,000 trees in Chennai Metropolitan Area. GCC has also roped in various private agencies and companies as part of CSR to plant 12,000 saplings. While the government continues to plant tree saplings across the city, the strategy notes that active involvement of local resident welfare associations (RWAs) and the public in planting and maintenance is critical to the strategy's success. Therefore, GCC encourages citizens, NGOs, RWAs, and the private sector to proactively plant trees, and is also open to working with them to achieve more holistic outcomes.

05 ★

Chennai Urban Horticulture programme

⏱ **TIMEFRAME**
Short term

🌱 **STATUS**
New / Proposed

This programme presents an innovative way of embedding 'green infrastructure' into the city by establishing rooftop vegetable gardens in government schools to start with. Initiated by Resilient Chennai in partnership with the GCC, this programme seeks to set up rooftop gardens in government schools within each zone and scale it up to model localities through RWAs. These gardens will help address multiple goals such as:

a. Providing access to fresh, nutritious, organic produce which can supplement the Government of Tamil Nadu's "nutritious meal" programme for school children;

b. Keeping the environment clean and consequently reducing health hazards through segregating at source and using organic waste as compost in the gardens;

c. Reducing temperatures and the need to transport produce, thereby saving fuel and lowering CO_2 emissions;

d. Offering an opportunity for citizens to engage positively and proactively with civic issues, and allow young people to channel their energy constructively;

e. Providing a lab for innovative approaches to urban development by showcasing good governance in action.

The programme has secured partial funding through Chennai Smart City Ltd (CSCL)'s 'Model and SMART Corporation Schools in Chennai' project[xix].

xix A detailed concept note can be viewed at:
https://resilientchennai.com/urban-horticulture

KEY PLAYERS

GCC, CSCL, Department of Horticulture and Plantation Crops, Tamil Nadu Corporation for the Development of Women, and NGOs such as The Magic Bean, Indra Gardens and My Harvest

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Meets basic needs;

Promotes cohesive & engaged communities;

Protects & enhances natural & man-made assets;

RESILIENCE CO-BENEFITS

The urban horticulture programme presents an opportunity for government, citizens and private actors to work together on the ground to address civic issues, build public awareness on benefits of gardening (**Governance Ecosystem - Goal 4.3**), and support sustainable solid waste management through waste segregation and composting (**Healthy Urbanisation - Goal 1.2**).

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06 🤲

Hydrological mapping to support urban planning

🕐 **TIMEFRAME**
Long term

🌱 **STATUS**
New / Proposed

Hydrologic, hydrodynamic and water resource mapping, especially along vulnerable areas is critical for land-use planning and ensuring that development is sensitive to the natural environment. Therefore, going forward, the city will explore opportunities to engage Chennai's well-established academic institutions and civic organisations to collect and map this spatial data. This exercise would involve mapping the aerial extent of surface water bodies such as rivers, lakes, ponds and streams, surface and ground water flows, flood plains, location of groundwater wells and corresponding water table observed over time, rainfall variability, topographic characteristics, hydrological features such as soil types, vegetation of watershed areas, soil moisture and water resource infrastructure such as dams, levees and embankments.

KEY PLAYERS

CMWSSB, IIT Madras, PWD, CMDA, Rain Centre

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Protects & enhances natural & man-made assets;

Ensures continuity of service;

RESILIENCE CO-BENEFITS

This strategy would help prioritise water challenges in urban design (**Water Systems – Goal 2.1**) and could contribute towards better coordination among stakeholders through data collection and collation (**Governance Ecosystem – Goal 4.1**).

07

Capacity building for planners & real estate developers to incorporate environment-friendly solutions into urban planning

TIMEFRAME
Short term

STATUS
New / Proposed

Chennai's academic institutions and urban design firms with expertise in green and clean infrastructure and design can initiate capacity building programmes that train a) urban planners in the CMDA and GCC and b) real estate developers, on how to include environment-friendly designs in urban planning and design.

The programme can essentially consist of a series of workshops where participants are exposed to various available environmental designs and learn how these can be incorporated into their work.

Through the workshops, participants may also have the opportunity to consult the Counselling and Consultancy Centre at CMDA (free of charge) on design related elements of their proposed projects. These plans may include re-designing existing parks, public spaces and buildings or developing new sites which showcase environment friendly solutions. Ultimately, these plans can also be developed into detailed project reports (DPRs) that can be implemented by interested agencies.

KEY PLAYERS

Centre for Urbanisation, Buildings and Environment (CUBE), IIT Madras, Anna University, urban design firms, Care Earth, CMDA, GCC, real estate developers

RESILIENCE LINKAGES

Fosters long term and integrated planning;

Empowers a broad range of stakeholders;

Protects & enhances natural & man-made assets;

RESILIENCE CO-BENEFITS

This strategy would help address water challenges through urban design (**Water Systems – Goal 2.1**).

08

Promote environmentally sustainable and disaster resilient building materials in real estate development projects

TIMEFRAME
Short term

STATUS
New / Proposed

The city will explore promotion of alternate and sustainable building material (like lime, fly ash brick and autoclaved aerated concrete) by:

a. Developing a catalogue with the help of relevant engineering institutions like CUBE, IITM that will be made available on the CMDA, GCC and Indian Institute of Architects websites. The catalogue will illustrate the variety of building materials available on the market and alternative building technology with the intent of informing citizens about different options in construction. Initial research on the current extent of resilient building practices will be carried out by University of British Columbia students; this information can feed into the catalogue;

b. Attempting to improve design and structure of informal housing in Chennai by developing disaster resilient housing for vulnerable communities;

c. Exploring possible ways to incentivise use of these materials (e.g. through subsidies/discounts on price or linking to property tax payments which will also offer a mechanism to monitor if sustainable building materials are actually being used on site).

KEY PLAYERS

GCC, CMDA, TNSCB, real estate/ building companies, CUBE, IIT Madras, Confederation of Real Estate Developers Association of India (CREDAI), Real Estate Regulatory Authority (RERA)

RESILIENCE LINKAGES

Fosters long term and integrated planning;

Empowers a broad range of stakeholders;

Protects & enhances natural & man-made assets;

RESILIENCE CO-BENEFITS

This action would help build capacity across government and community to be better prepared in the event of disaster (**Disaster Preparedness Goal – 3.4**).

09

Common database for underground infrastructure

TIMEFRAME
Short term

STATUS
New / Proposed

Developing and maintaining a common database for all underground infrastructure such as storm water drains, sewage lines and communication lines can support more integrated planning of these city assets.

The database can potentially ensure that the work carried out by each department is streamlined in coordination with other departments and that construction of new infrastructure doesn't damage existing infrastructure.

Most of the required data will have to be collected from the appropriate government departments and the database can be managed by a consortium of organizations, including the National Institute of Urban Affairs (NIUA), CSCL and Centre for Urbanisation, Buildings and Environment (CUBE), IIT Madras.

Currently, these organizations are already in conversation about building a Data Observatory to host a range of data to support data-driven planning and policy-making. The proposed common database on underground infrastructure could be one of the focus areas for the Data Observatory.

KEY PLAYERS

GCC, CSCL, CMWSSB, telecom companies, NIUA, CUBE, IIT Madras

RESILIENCE LINKAGES

Fosters long term and integrated planning;

Protects & enhances natural & man-made assets;

RESILIENCE CO-BENEFITS

This project would help make water the focus of urban design (**Water Systems – Goal 2.2**) and improve government efficiency in handling multiple resilience challenges such as disaster management or mobility and transportation by enabling knowledge transfer across agencies (**Governance Ecosystem – Goal 4.1**).

MISSION 1: Urbanising responsibly

GOAL 1.2 ADDRESS SOLID WASTE RELATED CHALLENGES MORE EFFECTIVELY.

One of Chennai's greatest challenges today relates to the management of solid waste. The amount generated per day has increased from 3,000 metric tons per day in 1996 to 4,067 metric tons per day in 2001 and 5,400 metric tons per day in 2016[106,107]. Most waste generated in the city is dumped into two landfills in Perungudi and Kodangaiyur. Part of the waste accumulates in city water bodies as a result of littering and illegal dumping. This chokes drains and restricts water flows during rainfall and poses a serious threat to Chennai's ecology and the health and well-being of its citizens. To address Chennai's solid waste management (SWM) issue, changes are required throughout the solid waste cycle, from packaging to waste generation, collection, transportation, treatment, disposal and recycling. This involves improving the solid waste governance system to implement the Solid Waste Management Rules, 2016[108] by a) mandating source segregation; b) decentralising waste processing; and c) engaging with different sections of society (contractors, citizens, RWAs, commercial establishments, manufacturing companies, bulk waste generators, empanelled list of service providers for bio-degradable waste and recyclers authorised by GCC) to make them understand their roles and responsibilities. Therefore, collective and sustained efforts are required to minimise waste generation and establish scientific methods to process and treat waste such that it does not negatively impact the ecosystem.

LINKS TO NATIONAL/ LOCAL POLICIES/ GOALS

Solid Waste Management Rules (SWM), 2016

Plastic Waste Management Rules (PWM), 2016

Swachh Bharat Mission

Tamil Nadu Plastic Ban

LINKS TO INTERNATIONAL POLICIES/ GOALS

CHENNAI INSPIRATION:

Ban on "one time use and throwaway" plastics & SWM Bylaws

The Government of India notified the Plastic Waste Management Rules, 2016, and imposed a nationwide ban on plastic carry bags less than 50 micron thickness. Recognizing that this ban did not bring about any noticeable reduction in the pollution caused by plastic carry bags, the Chief Minister of Tamil Nadu announced a ban on "one time use and throwaway" plastics on 05.06.2018 that came into effect on 01.01.2019. Fourteen single-use plastics, or disposable plastics such as plastic coated paper cups and plates, carry bags of all sizes and thickness, and straws, are banned since they are not easily biodegradable, contaminate food and cause hormone disruption, pollute water bodies and destroy marine eco-systems, and occupy large tracts of land preventing percolation of rainwater into underground wells. The ban will help address illegal dumping of plastics into storm water drains and waterbodies. An active website to disseminate information is maintained by the GoTN: http://www.plasticpollutionfreetn.org/bannedplastic.php

Resilient Chennai has also been working with the Greater Chennai Corporation's Solid Waste Management (SWM) Department which is tasked with enforcing the ban in Chennai city. Resilient Chennai is providing policy support to the SWM department acting on findings of the Citizen Perception Survey conducted during the Preliminary Resilience Assessment (PRA) which highlighted solid waste as one of the most important challenges in the city. Resilient Chennai supported the SWM Department in developing the Solid Waste Management By-laws of the city that stem from the Solid Waste Management Rules, 2016, passed by the Government of India. These By-laws call for the collection of monthly SWM user fees and littering fees. Resilient Chennai advised the SWM Department on what fees to charge and aligned the revenue collection categories with the Revenue Department's categories. Resilient Chennai also worked on the Plastic Waste Management By-laws of the city. The city already had a set of draft By-laws on Plastic Waste Management, however, this document needed to be updated and streamlined since a ban on single use plastics (one time use and throw away plastics Government Order 84) was passed by the GoTN. Resilient Chennai is now providing support for the development of a Solid Waste Management Policy for the city.

10

Redesigning solid waste management (SWM) contracts

TIMEFRAME
Short term

STATUS
Ongoing
(Needs strengthening)

Chennai was a pioneer in terms of involving private firms in municipal solid waste management. Almost 20 years ago, public-private-partnerships (PPPs) started to occupy this space. However, a common drawback among the various PPP arrangements was that the contracts did not make the contracted private firm accountable for abiding by the Municipal Solid Waste Rules, 2000 or the SWM Rules, 2016. The GCC is now addressing issues to better manage solid waste by making sure that the outsourced agency is evaluated in terms of scientific methods to collect, transport, treat and manage solid waste rather than weight of waste disposed. This includes prioritising source segregation, ensuring that recyclables are recycled, food waste is either composted or converted to energy in waste-to-energy plants, and that remediation, reclamation and rehabilitation of the two existing landfill sites in Perungudi and Kodungaiyur will be carried out.

KEY PLAYERS

GCC, the private sector

RESILIENCE LINKAGES

Promotes leadership & effective management;

Fosters long term and integrated planning;

RESILIENCE CO-BENEFITS

Redesigning vendor contract(s) for SWM, would help reduce and ultimately prevent solid waste dumping in water bodies and environmentally sensitive land, consequently reducing risk and impact of flooding (**Healthy Urbanisation – Goal 1.1; Water systems – Pillar 2; Disaster Preparedness – Pillar 3**).

11

Extended Producer Responsibility (EPR) in Solid Waste Management (SWM)

TIMEFRAME
Short term

STATUS
Piloted
(Needs scaling-up)

Manufacturers can be made to take greater responsibility for their products by broadening and integrating EPRs into SWM, in accordance with the Plastic Waste Management Rules, 2016. Some level of EPR already exists for electronic goods and old kitchen utensils, where retail outlets take back used goods. However, there are none at all for other goods, including packing materials for fast moving consumer goods (FMCGs) such as plastic shampoo bottles. Further, online shopping platforms could play a key role in leveraging their existing delivery networks to take back packaging material products that are beyond their life-cycle. Similarly, there could be kiosks or vending machines in multiple locations across the city to deposit plastic or packaging waste that can be recycled.

KEY PLAYERS

FMCG industry, Tamil Nadu Pollution Control Board (TNPCB), GCC

RESILIENCE LINKAGES

Promotes leadership & effective management;

Fosters long term and integrated planning;

RESILIENCE CO-BENEFITS

EPR could help reduce plastic and packaging waste dumped in water bodies and landfills by diverting it to a recycling centre, consequently making the city cleaner and reducing risk and impact of flooding (**Healthy Urbanisation – Goal 1.2; Water Systems – Pillar 2; Disaster Preparedness – Pillar 3**). It would also make different stakeholders (in this case manufacturing companies) be more responsible for their products and address solid waste management issues (**Governance Ecosystem – Goal 4.3**).

12 ✌

Decentralised compost units

⏱ **TIMEFRAME**
Short term

🌱 **STATUS**
Ongoing
(Needs strengthening)

Bio-degradable waste accounts for an estimated 45% of all the waste generated in Chennai[109]. The GCC has already set up decentralised resource recovery centres (RRCs) in wards. These are waste to energy units which are of different types such as bio-methanation plants that produce biogas and electric energy. GCC is also engaged in different types of composting such as vermi-composting. However, many RRCs are not equipped to handle and process segregated waste from nearby households and commercial places such as hotels, markets and *kalyana mandapams* (marriage halls).

Therefore, using these spaces to set up decentralised waste units to compost food waste with the support of interested NGOs, RWAs, and the empanelled list of services providers authorised by GCC, wherever possible, would enable dealing with waste locally (and thereby reducing transportation costs), reducing the quantity of waste being dumped into landfills and encouraging other interested organisations/citizens to start similar initiatives in their own wards.

Composting waste locally will help RWAs and citizens witness, first-hand, the conversion of their waste into compost, further sensitizing them to waste management best-practices.

KEY PLAYERS

GCC, RWAs, NGOs, empanelled list of services providers authorised by GCC, bulk waste generators

RESILIENCE LINKAGES

Fosters long term and integrated planning;

Promotes cohesive & engaged communities;

RESILIENCE CO-BENEFITS

🔧

Managing waste locally, through involvement of government and RWAs would bring together more citizens to engage with and take some responsibility towards solid waste management, a key civic issue in the city (**Governance Ecosystem – Goal 4.3**).

13 ✌

Targeted and sustained awareness programmes on waste management

⏱ **TIMEFRAME**
Short term

🌱 **STATUS**
Ongoing
(Needs scaling-up)

Chennai residents are generally indifferent to issues around solid waste. This is largely the result of a lack of awareness about the full implications of poor waste management on the environment and their own health.

It is also partly the result of limited awareness around how simple steps on the part of citizens can significantly help address the problems. Therefore, a series of sustained but targeted awareness campaigns for Chennai citizens, waste collectors and those involved in treatment can highlight the complexities of solid waste management and options for treatment.

All waste generators generate a variety of waste, including non-biodegradable waste that includes e-waste, bio-medical waste, plastic waste, paper waste, cloth, metals and so on, each of which requires different approaches to handling and different methods for processing and disposal. These may not be widely known or understood. Thus, the proposed awareness programmes would highlight the flow of solid waste from where it is generated to where it ends up, the impact of this journey on ground water, soil, air quality and citizens and various options available for treatment and details on the plastic ban.

KEY PLAYERS

GCC, NGOs, academic institutions, TNPCB, advertising agencies

RESILIENCE LINKAGES

Fosters long term and integrated planning;

Empowers a broad range of stakeholders

RESILIENCE CO-BENEFITS

🔧

This action would help make citizens more responsible for their own waste (**Governance Ecosystem – Goal 4.3**).

14

Children as change agents

TIMEFRAME
Short term

STATUS
Ongoing
(Needs scaling-up)

Children have been identified as the best agents when it comes to introducing behaviour change among families. For instance, they have been highly successful in propagating safe sanitation and hygiene practices and are an integral part of the India's Swachh Bharat programme.

The most effective manner to target children is in schools, where they congregate. CityWorks[xx] is planning to collaborate with Resilient Chennai to sensitise school children on the environmental impacts of poor SWM and encourage them to act as change agents in their families and communities.

The programme will initially be implemented in three GCC schools and will use "Trashonomics", a book developed by Solid Waste Management Roundtable (SWMRT), Bangalore. The book is application-based, and includes activities which are simple, fun, practical and results-driven. They give students the opportunity to visualise outcomes and also carry their learning back home.

Activities include: burying different types of waste to identify and understand which ones are bio-degradable and composting vegetable and fruit peels at home to understand that composting can be easy[xxi].

KEY PLAYERS

GCC, CityWorks, Resilient Chennai

RESILIENCE LINKAGES

Fosters long term and integrated planning;

Empowers a broad range of stakeholders;

Promotes cohesive & engaged communities;

RESILIENCE CO-BENEFITS

This action would help make citizens take greater responsibility for the waste they generate (**Governance Ecosystem – Goal 4.3**).

xx CityWorks is an architecture firm based in Chennai, that redesigns public and private spaces in environmentally sustainable manner.

xxi Refer concept note for more details:

https://resilientchennai.com/children-as-change-agents

15

Economic measures for people to comply with source segregation

TIMEFRAME
Short term

STATUS
Ongoing
(Needs strengthening)

Citizens are often indifferent to solid waste in part because they do not pay for it. Introducing positive and negative incentives will be one effective way to induce compliance to proper management such as source segregation at home, work or on the streets. New SWM by-laws have provisions for charging user fees and for fining offenders. These new by-laws will be implemented shortly.

KEY PLAYERS

GCC, Citizens, RWAs

RESILIENCE LINKAGES

Fosters long term and integrated planning;

RESILIENCE CO-BENEFITS

This action would help make citizens take greater responsibility for the waste they generate (**Governance Ecosystem – Goal 4.3**).

GOAL 1.3 ENCOURAGE A MORE MULTI-STAKEHOLDER DRIVEN URBAN PLANNING PROCESS.

4 ACTIONS

In most states and cities across India (including Tamil Nadu and Chennai), collective and participatory governance has not been sufficiently grounded in institutional structures and processes. It is often limited to aiding select government decision-making processes and is not integrated or mainstreamed as a planning tool. This creates mistrust and makes common citizens disinterested in city development programmesˣˣⁱⁱ that are in fact meant for them.

Therefore, going forward, Chennai's urban plans and programmes will attempt to incorporate processes that are multi-stakeholder driven in order to create ownership among non-governmental actors, and to ensure that the city urbanises responsibly and in an inclusive manner. This involves changing traditional processes by which government engages with its citizens, making structural changes in organisations that are legally enacted to include public representation and involving local ULBs in decision-making, especially with respect to metropolitan level planning in peri-urban areas of Chennai.

LINKS TO NATIONAL/ LOCAL POLICIES/ GOALS

National Mission on Sustainable Habitat, 2011

74th Amendment to India's Constitution

Chennai City Municipal Corporation Act, 1919

LINKS TO INTERNATIONAL POLICIES/ GOALS

SUSTAINABLE DEVELOPMENT GOALS

11 SUSTAINABLE CITIES AND COMMUNITIES

n U A

IMPLEMENTING THE NEW URBAN AGENDA

xxii A citizen survey conducted by the Resilient Chennai team in 2018 revealed that more than 50% of the total 478 respondents cited 'lack of communication from the government' and 'feeling of lack of power to make a difference' as the primary reasons for not engaging with government. https://resilientchennai.com/civic-survey

16

Strengthening public consultation processes

TIMEFRAME
Short term

STATUS
New / Proposed

Fostering collaboration between citizens, non-profit organisation, industries and government bodies ensures that multiple interests and visions are protected, and decisions move beyond economic visions. More importantly, this creates a sense of ownership among citizens for city initiatives. Since public consultations are the most common means of engaging multiple stakeholders in public planning, the city will consider ways to mobilise greater stakeholder involvement into these processes by:

a. Advertising upcoming consultations in multiple English and Tamil newspapers, official social media spaces and on the radio at least two weeks prior to each event;

b. Conducting the consultations in venues that are accessible to all, specifically vulnerable communities such as the differently-abled, low-income communities and the elderly;

c. Conducting online citizen surveys to get feedback and input on various policy options. The already existing "Namma Chennai" app could provide links to surveys;

d. Going to the relevant communities and conducting consultations in local community spaces, wherever applicable;

e. Sharing meeting notes with participants on next steps, and information on how the collected feedback will be factored into policymaking and planning with participants, via email or WhatsApp.

KEY PLAYERS

All departments, newspaper groups, radio stations, citizens

RESILIENCE LINKAGES

Fosters long term and integrated planning;

Promotes leadership & effective management;

Promotes cohesive & engaged communities;

RESILIENCE CO-BENEFITS

This action would help improve efficiency of communication between government and other stakeholders, especially citizens and encourage citizens to take more responsibility in addressing civic issues (**Governance Ecosystem – Goal 4.3**).

17

Strengthening citizen representation in 'Ward Committees'

TIMEFRAME
Long term

STATUS
New / Proposed

Chennai's current governance system includes Ward Committees for each of its 15 zones, each comprising of elected representatives or councillors of that zone. This is according to the Chennai City Municipal Corporation Act, 1919[110]. However, the system does not make public representation mandatory. Therefore, amending the existing Act to take a citizen-centric approach in the selection of committee members would ensure greater public participation. The Act could be amended to include representatives from RWAs, local Community Based Organisations (CBO), minority groups like women, vulnerable communities and other relevant community groups.

KEY PLAYERS

GCC

RESILIENCE LINKAGES

Fosters long term and integrated planning;

Promotes leadership & effective management;

Promotes cohesive & engaged communities;

RESILIENCE CO-BENEFITS

This action would help improve efficiency of communication between government and citizens and encourage citizens to take more responsibility in addressing civic issues (**Governance Ecosystem – Goal 4.3**).

18

Participatory planning for the Chennai Metropolitan Area (CMA)

TIMEFRAME
Long term

STATUS
New / Proposed

Currently, collective and coordinated planning between local authorities and state with respect to sharing natural resources, environmental protection and infrastructure development in the CMA is limited. The 74th Amendment to the Indian Constitution suggests formation of a Metropolitan Planning Committee that includes elected local ULB representatives. However, considering the city's governance structure, strengthening the already existing CMDA which has been institutionalised for this purpose would be more effective.

According to the Town & Country Planning Act 1971, CMDA's members include not more than 4 representatives from local authorities functioning in the CMA. However, the specific role of these members in the activities of the CMDA especially in planning is not clear. In addition, having elected representatives as members could better represent local authorities.

Therefore, the CMDA could be strengthened by a) clearly specifying the roles of members in its planning activities, master plan development and implementation and decision making; and b) including a proportionate number of elected representatives from local authorities as members which would give local actors an opportunity to participate in the planning process. This would ensure that local needs and city and state level visions for growth are incorporated while planning the Chennai Metropolitan Area (CMA).

KEY PLAYERS

CMDA, HUD

RESILIENCE LINKAGES

Fosters long term and integrated planning;

Promotes leadership & effective management;

Protects & enhances natural & man-made assets;

RESILIENCE CO-BENEFITS

Creating this committee would help improve coordination and data sharing among government agencies to plan better for the future (**Governance Ecosystem – Goal 4.1**).

19

Participatory budgeting for part of Greater Chennai Corporation's (GCC) budget

TIMEFRAME
Long term

STATUS
New / Proposed

Participatory budgeting is a process by which citizens can influence government budget allocations by sharing their views and demands in terms of civic priorities. This process has been very successful in Porto Alegre, Brazil, and has greatly improved citizen access to basic services there. Introducing a similar process, initially for allocating a part of GCC's budget, will add more transparency to the current budgeting process. It will also enable higher citizen participation in civic issues and be a catalyst for resilience building. Some ways in which participatory budgeting could occur include inviting people to send in their suggestions through an online form or a form available in ward offices and organising multiple public meetings in each zone.

KEY PLAYERS

GCC

RESILIENCE LINKAGES

Fosters long term and integrated planning;

Promotes leadership & effective management;

RESILIENCE CO-BENEFITS

This action would help empower citizens in the city governance process by giving them platform to intervene and encourage citizens to take more responsibility in addressing civic issues **(Governance Ecosystem – Goal 4.3)**.

MISSION 1: Urbanising responsibly

GOAL 1.4 PROMOTE TRANSIT-ORIENTED DEVELOPMENT TO MAKE CHENNAI A WELL-CONNECTED, PEOPLE AND ENVIRONMENT-FRIENDLY CITY.

5 ACTIONS

Chennai is one of the few cities in India (apart from Mumbai and Kolkata) to have four major modes of public transport: buses, the Metro, a suburban railway and the mass-rapid transport system (MRTS). While city residents seem to prefer commuting by public transport rather than their own vehicles[111], it still has the highest vehicle density (2,093 vehicles per km of road) in the country[xxiii][112], making it increasingly difficult to access places, activities and services in a timely fashion. These numbers also suggest that the city's road infrastructure is inadequate. Yet, expanding the road network will incentivise higher vehicular movement and increase air and noise pollution levels with severe long-term implications on health and climate. Therefore, it is crucial that the city and its peri-urban areas grow in a manner that simultaneously increases a) public transportation system connectivity to and within peri-urban areas; and b) mobility for all its citizens through non-motorised forms of transportation such as walking, cycling and cycling rickshaws which offer multiple benefits, including public health, improved quality of life, reduced environmental impact and reduced carbon emissions. This calls for paying special attention to the way transport systems and associated infrastructure are designed, such that they are accessible to all (e.g. elderly, disabled, women, etc.), affordable for all, and have limited impact on local natural resources and the environment at present and in the future.

LINKS TO NATIONAL/ LOCAL POLICIES/ GOALS

National Urban Transport Policy, 2014

National Transit Oriented Development Policy, 2017

AMRUT (Atal Mission for Rejuvenation and Urban Transformation)

Chennai Non-Motorised Transport Policy, 2014

CMDA 2nd Master Plan 2006 - 2026

LINKS TO INTERNATIONAL POLICIES/ GOALS

CHENNAI INSPIRATION:

Efforts by the Institute for Transportation and Development Policy (ITDP)

ITDP is proactively working with the GCC to increase mobility of its citizens by creating safe, walkable, and liveable streets that cater to all user groups. Its efforts include a) transforming over 100km of roads into Complete Streets that are designed with wide and continuous footpaths, safe pedestrian crossings, dedicated cycle tracks (where applicable), conveniently placed bus stops, clearly designated on-street parking, organised street vending, and properly-scaled carriageways; b) providing technical assistance to a bicycle sharing project, launched in February 2019 with 250 cycles across 25 stations in the populated areas of Anna Nagar and Marina beach. The project aims to provide residents with affordable, healthy, and sustainable mobility alternatives to meet travel demands; and c) creating a pedestrian plaza in association with Chennai Smart City Ltd (CSCL) along Chennai's shopping district, T Nagar. The 1.4 km stretch designed by Darashaw and Studio R+R with support from the ITDP India Programme, aims to transform the street to encourage more people to walk, shop and wander, without the fear of accidents. ITDP is also in the process of developing a non-motorised transport plan with GCC to create a city-wide network of streets for walking and cycling, with a detailed design of approximately 70 sq. km.

20

Develop a comprehensive sustainable urban mobility plan

TIMEFRAME
Short term

STATUS
New / Proposed

To ensure that the city's transportation system improves connectivity within and to peri-urban areas, and is affordable and accessible to all sectors of society while also reducing the city's carbon footprint, a comprehensive sustainable urban mobility plan is required. This plan will aim to integrate land-use planning and transportation to address the mobility needs of all citizens and infrastructure requirements of all modes of transport. It will also enable integration of existing modes of transport to ensure that commuters can move easily from one to the other. Elements of such a plan would include:

a. Introducing specific time-bound targets to be achieved, such as increasing use of public transport during peak hours or introducing a specific number of eco-modes of transport (e.g. electric buses, autos);

b. Integrating pedestrian facilities, non-motorised and public transport systems to ensure last-mile connectivity and connectivity between public transport systems by introducing road and street design standards;

c. Improving safety and security on public transport systems. This could be achieved by installing CCTVs in all stations and ensuring they are not tampered with during installation, ensuring that stations and bus stops are well-lit as per Bureau of Indian Standards norms[xxiv, 113], setting up/moving bus stops and stations out of isolated locations to areas that

can be naturally surveyed (by local commercial establishments), installing emergency panic buttons linked to police stations, etc.;

d. Reducing air and noise pollution by introducing electric buses, autos and share autos with necessary infrastructure for charging and expanding the bicycle sharing programme (currently in Anna Nagar, Shenoy Nagar and Marina Beach) to other areas;

e. Increasing the frequency of buses/trains and introducing new routes to peri-urban areas to improve connectivity;

f. Planning arterial roads for newly developing or planned areas prior to laying them, including plans for underground infrastructure, with the goal of improving access to basic services and last mile connectivity.

The Chennai Unified Metropolitan Transport Authority (CUMTA) recently notified by the State Government[114], may oversee the preparation of this plan.

xxiv According to World Resource Institute, "The average level of illumination on road surface in case of important roads should be 30 lux, for other main roads carrying mixed traffic the value should be 15 lux and for local roads and secondary roads carrying light traffic the value should be 8 lux and 4 lux respectively."

KEY PLAYERS

CUMTA, ITDP, CMDA, Commissionerate of Municipal Administration Tamil Nadu Transport Department, GCC, Directorate of Town and Country Planning (DTCP), Rural Development Department, Panchayati Raj Department

RESILIENCE LINKAGES

Fosters long term and integrated planning;

Promotes leadership & effective management;

Promotes reliable communication and mobility;

RESILIENCE CO-BENEFITS

This action could foster environment thinking in urban planning and design by planning for improved mobility and sustainable transport that would reduce carbon emissions from the transport sector (**Healthy Urbanisation – Goal 1.1**). It would also help address the mobility needs of different people including the disabled, poor and women (**Vulnerable Communities – Pillar 5**).

100RC INSPIRATION:

Singapore City, Singapore

Singapore is considered a top ranked sustainable city in Asia. The city's Land Transport Master Plans (2008 and 2013) have a significant role to play in making Singapore liveable, inclusive, more connected, and sustainable.

The second LTMP (2013) long term plan, in particular, aims at making public transport the primary public choice of transportation. The LTMP 2013 set out specific targets to achieve before 2030. For instance, 8 out of 10 households will be living within 10 minutes' walk from a train station; 85% of public transport journeys under 20 km will be completed within 60 minutes; and 75% of all peak hour journeys will be made using public transport. The LTA's land transport master plan 2013 also targets the expansion of the Mass Rapid Transit (MRT) network to 360 km by 2030, improve walkability, bicycling facility, and reduce the reliance on private transport by improving the road system and network, closely monitoring vehicle population growth rate, fine-tuning road usage charges, and improving road safety.

Singapore's efforts especially highlight the importance of participatory planning to understand and incorporate commuters' opinions, feedback, and concerns before drafting the plan and policies. Key learnings from Singapore's transportation related actions include the need for a regional/integrated, long term, and participatory mobility plan that sets specific targets.

21

Scale up existing efforts to redesign roads to improve mobility for all

TIMEFRAME
Short term

STATUS
Piloted
(Needs scaling-up)

Several city roads are currently being upgraded to include bicycle lanes, wider pavements and innovative sign boards that encourage people to cycle. The city will work towards scaling up these efforts through the Chennai Smart City Ltd (CSCL), introduce smart signalling that detects traffic flow and controls lights, and earmark spaces for street vendors, bicycles and parking. The effort can simultaneously make Chennai's roads accessible to people with disabilities.

KEY PLAYERS

GCC, CSCL, ITDP, urban design firms, DTCP, Commissionerate of Municipal Administration

RESILIENCE LINKAGES

Fosters long term and integrated planning;

Promotes leadership & effective management;

Promotes reliable communication and mobility;

RESILIENCE CO-BENEFITS

This effort helps incorporate environment friendly design in urban transport planning by encouraging people to cycle and walk, that would reduce carbon emissions from the transport sector (**Healthy Urbanisation – Goal 1.1**). It also caters to the mobility needs of different segments of society such as the disabled and the elderly (**Vulnerable Communities – Pillar 5**).

CHENNAI INSPIRATION:
Complete Streets Project

ITDP's 'Complete Streets' project seeks to enhance accessibility and mobility for all street users. With a larger vision of increasing the ease of walking and use of cycles to bring about sustainable growth, 'Complete Streets' are designed with wide and continuous footpaths, safe pedestrian crossings, dedicated cycle tracks (where applicable), conveniently placed bus stops, clearly designated on-street parking, organised street vending, and properly-scaled carriageways. In 2014, Chennai became the first city in India to adopt the Non-Motorised Transport (NMT) Policy. The policy, reviewed by the ITDP India Programme, sets aside 60% of the Chennai Corporation's transport budget for the creation and maintenance of walking and cycling networks in the city. So far, Chennai has accomplished over 75 km of Complete Streets and is re-designing an additional 60 km of street network.

22
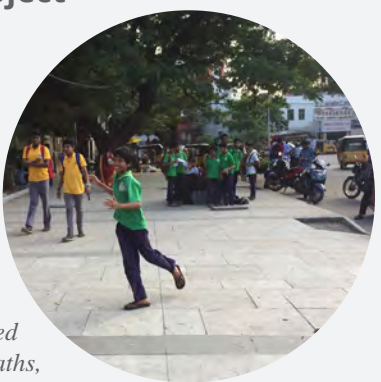
Promote use of public transportation through feeder services

TIMEFRAME
Short term

STATUS
Piloted
(Needs scaling-up)

By offering connecting transportation services between Mass Rapid Transport System (MRTS) or sub-urban railway, major bus-stations and Chennai Metro Rail (CMRL) wherever needed, Chennai city can encourage wider use of public transport and provide last mile connectivity. The CMRL offers newly introduced auto/cab feeder services that connect several Metro stations including Koyambedu, Ekkaduthangal, Guindy, Ashok Nagar, Thirumangalam and Little Mount to MRTS stations with important places of work, education, medicine and leisure (see *Figure 18*). In addition, CMRL has introduced bicycle sharing systems from most stations on its "green line" (St. Thomas Mount to Chennai Central), which passengers can hire free of charge to commute locally. Similar efforts will help promote use of public transportation more widely across the city.

KEY PLAYERS

CMRL, Tamil Nadu Transport Department, Southern Railway

RESILIENCE LINKAGES

Fosters long term and integrated planning;

Promotes leadership & effective management;

Promotes reliable communication and mobility;

RESILIENCE CO-BENEFITS

This effort helps incorporate environment friendly design in urban transport planning by encouraging people to use shared transportation services, that would reduce carbon emissions from the transport sector (**Healthy Urbanisation – Goal 1.1**).

Figure 18: Route of the feeder service from a metro station
Source: CMRL

23

Incentivise "clean" transport

TIMEFRAME
Short term

STATUS
New / Proposed

The city will consider investing in innovative incentive programmes that encourage people to use "clean" modes of transport—i.e. those that pollute less. This may include partnering with cab companies to introduce electric autos, sponsor companies providing benefits for clean transport users (e.g. access to promotional products) or employers providing toll waivers for private buses (such as company or college buses) that run on clean fuel or electricity and/or reducing state taxes on hybrid vehicles.

KEY PLAYERS

Tamil Nadu Transport Department, Metropolitan Transport Corporation (MTC), cab companies, Commissionerate of Municipal Administration, DTCP

RESILIENCE LINKAGES

Fosters long term and integrated planning;

Promotes leadership & effective management;

Promotes reliable communication and mobility;

### RESILIENCE CO-BENEFITS

This effort would help reduce carbon emissions from the transport sector (**Healthy Urbanisation – Goal 1.1**).

CHENNAI INSPIRATION:
Electric Bus Initiative

Tamil Nadu has become the first state in India to sign the "Clean Bus Declaration" with C40 Cities Climate Leadership Group, a global partner of 100RC. By signing the declaration, the Government has indicated its support to shifting to low emission buses, thereby reducing carbon emissions from the transport sector. As a result, Chennai, a C40 member city, will see electric buses on select routes in the city. The Government of Tamil Nadu has forwarded a Detailed Project Report to the Government of India for the purchase of 70 electric buses with a total cost of INR 1.4 billion, with a funding pattern of INR 1.05 billion from the Government of India and INR 350 million from the Government of Tamil Nadu. Charging infrastructure amounting to INR 150 million would be included in the Government of India's share.

24

Embedding green infrastructure in road networks

TIMEFRAME
Short term

STATUS
New / Proposed

Select roads can be retrofitted to serve multiple functions beyond simply enabling faster connectivity in the city. These roads can include elements such as porous pavements and roads, tree plantations (to be determined by the plantation strategy), bioswales next to pedestrian pathways, etc. Through Chennai's Water as Leverage (WaL)[xxv] project, the "City of 1000 tanks" team has proposed to redesign main roads in Mylapore to include blue-green conduits and bioswales to cleanse excess road run-off, directing it to nearby temple tanks.

xxv For a description of WaL please see, p.g. 135.

KEY PLAYERS

GCC, WaL and the "City of 1000 tanks" team, Care Earth, EFI, TNC

RESILIENCE LINKAGES

Fosters long term and integrated planning;

Promotes leadership & effective management;

Promotes reliable communication and mobility;

Protects & enhances natural and man-made assets;

RESILIENCE CO-BENEFITS

This effort helps incorporate environment and water friendly design in urban transport planning by allowing for green and blue infrastructure along road networks (**Healthy Urbanisation – Goal 1.1; Water Systems – Goal 2.2**).

CHENNAI ASPIRATION:
Mylapore

As part of the Water as Leverage (WaL) project, the team – 'City of 1000 tanks' proposes to restore two historic temple tanks – the Kapaleeshwarar temple tank and Chitra Kulam to their historical function of water storage tanks with enlarged catchments. They propose to employ nature-based solutions that treat greywater and diffuse runoff in the restoration process. Specifically, the project design includes restoring the water tank with cleansing helophyte filter, restoring historical water connections between important water related historic sites by connecting them with a network of bioswales, which would also improve pedestrian movement, identifying and retrofitting public spaces for rain water runoff treatment and recharge on the ground water aquifer, treating grey water from restaurants and commercial establishments in the four Mada streets (directly around the temple) through decentralised nature based solutions and incentivising private property owners to develop rain water harvesting structures in their buildings and/ or open spaces.

Appealing to Chennai's water management heritage, this project seeks to demonstrate the effectiveness of recharge to combat droughts and floods. The project has strong backing from the local MLA, residents' groups and local institutions and can improve the recharge and retention capacity by 3MLD.

RESILIENCE PILLAR 2: WATER SYSTEMS

© Resilient Chennai - Adyar Poonga

As a coastal city with around 3600 water bodies, three river systems and arguably adequate rainfall, Chennai has the potential to be the 'water capital' of Asia—i.e. an exemplary city in this part of the world that showcases innovative and carefully considered water resource management. Historically, water in Chennai and Tamil Nadu was managed by a traditional *ery* system, which ensured that the adequate but seasonal water supply from the northeast monsoons was available to all throughout the year, including during drought years, while also mitigating flood risk. As such, the *ery* system is, to this day, recognized as an engineering and management marvel, with many lessons to learn from. Nonetheless, unplanned development and poor water management in Chennai over the years have rendered the ery system dysfunctional, while also leading to the current state of affairs wherein the city struggles at any given time with either too little water (in the form of droughts) or too much (in the form of floods), with detrimental effects on people, infrastructure and livelihoods. Further, Chennai's water system is at risk from climate change, which is likely to manifest through extreme precipitation events—resulting in more droughts and floods—sea level rise and increasing temperatures which in and of itself is likely to exacerbate existing water system challenges.

Chennai's water woes have been further shaped by institutional and data fragmentation, siloed thinking and action, lack of human and financial resources and a failure to recognize that water systems traverse natural and socio-technical environments, therefore requiring a holistic approach for efficient management.

Post the 2015 floods, city authorities and citizens have become increasingly sensitive to the complexity of water systems. There is growing recognition of how water related challenges such as availability, affordability, pollution, flood mitigation, and ground water recharge are interconnected. Simultaneously, the city is beginning to recognize that droughts, temperature rise and sea level rise are longer term events that manifest over many years. Therefore, these events require longer term adaptation measures that integrate efforts to protect, restore and conserve water resources with efficient urban land-use planning, solid waste and wastewater management, and stringent monitoring and enforcement mechanisms.

MISSION 2: Carving a resilient future around our water resources

In light of the above discussion, one of Chennai's missions is to carve a resilient future around the city's water resources. This entails more than bouncing back from water related disruptions; it involves building linkages and initiating integrated efforts on a continual basis, so that solutions to Chennai's water problems are holistic and sustainable in the long run. Three specific goals will help achieve this mission:

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

GOAL 2.1 FOSTER RESPONSIBLE WATER USAGE.

6 ACTIONS

An emphasis on effective demand management, responsible water usage and responsible water sourcing have emerged as a critical means of enhancing water security in Chennai city. Achieving this, would entail a) ensuring that the value of water is recognised by society through effective pricing; b) ensuring water conservation through the installation of water meters; c) urging domestic, commercial and industrial users to reduce dependency on fresh water by switching to alternative sources of water including recycled waste water, storm water and harvested rain water for non-drinking purposes, and; d) ensuring that the cost and price of these alternatives are lower than fresh water sources, specifically that from private bore wells.

Chennai was the first city in India to make rain water harvesting (RWH) compulsory[xxvi]. This was done in 2003, in response to a severe drought that led to a complete shutdown of the city's piped water system. It was also one of the first cities in the country to provide recycled water to industries and is currently increasing sewage treatment plant capacity. Further, water sector stakeholders and residents themselves have indicated that the way forward should primarily involve demand management rather than conventional supply-side solutions. While, the Chennai Metropolitan Water Supply and Sewage Board (CMWSSB)'s master plan emphasises source augmentation through desalination plants, CMWSSB also encourages users to tap into alternate, more sustainable sources of water like recycled waste water. It is also simultaneously beginning to explore demand-side solutions that reduce overall water consumption and system losses. It is important that this momentum to source water responsibly and better manage water demand through conservation measures is further leveraged.

LINKS TO NATIONAL/ LOCAL POLICIES/ GOALS

National Water Policy, 2012

Tamil Nadu Vision, 2023

Chennai Metropolitan Area Groundwater (Regulation) Act, 1987

Tamil Nadu Combined Development Regulation and Building Rules 2018

CMWSSB Press Release (22.4.2017) mandating waste water recycling

Chennai Smart City Ltd Programme

LINKS TO INTERNATIONAL POLICIES/ GOALS

xxvi Amendments were made to Section 215 (a) of the Tamil Nadu District Municipalities Act, 1920, and the Building Rules, 1972 which makes it mandatory for all buildings in the state to provide RWH structures. Further, the Chennai Metropolitan Area Groundwater (Regulation) Act, 1987 stipulates that no new site plans can be sanctioned without provision for rainwater harvesting.

25

Rise to recycle water—creating awareness around water recycling

TIMEFRAME
Long term

STATUS
Ongoing
(Needs scaling-up)

This project will involve two components. The first will be the launch of a widespread and sustained campaign (through multiple media streams) to raise awareness about the benefits of waste water management and to stimulate behavioural change and public acceptance among residents around recycled water. The campaign objective is to ensure that residents begin to accept and use treated waste water for domestic purposes (e.g. gardening, sanitation, cleaning, washing etc.) and eventually for drinking and cooking. The campaign will be conducted in Tamil and English and will include information about the benefits of recycling, the reliability of tertiary treated water for drinking purposes, methods to recycle water and costs associated with different treatment techniques. A similar campaign will be conducted in both public and private educational institutions to ensure maximum reach. The second component of the project will be creation of a data repository on best practices in water recycling that includes information about what works, what doesn't work, why, and the costs associated with recycling at different scales. This internet-based archive will bring together case studies from across sectors, including government, the private sector and industry, and will be constantly updated to reflect the latest field learning. Its aim will be to address a current knowledge gap and to provide information to industry, institutions and interested residents on alternative and affordable practices accessible to all.

KEY PLAYERS

CMWSSB, the private sector, industry associations, NGOs, Resident Welfare Associations (RWAs), academic institutions, National Institute of Urban Affairs (NIUA)

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Promotes cohesive & engaged communities;

RESILIENCE CO-BENEFIT

The awareness campaign would help build public awareness on civic issues, specifically sustainable water and environment management (**Governance Ecosystem – Goal 4.3**).

26

Water recycling directive for domestic and industrial use

TIMEFRAME
Long term

STATUS
Ongoing
(Needs scaling-up)

Mandating water recycling provides the necessary policy impetus required to increase adoption of water recycling. CMWSSB already issued an advisory in April 2017, stating that new water and sewage connections will be refused for 'special and multi-storied buildings' that do not recycle or use waste water. Accordingly, new water and sewage connection applicants have to include a self-declaration that they will comply with this rule by separating grey water from black water (e.g. by dual plumbing). Expanding the scope of this mandate to include commercial and industrial establishments, and giving it the necessary legal backing so that non-compliance is punishable by law, would be a step forward, as would publicising and communicating the provisions of the existing mandate to RWAs and industries.

KEY PLAYERS

CMWSSB, TNPCB

RESILIENCE LINKAGES

Fosters long term and integrated planning;

Meets basic needs;

Ensures continuity of critical services;

RESILIENCE CO-BENEFIT

A directive from the government can make citizens and industry more responsible in the way they manage water and would incentivise water conservation (**Governance Ecosystem – Goal 4.3**).

27

Decentralised water treatment systems (DEWATS)

TIMEFRAME
Short term

STATUS
Ongoing
(Needs scaling-up)

Investing in decentralised waste water treatment systems at household and neighbourhood scales for localised waste water treatment and reuse can greatly reduce demand for fresh water. DEWATS technology serves individual or small groups of properties, require less up-front investment and land than large systems, and are more effective at coping with the need to scale up (or down) services to correspond to needs[115]. These are in contrast to traditional centralised systems that require greater financial investment on multiple fronts—land, technology, capacity, maintenance—that make them difficult to implement.

CMWSSB is already looking to invest more in decentralised systems, particularly tertiary treatment reverse osmosis (TTRO) plants to manage water demand with construction of two new plants of 45MLD capacity underway at Koyambedu and Kodungaiyur. These plants will provide water to industries in nearby Irrungattukottai, Sriperumbudur and North Chennai[116]. It also plans to set up two TTRO plants in Perungudi and Nesapakkam to supply to nearby households[117]. While setting up DEWATS in the city could be challenging as it would require extensive retrofitting of the entire piped network, prioritising DEWATS for industries and new developments that do not have piped water connections, could be a first step. In addition, DEWATS could also be used to check sewage inflow into water bodies, by directing the sewage into these in-situ treatment systems. In Chennai, decentralised systems such as 'BioGill' and 'Solar Active Island Reactor' are already being used for this purpose.

KEY PLAYERS

CMWSSB, RWAs, NGOs, waste water management entrepreneurs, residents

RESILIENCE LINKAGES

Meets basic needs;

Protects & enhances natural & man-made assets;

RESILIENCE CO-BENEFIT

Investment (through individuals, housing complexes, commercial and industrial actors) in DEWATS can make citizens more responsible in the way they manage water and would incentivise water conservation (**Governance Ecosystem – Goal 4.3**). It would also generally equip the city to manage its waste more efficiently in an environment-friendly manner, keeping its water bodies clean. (**Healthy Urbanisation – Pillar 1**).

CHENNAI ASPIRATION:
BioGill Waste Water Treatment System

BioGill is an Australian decentralised waste water treatment company that uses modular, and natural systems, ideally suited to treat waste water at the point where it enters water bodies. The Adyar River, for instance, has over 64 outlets bringing raw sewage into the river. This system allows us to treat the waste water at the point it enters the river and releases the treated water into the river, the added benefit being that the treated water contains microbes that will continue to treat the water in the river. BioGill has a local partner, Aspick Engineering, in Chennai. They have offered to show proof of concept using one of their systems on Sembakkam Lake, which is being restored by The Nature Conservancy.

BIOGILL

CHENNAI INSPIRATION:
Solar Active Island Reactor

The Solar Active Island Reactor project aims to break the cycle of contamination and begin a process of waterway restoration by demonstrating a floating, decentralised, nature-based water treatment system on the Adyar river. Facilitated by Resilient Chennai and led by Pitchandikulam Forest Consultants, the reactor or 'live boat' has been set up on the Adyar River, next to Madras Boat Club and has a treatment capacity of 30,000 litres. The live boat is designed like an island and has four components – bioremediation, floating horticulture, solar water treatment, communal water stewardship and education. The island contains natural wetland plants that support aerobic treatment and a solar PV powered aeration system that drives active aeration and the water treatment process. Initial water quality tests (conducted in March 2019) reveal an 89% reduction in total suspended solids and 71% in chemical oxygen demand in the area, compared to pre-installation. The pilot project has been donated to Chennai Rivers Restoration Trust by Biomatrix/Conscious Ground, working in collaboration with Pitchandikulam Forest Consultants.

BIOMATRIX WATER

28

Install water meters to monitor water consumption

TIMEFRAME
Long term

STATUS
Ongoing
(Needs scaling-up)

Chennai, like many other Indian cities, does not measure water use at the customer end, and therefore does not price water based on consumption. CMWSSB has made several attempts to introduce water meters for but they have been unsuccessful, primarily because of a combination of technical, logistical and pricing issues. However, a survey carried out by the Resilient Chennai team reveals that 72% of participating citizens are willing to support government metering policy[xxvii]. The Chennai Smart City Ltd programme will introduce domestic water metering for households in T-Nagar as part of an 'area based plan.' It will also introduce 'AMR (automatic meter reading) meters for high volume consumers such as institutions and marriage halls in the city[xxviii]. The city will consider building on this programme by introducing it to other city wards and zones to measure water consumption, and consequently frame an effective water pricing policy that strikes the right balance between affordability, cost recovery, economic efficiency and conservation.

KEY PLAYERS

CMWSSB, Chennai Smart City, Ltd.

RESILIENCE LINKAGES

Meets basic needs;

Ensures public health services;

RESILIENCE CO-BENEFIT

This action would help monitor household and commercial water consumption and induce water conservation through water pricing (**Governance Ecosystem - Goal 4.2**).

100RC INSPIRATION:
Cape Town, South Africa

Through an amendment in their Water By-Law 2018, Cape Town introduced water management devices (WMDs) that replace standard water meters for users. These WMDs are programmed to provide a daily allocation of water for customers, by switching on at a fixed time every morning (e.g. 4 am) and generally restricting water supply to 350 litres per day and 10.5 KL per month. The device switches off when the household has used its daily water quota and resets the next morning to release the daily amount. Any amount not used is carried over to the next day during that calendar month. The key function of the WMD is that, customers will not be able to use more water than their daily limit in one day and if they use up all their water, they would have to wait until the next day to receive more. A WMD can therefore, help manage water consumption and provides customers with a daily allocation of free water (or a greater quantity by agreement), and helps customers limit or completely avoid water and sanitation charges. Further, for low income households, Cape Town city government will provide, an additional allocation of 4.5 KL per month free of charge, install the WMD without any charge, write off all water and sewage arrears (once-off), and fix and replace faulty plumbing (once-off repairs).

xxvii Water Survey: https://resilientchennai.com/water-survey/
xxviii CMWSSB interview, September 2018

29

Monitor water flow and leakage through electromagnetic flow meters

TIMEFRAME
Short term

STATUS
New / Proposed

Non-revenue water (NRW)[xxix, 118] accounts for approximately 20% of water produced in Chennai[119]. High NRW has consequences, notably in terms of water quality and energy costs, because a high percentage of leaks indicate higher chances of water contamination, and higher treatment and energy costs to maintain water pressure and quality. It also has consequences for water availability in the system, and the quantity of water that ultimately reaches users. Therefore, it is essential that electromagnetic flow meters are installed at Chennai's reservoirs, treatment plants, desalination plants, zonal and ward level pumping stations and the piped network to measure flow, detect leakage and maximise water availability. This system should be connected to a centralised control centre for continuous monitoring to prevent water wastage.

KEY PLAYERS

CMWSSB, Tamil Nadu Water Investment Company (TWIC)

RESILIENCE LINKAGES

Meets basic needs;
Ensures public health services;

RESILIENCE CO-BENEFIT

This action illustrates how data and technology could be used more effectively for, water governance, enforcement and monitoring of water rules and regulations (**G**overnance **Ecosystem – Goal 4.1 & Goal 4.2**).

30

Strengthen and monitor rainwater harvesting systems

TIMEFRAME
Short term

STATUS
Ongoing
(Needs strengthening)

Tamil Nadu was the first state in India to make rain water harvesting mandatory in 2003 through amendments to Section 215 (a) of the Tamil Nadu District Municipalities Act, 1920 and Building Rules 1972. Since then, and particularly over the past decade, a significant number of RWH structures in homes and across institutions are not functional due to poor maintenance and design of the original system. CMWSSB is now checking the functionality of existing systems. Therefore, this action will support the ongoing effort to ensure functionality of systems, identify and restore dysfunctional systems, establish new ones where they do not exist, specifically with an eye for over-exploited/critical/ semi-critical aquifer regions[120].

KEY PLAYERS

CMWSSB, Rain Centre, RWAs

RESILIENCE LINKAGES

Fosters long term and integrated planning;

Meets basic needs;

Protects & enhances natural and man-made assets;
Ensures continuity of critical services;

RESILIENCE CO-BENEFIT

This action would help monitor if households, commercial establishments and institutions have set up RWH structures and if they are in working condition (**Governance Ecosystem - Goal 4.2**).

xxix NRW refers to the physical loss of water through bad piping infrastructure, commercial loss through theft and illegal water usage and unbilled authorized user loss (Gupta, et al., 2016).

GOAL 2.2 GIVE PRIMACY TO WATER RELATED CHALLENGES IN URBAN DESIGN EFFORTS.

5 ACTIONS

Chennai is prone to floods and more so to droughts. Over the past two decades, these have become increasingly frequent and intense, partly indicating climate change, and partly due to rampant urban development with limited attention to the environment and the resources/services it offers. Planning and designing urban land use and infrastructure can be a key tool to mitigating risks associated with Chennai's water related challenges. Taking a long term and systemic approach to considering issues of climate change, potential sea level rise, impending floods and droughts when planning new developments or designing new infrastructure can strengthen Chennai's capacity to reduce risks and build city resilience. Giving primacy to water in planning and design therefore requires mainstreaming risk mitigation within current infrastructure development efforts (e.g. building bioswales to help ground water recharge).

LINKS TO NATIONAL/ LOCAL POLICIES/ GOALS

National Mission on Sustainable Habitat

The Environment (Protection) Act, 1986

Coastal Regulation Zone Rule (CRZ) Notification 2018

Tamil Nadu Vision 2023

Tamil Nadu Combined Development Regulation and Building Rules 2018

CMDA 2nd Master Plan 2006 – 2026

AMRUT

LINKS TO INTERNATIONAL POLICIES/ GOALS

SUSTAINABLE DEVELOPMENT GOALS

6 CLEAN WATER AND SANITATION

11 SUSTAINABLE CITIES AND COMMUNITIES

13 CLIMATE ACTION

15 LIFE ON LAND

n U A

UNITED NATIONS PARIS CLIMATE AGREEMENT SIGNING CEREMONY — 22 APRIL 2016

IMPLEMENTING THE NEW URBAN AGENDA

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31 🙌

Capacity-building on water centric design

TIMEFRAME
Short term

STATUS
New / Proposed

Training programme that focuses on how to design 'water-friendly' infrastructure can inform planners and designers within government agencies and other interested people such as project beneficiaries or RWAs. These programmes can be conducted by a consortium of experts from academic and planning institutions or architecture/urban design firms, possibly in CMWSSB's own training centre. The training will include a project where participants design or redesign an existing neighbourhood/ward/zone in the city based on what they have learned and keeping in mind existing constraints.

KEY PLAYERS

Academic Institutions (e.g. Anna Institute of Management and others), Urban design firms, CMWSSB

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Fosters long term and integrated planning;

Protects & enhances natural and man-made assets;

Ensures continuity of critical services;

RESILIENCE CO-BENEFIT

This project showcases how to integrate environment thinking in urban design and planning (**Healthy Urbanisation - Goal 1.1**).

32 ★

Pilot project showcasing water-sensitive design

TIMEFRAME
Short term

STATUS
New / Proposed

Inspired by the Adyar Poonga, the city can invest in a pilot project (or projects) to showcase how water-sensitive urban design can address multiple water related goals such as conservation, quality, flood management and beautification simultaneously.

As part of the Water as Leverage Project (WaL), a consortium of local and international partners has proposed to redesign the Mambalam Canal with a similar goal. The Mambalam area is situated to the west of the old city centre, between the Cooum and Adyar Rivers, and is synonymous with flooding and poor drainage. Historically, this area was the former "Long Tank", a large reservoir that served as the city boundary until 1921. Currently, the Mambalam basin with a residential population of around 380,000, has the largest shopping district in India (T. Nagar), generating INR 200 billion—USD 2.7 billion—per year. The proposal aims to transform the Mambalam canal and through it the larger Mambalam basin, to become more resilient to floods, drought and pollution, and become a flourishing public space at the city centre. The proposal includes the following essential elements:

a. Incentivising local stakeholders to introduce a series of nature-based solutions including onsite grey water treatment and ground water recharge systems;

b. Plugging solid waste and sewage dumping into the canal;

c. Redesigning the canal profile and building numerous bridges over the canal to include solid waste collection points;

d. Introducing permeable surfaces and infiltration trenches along the embankments to enable ground water recharge;

This proposed project could illustrate how Chennai could become a 'water capital' of Asia and serve a key educational/capacity building purpose for the city's planners and citizens alike. Depending on funds and interest from public and private partners, this action can be replicated across the city, not just for developments in or along waterbodies, but also in parks, buildings, neighbourhoods and can include water conserving elements like dual flushing in toilets.

WATER AS LEVERAGE FOR RESILIENT CITIES: ASIA

Chennai is one of three target cities for the 'Water as Leverage for Resilient Cities Asia' project which was launched at the UN Climate Conference COP23 in Bonn, Germany, on November 9, 2017. It is spearheaded by the Dutch Special Envoy for Water Affairs Henk Ovink, the Asian Infrastructure Investment Bank, the Global Center on Adaptation, 100 Resilient Cities, Architecture Workroom Brussels and the International Architecture Biennale Rotterdam. Its overall purpose is to foster collaboration across public, private and civic agencies to identify sustainable solutions for water related challenges that can be scaled up and that can act as leverage points for addressing the multitude of resilience challenges faced by these three cities. In Chennai, the WaL project aims to tackle the city's water challenges in an innovative and inclusive way. Two international, multi-disciplinary teams with local expertise–Rise Chennai and City of 1,000 Tanks were chosen to develop on-the-ground projects that address Chennai's challenges with floods, droughts and water related disasters.

KEY PLAYERS

Urban design firms, TNSCB, TWIC, Municipal Administration and Water Supply Department (MAWS), CMDA, GCC, RWAs, IIT Madras, Care Earth

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Fosters long term & integrated planning;

Protects & enhances natural & man-made assets;

RESILIENCE CO-BENEFIT

This project showcases how to integrate environment thinking in urban design and planning (**Healthy Urbanisation - Goal 1.1**).

CHENNAI INSPIRATION: Tholkappia Poonga *(Adyar Poonga)*

In its effort to restore the Adyar River, Chennai Rivers Restoration Trust (CRRT) completed the eco-restoration of 58 acres of the Adyar Creek in Phase I of the Adyar Eco Park project. The Adyar Creek and estuary cover an area of about 358 acres. A survey of historic plans showed that the area functioned as a storm water outflow for the watershed around the Creek and a reservoir for tidal water during high tide. CRRT aimed to restore the degraded creek, rehabilitate its coastal ecology, and introduce an environmental educational component with Adyar Poonga as a research base. The restoration effort included excavating and desilting to increase the water spread area by 59%, arresting sewage discharge into the creek by diverting it into sewer pipelines and recreating natural bio-diversity by planting around 172 species of plants such as mangroves, mangrove associates, reeds, terrestrial and aquatic plants. The project has resulted in an increase in the number of amphibians, reptiles, birds and mammals in the Poonga. The Poonga also includes an interactive learning space, an environmental education programme to create awareness about ecology and coastal ecology among school children.

Phase II of the project (spanning 300 acres), aims to restore the creek's ecological functions of acting as a water retention site and a natural buffer against tidal waves and storm surges.

100RC INSPIRATION: Mexico City, Mexico

Mexico City has a similar history of developing by encroaching and building upon its natural waterbodies like Chennai. Hence, as part of their resilience strategy, the city aims to improve its flood-prevention capacity using innovative water-sensitive green and blue urban design solutions that are capable of capturing rainwater and either retaining it for later use or infiltrating it into the ground.
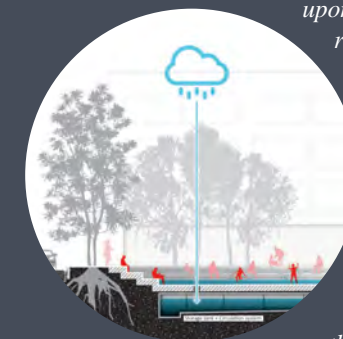
In 2015, the city in collaboration with the 100RC Platform Partner Deltares initiated a project to build water plazas in the city's unique zone of Xochimilco, a residential and agricultural area threaded with islands and canals. Under normal weather conditions, the planned water plazas are meant to operate like any other public square, where people meet, spend time, and attend special events. During rainstorms, water from surrounding streets is directed into the squares, which have been specially engineered for pooling and draining. The French Development Bank is already funding Phase I of Deltares' plan for Xochimilco, while 100RC's partner Rebuild by Design (RBD) is leading a community engagement process to ensure that the water plazas not only provide catchment areas to control flooding, but also promote social cohesion and offer appealing public spaces. These solutions need to be appreciated and replicated for their ability to address multiple goals.

33

Web-based platform on water-centric urban design

TIMEFRAME
Short term

STATUS
New / Proposed

A platform will be created for storing information on urban design projects that have incorporated water sensitive elements. Targeted towards urban planners within government and interested citizens, this platform could be created by a consortium of architecture/design firms and research institutions, and be hosted by CMWSSB. The website will include links to potential partners/funders looking to collaborate on similar work.

KEY PLAYERS

Urban design firms working on sustainable and green design, academic institutions such as Anna University and IIT Madras

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

RESILIENCE CO-BENEFITS

This project showcases how to integrate environment thinking in urban design and planning (**Healthy Urbanisation – Goal 1.1**).

34

Buffering the Chennai coast by using natural infrastructure

TIMEFRAME
Long term

STATUS
New / Proposed

Bio shields can be developed to act as buffer zones to mitigate floods and storms along the coast of Chennai. These shields would include planting local varieties of wetlands and other plant species such as trees, shrubs, aquatic plants and tuberous species that will help reduce the impact of storm surges and cyclones. This project can ensure involvement of a wide engagement of a wide range of stakeholders including the local fishing communities throughout the process to ensure their lives and livelihoods are protected.

KEY PLAYERS

CRRT, Forest Department, Care Earth, TNSCB, GCC

RESILIENCE LINKAGES

Fosters long term & integrated planning;

Protects & enhances natural & man-made assets;

Ensures continuity of critical services;

RESILIENCE CO-BENEFITS

This project showcases how to enable participatory planning by involving fishing communities in the planning process (**Healthy Urbanisation – Goal 1.3**) and how to integrate environment thinking in urban design and planning (**Healthy Urbanisation – Goal 1.1**).

CHENNAI ASPIRATION:
Muttukadu Backwaters

Among the many components of the RISE Chennai team's work as part of the 'Water as Leverage Project' (WaL), one sub-component is to strengthen the role of Muttukadu backwaters and Buckingham Canal to act as a natural buffers against sea level rise and coastal flooding, while also addressing issues of encroachments, water quality and local livelihoods. It will do so by developing an adaptive coastal defence plan that follows a more moderate and gradual approach to sea level rise, aiming at the short term, with a focus on increasing safety levels when required, in the long term. Some elements of the plan include: introducing sand nourishment along the beach to strengthen the eroded coastline along Muttukadu village; dredging the river mouth and transporting the sediments further north, where it can prevent future siltation; installing flap gates along Buckingham Canal (feeds into Muttukadu) to prevent entry of backwater into the storm water drain system, west of the canal; developing habitat islands within an existing lagoon that can help restore the biodiversity while also acting as a natural mechanism to reduce impact of rising sea levels; integrating eco-tourism activities with protection of biodiversity; redirecting inflows of waste water and restoring the Muttukadu wetland through removal of contaminated sediments and deepening of the lagoon.

35

Green storm water drains (SWD)

TIMEFRAME
Long term

STATUS
New / Proposed

The city will work towards reinforcing the existing storm water drainage system and investing in new multi-purpose systems that allow for a systemic approach to addressing the risk of flooding, ground water depletion, water insecurity and water pollution simultaneously. Through the ongoing Integrated Storm Water Drain Project, the Greater Chennai Corporation (GCC) is already attempting to construct recharge wells and connect SWD to temple tanks wherever possible to allow for ground water recharge. This effort needs to scale up by mapping out ground water aquifers to understand local hydrology—where recharge can have maximum impact on storage and water quality—and replicating natural drainage processes on site to manage rainfall close to where it falls. The essential elements of this network are: to ensure a significant amount of ground water recharge; to control the quantity of runoff such that the system can deal with everyday flooding and specific rainfall events; to manage the quality of runoff to prevent pollution; and to create better spaces for people (especially pedestrians) above the ground.

KEY PLAYERS

GCC, CMWSSB

RESILIENCE LINKAGES

Fosters long term and integrated planning;

Meets basic needs;

Protects & enhances natural and man-made assets;
Ensures continuity of critical services;

RESILIENCE CO-BENEFIT

This project showcases how to integrate environment thinking in urban design and planning (**Healthy Urbanisation – Goal 1.1**).

100RC INSPIRATION:
Berkeley, United States

To reduce risk of flooding and make its storm water drain infrastructure more resilient Berkeley used an innovative financing mechanism worth learning from. 86.5% of Berkeley voters approved USD 100 million general obligation infrastructure bond in 2016. The bond known as Measure T1 was primarily meant to fund repair work, renovation or replacement of the city's aging infrastructure, including storm water drains. Berkley stands out also for taking a comprehensive approach to storm water management. Instead of focusing on conventional storm water infrastructure alone, Berkeley uses multi-purpose green infrastructure (GI) (e.g. rain gardens, permeable pavements, and cisterns) that offer multiple benefits relating to flood mitigation, water conservation, removal of pollutants, climate adaptation, beautification of neighbourhoods etc.

CHENNAI ASPIRATION:
Kosasthalaiyar Integrated
Storm Water Drains Project

For phase III of the Integrated Storm Water Drains project, GCC is proposing to construct over 763 km of storm water drains in Manali, Madhavaram, Thiruvottiyur, parts of Thiru-Vi-Ka Nagar, Ambattur and Anna Nagar zones. The project design would include, allowing for rain water harvesting by integrating local tanks as retention reservoirs and construction recharge pits; identification of, and restricting sewage discharge into storm water drains; and restoration of 55 water bodies. With an approximate project cost of INR 25.18 billion, the overall aim is to improve living standards and enhance fresh water availability in the basin. As of May 2019, a detailed project report has already been prepared by GCC and an external consultant.

MISSION 2: Carving a resilient future around our water resources

GOAL 2.3 ENSURE BETTER COORDINATED EFFORTS BETWEEN PUBLIC, PRIVATE AND CIVIC AGENCIES TO RESTORE AND PROTECT WATER BODIES (INCLUDING THE SURVIVING ERYS).

3 ACTIONS

The 2015 floods and resulting devastation brought home the importance of conserving regional water bodies and water ways. As a result, several efforts are underway by actors such as GCC, PWD, CSCL, CRRT, EFI and TNC. At present, GCC has identified 210 water bodies and is working towards restoring them. Some of these efforts are being undertaken in partnership with non-governmental organisations and through CSR support. Other examples include the Integrated Cooum River Eco-Restoration Project, Chetpet *Ery* restoration and lake restoration projects by CSCL. These projects have the overall objective of restoring and rejuvenating water bodies including lakes, rivers, ponds and tanks/*erys* to mitigate the impact of extreme events (such as floods and drought). This goal intends to influence existing projects so they achieve their full potential through coordinated actions from the various government departments and non-governmental organisations involved, including the GCC, PWD, CRRT, CSCL and EFI. This entails:

a. coordination/communication (and data sharing) across government departments and agencies so that individual actions support and complement the other departments work rather than being counter-productive or repetitive;

b. coordination/communication, not just across government departments that own and manage water bodies but also across other associated departments such as TNSCB (for low income housing), GCC (for solid waste management) and TNPCB (for water quality) beyond specific project periods so complex issues of encroaching on or polluting water bodies can be tackled in an integrated manner; and

c. communication across government and non-governmental actors for collective learning and common understanding of effective restoration procedures to ensure that ongoing efforts collectively have a higher impact.

CHENNAI INSPIRATION:
Sembakkam lake restoration

The Semmbakkam lake restoration project is an example of several actors working together to restore and rejuvenate a water body in Chennai. The restoration project is being led by The Nature Conservancy (TNC) which is an international NGO that works to conserve water bodies, lands and forests and a platform partner for 100 Resilient Cities. The lake has degraded over time due to siltation, untreated sewage disposal, solid waste dumping and illegal encroachments, significantly reducing its ability to act as a flood sink. TNC is working actively to involve the local community in restoration efforts and with other stakeholders across the city government, research institutions and private companies to effectively address issues of water pollution from solid waste dumping to waste water discharge.

This effort prioritizes nature-based solutions for restoration, which provide multiple ecosystem benefits. Strategies for restoration are aimed at improving water storage capacity, reviving inlet and outlet channels to facilitate water flow into other lakes that are part of the same cascading system, improving water quality and habitat for biodiversity, while also creating a recreational space integrating people and nature. The project began in March 2018 and will likely be completed by December 2019.

LINKS TO NATIONAL/ LOCAL POLICIES/ GOALS

The Environment (Protection) Act, 1986

National Water Policy, 2012

Chennai Smart City Ltd programme

Wetlands (Conservation and Management) Rules, 2017

LINKS TO INTERNATIONAL POLICIES/ GOALS

36

Water restoration dashboard

TIMEFRAME
Short term

STATUS
New / Proposed

A Chennai City Connect initiative is working on addressing coordination among water restoration efforts by developing an internet-based platform that is accessible to all. The platform will provide details of all ongoing and completed efforts around water body restoration in the Chennai Metropolitan Region. It will also include details of location of effort, leading organisation(s) funding and involved in the effort and description of the work being done. In addition to ongoing efforts, the dashboard will also list agencies that have technical expertise, resources and interest in restoration efforts. This information will help other individuals/organisations that are interested in initiating new efforts.

KEY PLAYERS

Chennai City Connect, CRRT, GCC, Chennai Smart City Ltd., CMWSSB, EFI

RESILIENCE LINKAGES

Fosters long term and integrated planning;

Empowers a broad range of stakeholders;

Promotes cohesive & engaged communities;

Protects & enhances natural and man-made assets;

RESILIENCE CO-BENEFIT

This project would help inform interested citizens/ RWAs who wish to take a more active role in restoration efforts in their neighbourhood (**Governance Ecosystem – Goal 4.3**).

37

A consortium for integrated restoration and protection of water bodies and waterways

TIMEFRAME
Short term

STATUS
New / Proposed

Under the leadership of organisations that are active in the lake restoration space such as EFI and CRRT, a consortium of government, citizen, corporate and non-profit representatives can be created to advise lake restoration efforts, monitor regulatory compliance and to forge collaboration across various parties so that different agencies work efficiently and not at cross purposes. This multi-stakeholder group would include government and non-government experts across sectors like water, solid waste management, housing, pollution, etc., complementing existing CRRT efforts to bring all government actors together for water body restoration efforts.

KEY PLAYERS

CRRT, CMWSSB, GCC, PWD, CSCL, EFI, Care Earth, Chennai City Connect, TNC, RWAs, Industry

RESILIENCE LINKAGES

Fosters long term and integrated planning;

Empowers a broad range of stakeholders;

Promotes cohesive & engaged communities;

Protects & enhances natural and man-made assets;

RESILIENCE CO-BENEFIT

This project would help ensure that the housing and associated needs of informal settlers along water bodies are met in a more humane manner (**Vulnerable Communities – Goal 5.3**). This project is also an example of taking an integrated approach to address environmental challenges through urban design (**Healthy Urbanisation – Goal 1.1**).

CHENNAI INSPIRATION:
Chennai Rivers Restoration Trust

The 42km long Adyar River, flows into the Southern parts of Chennai city, originating from Adanur tank near Guduvancherri and carrying the surplus flow from Chembarambakkam Lake. Untreated waste water discharged into the river from drains within CMA, industrial effluents from Pammal region, open defecation, and illegal solid waste dumping on the river banks and encroachments in the city, are some of the causes the river is degraded and polluted. As a result, Chennai Rivers Restoration Trust has undertaken the eco-restoration projects with the aim of establishing a healthy river ecosystem to reverse the above mentioned damages caused to the river[121]. Some of these measures are implemented in the Adyar/ Tholkappia Poonga Restoration project.

The Cooum River runs through a distance of 20 km within Chennai city, and originates from the surplus course of Cooum Tank. Prior to entering city limits, the upper-catchment of the river serves the purposes of irrigation and supports additional rain fed agriculture in rural parts of the state. As the river enters the peri-urban and municipalities there is an evident problem of reduction of water quality and drop in oxygen levels due to pollution caused by solid waste disposal, waste water discharge and refuse from localities along the river being illegally dumped into the Cooum. Within city limits, the river is treated as an urban sewer. Therefore, CRRT, along with various other line departments of the State government is undertaking 69 activities which are to be completed in three phases to restore the quality of river water and its ecosystem. The proposed and implemented activities are similar to the Adyar River restoration project[122].

While restoring Adyar and Cooum Rivers, it is critical to restore the Buckingham Canal since it crisscrosses these two rivers, flowing through a stretch of 163 km in Tamil Nadu, and from Ennore to Muttukaadu in Chennai (48 km). Due to urbanization, encroachments, illegal solid waste disposal, and lack of sewage water treatment; this canal has lost its past glory of ferrying and cargo movement. On the request of CRRT, TNUIFSL has appointed a consultant for the preparation of DPR for restoration of Buckingham Canal on similar lines of the above two ongoing projects.

38

Lake restoration—A guide book

TIMEFRAME
Short term

STATUS
New / Proposed

The city needs to define a set of guidelines that will direct multiple lake restoration efforts that are currently underway–such that they address hydrological problems using a people-centric approach and specify various steps involved in restoration. Non-profit organisations active in lake restoration efforts and technical experts from academic institutions can develop a lake restoration guidebook. This document would be a primer for local government, NGOs and CBOs, engineers and technical experts and organisations looking to intervene. It would include details on hydro-geological, economic, ecological, socio-cultural and other factors that need to be considered in the restoration process. It would also contain information on what should be achieved by restoration efforts and the role of stakeholders in the process.

KEY PLAYERS

CRRT, GCC, PWD, CMWSSB, Chennai Smart City Ltd., EFI, TNC, IIT Madras

RESILIENCE LINKAGES

Fosters long term and integrated planning;

Empowers a broad range of stakeholders;

Promotes cohesive & engaged communities;

Protects & enhances natural and man-made assets;

RESILIENCE CO-BENEFIT

This guidebook would support greater coordination and collaboration among government, citizens and private companies (**Governance Ecosystem – Goal 4.3**) for lake restoration efforts and generally support more integrated urban planning.

Rowing on the Adyar Creek between Whale Island and Theosophical Soceity | Courtesy Madras Boat Club

RESILIENCE PILLAR 3: DISASTER PREPAREDNESS

© Adithya Anand - 'Duty Calls', Kilpauk, Chennai Floods 2015

Historically, Chennai has been disaster-prone, experiencing climate and non-climate related disasters. However, the frequency of disasters in Chennai—specifically, floods and droughts—has increased, and its impact on Chennai's residents, economy and infrastructure is widespread. While integrated and proactive actions in planned urbanisation, a well-managed water system and collaborative urban governance can help prevent certain events, or at least minimise their intensity, Chennai must simultaneously prepare itself to face and tackle disasters when they do happen. Special attention needs to be given to vulnerable communities and small businesses, which typically tend to be most affected by disaster events.

⚠ *MISSION 3: Making Chennai a prepared city*

To minimise the loss and damage resulting from future disaster events, the city will earnestly focus on actions to strengthen its preparedness and work to reduce response time by focusing on the following four goals:

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

GOAL 3.1 LEVERAGE DATA AND TECHNOLOGY TO COPE WITH DISASTERS MORE EFFICIENTLY.

3 ACTIONS

The biggest challenge to enabling quicker and more efficient disaster response is the lack of quality data to inform and direct planning and rescue efforts. In the aftermath of the 2004 tsunami, the Indian National Centre for Ocean Information Services (INCOIS), Hyderabad set up early warning systems that alert coastal states in the event of undersea earthquakes that may trigger tsunamis[123]. However, no similar tool is in place to warn against drought, storm surges or floods. The December 2015 floods in Chennai effectively highlighted how data and technology could have drastically reduced the impact of the event on the city. Accurate and quality data on, for instance, weather conditions in urban areas to predict precipitation magnitude or water flows into the Adyar and Cooum rivers and the Buckingham Canal would have been extremely useful to take timely and appropriate steps in preparation for the event. Furthermore, numerically robust hydrological models and detailed urban flood simulations based on accurate data would have also improved city capacity to deal with the disaster[124]. Therefore, leveraging accurate sources of data and data-driven techniques seem imperative for Chennai to become a prepared city.

LINKS TO NATIONAL/ LOCAL POLICIES/ GOALS

National Disaster Management Plan 2016

Prime Minister's 10-point Agenda on Disaster Risk Reduction 2016

Urban Flooding—Standard Operating Procedures 2017

Tamil Nadu State Disaster Management Perspective Plan (TNSDMP) 2018-2030

Chennai City Disaster Management Plan (CDMP) 2018

LINKS TO INTERNATIONAL POLICIES/ GOALS

39

Multi-hazard data collection & mapping

TIMEFRAME
Short term

STATUS
Ongoing
(Needs strengthening)

The city will continue to invest in collaborative efforts to collect and analyse good quality and accurate data, and then map and assess the most significant disaster risks for Chennai city[xxx]. The first step to mitigating disaster risks is to have the right data on likely threats (droughts, tropical cyclones, storm surges, earthquakes and tsunamis) and on regions and communities that are at risk from these threats. Therefore, different types of data will be collected, including precipitation, surface and groundwater levels, soil moisture, stream flows and sea surface temperature. Since some of the data are already available or are being collected by different departments and organisations, collaborations across government and private agencies will be critical. The data will be spatially mapped and overlaid by data on socio-economic characteristics, resident access to various basic services such as water, sanitation and electricity to assess disaster risk and to create detailed GIS-based risk maps and hydrological models. This project will support government agencies like the Tamil Nadu State Disaster Management Authority (TNSDMA), and institutions like the Indian Institute of Technology, Madras (IITM) and Anna University to develop efficient early warning systems and make urban planning processes data driven.

xxx According to the Tamil Nadu State Disaster Management Plan (TNSDMP), the Government of Tamil Nadu has announced that it will establish a GIS cell within the Revenue and Disaster Management Department, for risk and hazard assessment. This cell will also be integrated with early warning systems and other decision support systems.

KEY PLAYERS

TNSDMA, Revenue and Disaster Management Department, PWD, CMDA, GCC, IITM, Anna University (Remote Sensing Department), National Centre for Coastal Research (NCCR), INCOIS, Indian Meteorological Department (IMD)

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Fosters long term & integrated planning;

Ensures continuity of critical services;

RESILIENCE CO-BENEFITS

This action would help focus urban planning and design on water and environment issues (**Water Systems - Goal 2.2; Healthy Urbanisation – Goal 1.1**) and improve knowledge transfer across government departments (**Governance Ecosystem – Goal 4.1**).

CHENNAI INSPIRATION:
RiskMap *(www.riskmap.in)*

RiskMap showcases how citizen reporting and social media can be leveraged to map real-time information during a disaster event. Developed by Urban Risk Lab, Massachusetts Institute of Technology, the map was used to great effect during high intensity rainfall events between November 1 and 6, 2017 in Chennai. Essentially, the platform connects residents with emergency managers to drastically cut down on response times. Through the live map, residents are also able to inform each other about dynamically changing situations in the city and help each other navigate to safety. The platform currently works with Twitter, Facebook, and Telegram, and also displays real-time sensor information, such as changing water levels in flood gauges, monitoring wells and pumping stations.
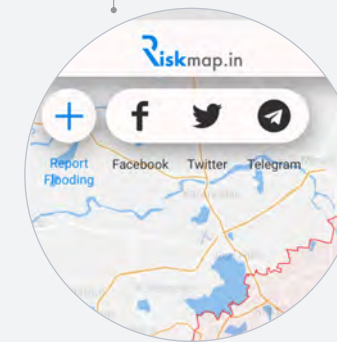
100RC INSPIRATION:
Rio de Janeiro, Brazil

The city of Rio de Janeiro, the second largest city in Brazil in terms of population and GDP, sits between the sea and the mountains facing multiple risks due to urbanisation and climate change. The city's climate adaptation plan identified exposure to sea level rise, landslides, urban heat islands, flooding, and prolonged drought as some of the major risks that Rio faces. Recognizing the need for multi-hazard mapping to assess these disparate risks and analyse their interaction with city's people and infrastructure, Rio has embarked on an effort to develop multi-hazard assessment maps using computational models, real-time sensing, and Big Data. Incorporating the information available from such exercises strengthens the city's position to comprehend potential impact, plan in advance, target efforts to specific areas, communities etc. While the initiative was implemented by Rio Resilient in the early stages, it was fully incorporated in the city's Strategic Plan 2017-2020.

DISASTER PREPAREDNESS

MAKING CHENNAI A PREPARED CITY

3.1

GOAL

DISASTER PREPAREDNESS

MAKING CHENNAI A PREPARED CITY

3.1

GOAL

40
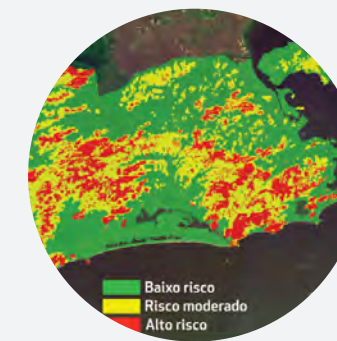
Detailed flood monitoring and forecasting

TIMEFRAME
Short term

STATUS
Piloted
(Needs scaling-up)

Investments will be made in a GIS-based flood monitoring and forecasting tool to observe long-term trends and to help government, communities and emergency teams respond more quickly to flooding events and to reduce their impact (according to the TNSDMP). This type of system will comprise of:

- Real-time telemetry/GPRS network from stations such as Automatic Weather/Automatic Rain Gauge stations;
- Online stream inflow and outflow meters that collect data on a continual basis;
- A spatial support system for the Adyar, Cooum, Kovalam and Kosasthaliyar river basins.

All collected data will be transmitted to a centralised control room to provide real-time information for:

- Flood mapping;
- Analysis of state of surface water systems;
- On-line operation of waterways.

This will enable floods mapping and the ability to communicate likely risks to communities. The National Centre for Coastal Research, IITM, IIT Bombay and Anna University are jointly developing a tool to forecast and observe rainfall levels, reservoir and river levels, and other parameters. Named CFLOWS, this tool is currently being tested.

KEY PLAYERS

TNSDMA, Revenue and Disaster Management Department, PWD, IITM, Anna University, Central Water Commission, IMD, National Centre for Coastal Research (NCCR), IIT Bombay

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Fosters long term & integrated planning

Ensures continuity of critical services;

RESILIENCE CO-BENEFITS

This action would help focus urban design around water challenges (**Water Systems - Goal 2.1**) and improve coordination and data sharing across government departments (**Governance Ecosystem – Goal 4.1**).

LEGEND
— Major Rail Network
— Chennai Metropolitan Area (GMA)
— Major Road Network
Existing water bodies
Depleted water bodies
Built up area
ZONES
Barren Land
Low Flood Prone (LFP) area
Medium Flood Prone (MFP) area
High FLood Prone (HFP) area
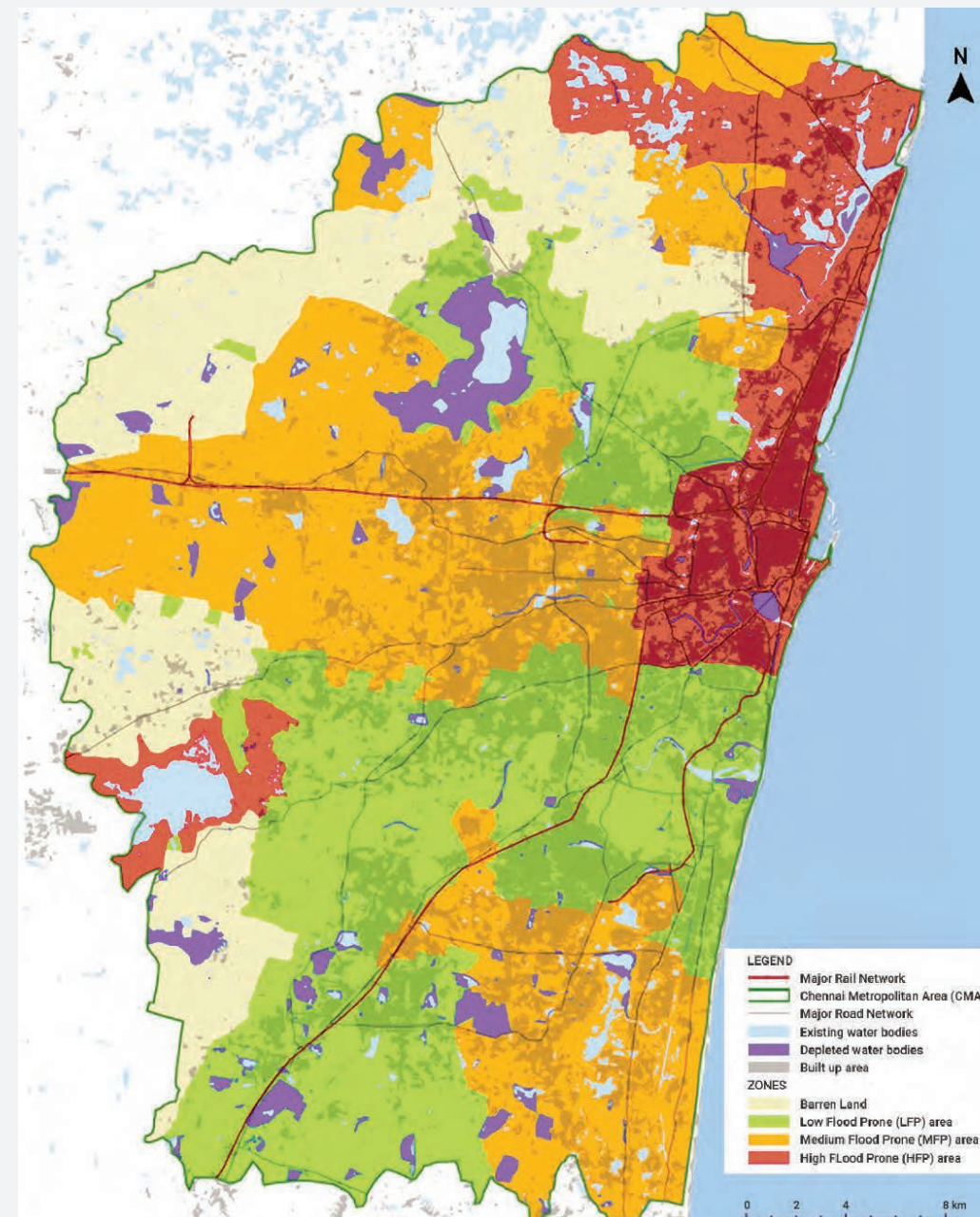
0 2 4   8 km

Figure 19: Flood prone map and depleted water bodies
Source: Ahmed and Kranthi, 2018[125]

41

Early warning systems for forecasting extreme events

TIMEFRAME
Short term

STATUS
Ongoing
(Needs scaling-up)

Investments will be made in state-of-the-art early warning systems to alert emergency response teams and reach communities on imminent disasters, according to the TNSDMP. These systems will include hazard and risk forecasting which discuss probability, confidence and impact of the forecasts on communities, critical infrastructure and the natural environment. Managed by Chennai's Disaster Management Authority, these systems will provide real time situational awareness on areas at risk across the district, which can then inform and direct emergency response teams.

KEY PLAYERS

TNSDMA, Revenue and Disaster Management Department, IMD, IITM, Anna University, INCOIS, National Centre for Coastal Research (NCCR), GCC

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Fosters long term & integrated planning;

Ensures continuity of critical services;

RESILIENCE CO-BENEFITS

Early warning systems can play a critical role in making communities more prepared for disasters (**Disaster Preparedness – Goal 3.4**) and it can particularly help protect and warn vulnerable communities, especially those living along water ways (**Disaster Preparedness – Goal 3.2, Vulnerable Communities – Pillar 5**).

MISSION 3: Making Chennai a prepared city

GOAL 3.2 SPECIFICALLY ADDRESS CHALLENGES FACED BY VULNERABLE GROUPS LIVING IN DISASTER PRONE AREAS.

3 ACTIONS

Disaster vulnerability for the urban poor and other vulnerable groups is constituted and exacerbated by socio-economic conditions such as poverty, precarious livelihoods, insecure housing and dependence on state services. As flood, drought and cyclone events increase in frequency and intensity in Chennai, this acute vulnerability turns chronic[126]. Providing relief to Chennai's vulnerable proved to be a challenge during major disasters such as the 2015 floods and the 2004 tsunami. Innovative systems for organising and distributing relief and rescue assistance were deployed by some state agencies and NGOs. However, these were not replicated across state agencies, nor were they incorporated into ongoing protocols for future response or mitigation efforts. Many NGOs note that the manner of disbursing humanitarian assistance to vulnerable populations in the aftermath of disasters undermines the vulnerable communities' dignity and creates a heavy dependence on external assistance, often reducing communities to passive recipients. An important ongoing challenge, then, is to devise modes of relief distribution that maintain and enhance the dignity of vulnerable people.

LINKS TO NATIONAL/ LOCAL POLICIES/ GOALS

National Disaster Management Plan 2016

Prime Minister's 10-point Agenda on Disaster Risk Reduction 2016

Tamil Nadu State Disaster Management Perspective Plan (TNSDMP) 2018-2030

Chennai City Disaster Management Plan (CDMP) 2018

LINKS TO INTERNATIONAL POLICIES/ GOALS

42

Disaster response plan for vulnerable communities

TIMEFRAME
Short term

STATUS
New / Proposed

Differently-abled people, children, women, the elderly and low-income communities are some of the population segments that are typically more affected by disasters. Reduced impact, quick and efficient disaster response and increased preparedness is required for these segments, and can be achieved by formulating a disaster response plan which includes information on emergency shelters, contact numbers, a list of "dos and don'ts" for before, during and after disaster events. Therefore, the city will consider developing a targeted disaster response plan for the vulnerable. This plan would include the following points:

a. Providing sensitive and quick disaster relief that is appropriate to the needs of different vulnerable groups, based on assets and livelihood losses;

b. Assessing losses both in terms of life and property and in terms of key documents (e.g. voter ID, school records and property title deeds) and restoring these critical resources more effectively;

c. Providing safe spaces where people and animals can take shelter in the event of disasters, such as community halls/shelters on elevated grounds, and ensuring that they are accessible to all, including the elderly and people with disabilities;

d. Providing storage space for key assets;

e. Designing settlement and buildings such that they have emergency exits and routes for rescue/relief operations and evacuation;

f. Building capacity of government personnel (including National Disaster Response Force and State Disaster Response Force) to recognise the diversity of vulnerable communities and provide appropriate humane and sensitive relief.

This plan could potentially be incorporated into the GCC's Chennai Disaster Management Plan.

KEY PLAYERS

TNSDMA, District Collector's Office, Department for Welfare of Differently-abled Persons, TNSCB, GCC, Greater Chennai City Police, NGOs – Indian Red Cross, Vidya Sagar, Spastics Society[xxxi], IRCDUC[xxxii], *Uravugal* and *Pennurimai Iyakkam*[xxxiii], Blue Cross of India

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Fosters long term & integrated planning;

Ensures continuity of critical services;

RESILIENCE CO-BENEFITS

This action would help identify and meet the needs of different vulnerable communities during, before and after a disaster (**Vulnerable Communities – Goal 5.1**).

[xxxi] *Vidya Sagar is an institution that actively works with differently-abled children and adults to improve their lives and provide necessary support.*
See: *http://www.vidyasagar.co.in/en/index.php*
Spastics society of Tamil Nadu empowers and enables disabled people to reach their full potential through Education, Training and Employment.
See: *http://www.spastn.org*

CHENNAI INSPIRATION:

Perumbakkam Community-driven Vulnerability Mapping and Disaster Response Plan

With support from the Resilient Chennai office, Information and Resource Centre for Urban Deprived Communities (IRCDUC) is working closely with residents of Perumbakkam, which is one of the largest resettlement sites in Chennai, to enhance capacities and build the resilience of the community, especially women and children, to cope with vulnerabilities associated with safety and disaster risks. This work involves:

-   *Facilitating formation of a cadre of women leaders who will facilitate the community level planning process for envisioning a safe space of habitation for women and children;*
-   *Conducting a survey and organizing a series of workshops to get inputs from the community on their vulnerability, and inform them about their roles, responsibilities, and rights;*
-   *Assessing the larger community's vulnerability to disaster risks (flood, fire, droughts etc);*
-   *Informing the community of available resources and appropriate steps for safety during disasters.*

The ultimate goal of this exercise is developing a participatory plan for safe habitation and improved disaster response that will be shared with relevant public and civic agencies for implementation.

100RC INSPIRATION:

Semarang, Indonesia

As a port city Semarang is facing pressing challenges relating to tidal and flash floods which are being aggravated by climate change, sea level rise, coastal erosion, and land subsidence. Supported by the Rockefeller Foundation's Asian Cities Climate Resilience Network (ACCCRN), Semarang has developed a flood early warning system that requires effective coordination between key stakeholders across governmental departments and sectors, including the planning, water resources, meteorological and disaster management agencies.

What makes Semarang stand out as an inspiration is that their effort uses simulations to prepare communities to know what would happen and what should be done in the event of a flood. For instance, in 2014 such a simulation was carried out for the Wonosari community. The simulation involved a training exercise for the community starting from evacuation alerts with a siren, and a community disaster team evacuating the people to the shelter, which was located on high ground. Once all members were at the shelter, the exercise ended with a community-wide debrief. Leaders shared reflections pointing out issues they saw arise and any improvements needed in the procedure. As such Semarang's effort highlights the need for improving the awareness building element within disaster management processes.

[xxxii] *IRCDUC (Information and Resource Centre for the Deprived Urban Communities) is a Chennai-based consortium of community-based groups and individuals from different sectors working to assert the rights of urban deprived communities.*
[xxxiii] *Both these organisations are Chennai-based and work actively on the ground, to uplift the lives of vulnerable communities.*

43

Strengthening capacity of vulnerable communities to cope with disasters

TIMEFRAME
Short term

STATUS
Ongoing
(Needs scaling-up)

The city will consider developing a capacity building programme that would focus on the need for providing relief and help that is sensitive to the diversity of needs across vulnerable populations. The programme would target the communities themselves to deal with disasters collectively. It will include elements of skills development, training and technology transfer such as training groups of local volunteers (who are familiar with the residents and vice versa) to assist official relief efforts and conducting safety drills on dos and don'ts during different types of disasters[xxxiv].

KEY PLAYERS

TNSCB, GCC, Indian Red Cross, NGOs, including IRCDUC, *Pennurimai Iyakkam, Uravugal,* Bhoomika Trust[xxxv], Blue Cross of India

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Fosters long term & integrated planning;

Promotes leadership & effective management;

RESILIENCE CO-BENEFITS

This action would help identify and meet the needs of different vulnerable communities during, before and after a disaster (**Vulnerable Communities – Goal 5.1**).

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xxxiv The Revenue and Disaster Management Department is already conducting tsunami response drills in fishing communities.

xxxv Bhoomika Trust is a Chennai based non-governmental organization that works in the areas of disaster relief, rehabilitation, mitigation/ preparedness and education. See: http://www.bhoomikatrust.org

44

Emergency supply of food and drinking water

TIMEFRAME
Short term

STATUS
Ongoing
(Needs scaling-up)

In the event of disasters, ensuring standby supply of basic provisions, especially for the most vulnerable communities is crucial. Therefore, the city will consider options of storing food, water, medicines, blankets and used tyres (which can act as flotation devices) in local community centres or already identified relief centres as per the Chennai City Disaster Management Plan (CDMP) 2018. This supply of food and water would be kept as reserves in notified and un-notified slums, resettlement colonies, fishing villages, homeless shelters, homes for the destitute and elderly, institutions for differently-abled and other relevant spaces. Such supplies could be available each year between October and the end of December (when the threat of flooding is higher) and during any other required time, depending on the type of threat.

KEY PLAYERS

GCC, ration shops, *Amma* canteens, Chennai Volunteers, Chennai Trekking Club

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Promotes cohesive & engaged communities;

Ensures continuity of critical services;

RESILIENCE CO-BENEFITS

This action would help identify and meet the needs of different vulnerable communities before, during, and after a disaster (**Vulnerable Communities – Goal 5.1**).

MISSION 3: Making Chennai a prepared city

GOAL 3.3 SUPPORT SMALL AND MEDIUM SCALE BUSINESSES THROUGH A COMBINATION OF ECONOMIC AND NON-ECONOMIC MEASURES TO HELP THEM COPE BETTER WITH DISASTERS.

4 ACTIONS

Tamil Nadu's well-established Micro, Small and Medium Enterprise (MSME) sector has a diversified portfolio of industries for domestic and international buyers. It includes textile, electronics, engineering, auto components, leather, chemicals and plastics[127]. Among Tamil Nadu's districts, the Chennai Metropolitan Area is ranked highest in the state in terms of new firms entering the sector, registering a 50% growth rate in the number of MSMEs between 2007 and 2008 and 2014 and 2015[128]. Yet, even as the sector grows economically, it remains highly vulnerable to disasters. While large companies tend to have a disaster contingency plan, MSMEs often do not. MSMEs are particularly vulnerable to disruptions caused by natural disasters because of the limited resources they usually have and because of the informality of the sector[129]. For MSMEs to build resilience to disaster events they need to overcome obstacles relating to inadequate, unreliable and untimely access to finance and insurance at all times, and more so after disaster events.

LINKS TO NATIONAL/ LOCAL POLICIES/ GOALS

National Disaster Management Plan 2016

Prime Minister's 10-point Agenda on Disaster Risk Reduction 2016

Tamil Nadu State Disaster Management Perspective Plan (TNSDMP) 2018-2030

Chennai City Disaster Management Plan (CDMP) 2018

LINKS TO INTERNATIONAL POLICIES/ GOALS

45

Single window system for Micro, Small and Medium Enterprise (MSME) relief

TIMEFRAME
Short term

STATUS
New / Proposed

After the December 2015 floods, MSMEs found it challenging to contact appropriate government agencies for relief and were unaware of the types of relief measures available to them[130]. Developing a formal platform where they can reach out to government departments for such assistance will improve resilience. This platform could be a physical office located in the State MSME department and would act as nodal point of contact. The office can also be linked to a website with relevant details on the various relief schemes, helpline numbers for other departments such as TANGEDCO and GCC and contact information for emergency response forces (SDRF and NDRF).

KEY PLAYERS

MSME Department, TNSDMA, District Collector's Office, Revenue and Disaster Management Department, GCC

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Supports livelihoods & employment;

RESILIENCE CO-BENEFITS

This action would help identify the needs of vulnerable communities (i.e. small business owners and their employees) before, during, and after a disaster (**Vulnerable Communities – Goal 5.1**).

46

Strengthening insurance support by offering specific disaster insurance

TIMEFRAME
Long term

STATUS
New / Proposed

Insurance support to MSMEs post-disaster is largely unavailable for many firms. This is particularly true for MSMEs. Even those firms that do possess coverage have found it to be inadequate, because a very small percent of total claims are actually met. Therefore, insurance support needs to be strengthened by offering specific disaster insurance plans with low premiums. The insurance could function as does the existing Pradhan Mantri Suraksha Bima Yojana scheme, which is offered through banks and administered by public sector general insurance companies. In addition, the city will consider working with the Insurance Regulatory and Development Authority and the State MSME department to ensure that insurance companies release above 50% of claims on existing policies and that claims are processed within the standard 15-day processing window (including site inspections).

KEY PLAYERS

Insurance Regulatory and Development Authority, insurance companies, banks, other financial institutions, MSME Department

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Supports livelihoods & employment;

RESILIENCE CO-BENEFITS

This action helps identify the needs of vulnerable communities (i.e. small business owners and their employees) before, during, and after a disaster (**Vulnerable Communities – Goal 5.1**).

47

Assistance from banks

TIMEFRAME
Long term

STATUS
New / Proposed

Banks play a critical role in supporting businesses during disasters, primarily through relief measures. Yet these measures have proven inadequate and limited in terms of the extent of support actually provided (as witnessed after the December 2015 floods)[131]. Banks can take several measures to help firms recover from losses, such as:

a. Extending the loan repayment window or modifying existing repayment arrangements so that they are flexible to enterprise needs;
b. Extending overdraft limit on accounts;
c. Providing credit immediately following disasters;
d. Reducing interest rates and equal monthly instalments for a minimum of six months.

KEY PLAYERS

Reserve Bank of India (RBI), banks and other financial institutions

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Supports livelihoods & employment;

RESILIENCE CO-BENEFITS

This action helps identify the needs of vulnerable communities (i.e. small business owners and their employees) before during, and after a disaster (**Vulnerable Communities – Goal 5.1**).

48

Collective aid for MSMEs by MSMEs

TIMEFRAME
Short term

STATUS
New / Proposed

While MSMEs may not individually possess the resources required to cope with major disasters, they can leverage their collective resources during such events. Together, MSMEs can create a foundation that maintains a pool of funds collected from all MSMEs based on their income. This can be accessed in times of need. In addition, the foundation will help develop a contingency plan based on collective inputs to enhance cash flow during a disaster.

KEY PLAYERS

MSME associations, industry associations

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Supports livelihoods & employment;

RESILIENCE CO-BENEFITS

This action helps identify the needs of vulnerable communities (i.e. small business owners and their employees) before, during, and after a disaster (**Vulnerable Communities – Goal 5.1**).

CHENNAI ASPIRATION:
Business Continuity Plan for MSMEs

Companies can combat natural, economic, and geopolitical disasters by devising a comprehensive risk management protocol through Business Continuity Plans (BCP). Although this task may seem daunting, over the last decade, BCP have helped firms throughout Chennai safeguard against catastrophe. More specifically, BCPs can help MSMEs determine how to allocate their limited resources in a manner that both protects their business model from shocks and optimizes financial performance.

The primary purpose of a BCP is to ensure that a business's employees, clients, and operations can withstand incremental disruptions. It should plan for all potential risks a company faces, including internal challenges such as resource availability, People, Infrastructure, Network (PIN), and external setbacks such as floods, droughts or earthquakes.

Therefore, a BCP should have a defined scope, which could consist of a department, service, product, or branch or the overall firm, by assessing which core business areas are key to their companies' survival and by considering what types of risks are material to those areas. Formulating the plan would involve conducting a simple impact analysis to address questions including; what penalties the firm would have to pay if it failed to carry out its contract, which processes or activities help deliver key products and services following a disruption, and what is maximum time process or activities (especially those dependent on an external vendor) could be down before the business is impacted. In addition, a BCP should also include:

a. *A strategy to ensure effective response to emergencies that could include: evacuating to ensure employee safety; setting up an 'Emergency Operation Center' and carrying out situation assessment; confirming employee safety; devising measures to restrict further damage and carrying out damage assessment; and reporting damage.*
b. *A continuity strategy that enables it to deliver its product or services under abnormal circumstances. For e.g. to maintain operations, MSMEs can rent undamaged business centers, ask employees to work from home, rely on clients' resources, or strike reciprocal agreements with peer firms, whereby each company can use the other's facility during crisis situations. MSMEs with multiple branches can transfer activities to its unharmed offices. However, if none of these strategies are viable, MSMEs should, at the very least, set aside reserve cash as part of their budgets for potential disasters, to bounce back quickly.*

Leaders must then select a senior level employee to oversee the BCP. Typically, this employee is a Business Manager or Operations Manager, or a Managing Director who should be able to communicate the collective agenda of the group of MSMEs to all relevant junior staffers, to implement and review the BCP effectively. For MSMEs that are preparing a collective BCP, a representative from each MSME or a proportionate number of representatives can perform this function. As businesses grow, they should continue to update their BCP.

For a more complete review on BCPs visit: https://resilientchennai.com/business-continuity-plan.

Cognizant

MISSION 3: Making Chennai a prepared city

GOAL 3.4 BUILD CAPACITY ACROSS GOVERNMENT & COMMUNITY TO BE BETTER PREPARED IN THE EVENT OF DISASTERS.

5 ACTIONS

One of the biggest challenges in limiting disaster impact is ensuring that government and community both have the capacity to respond quickly to disasters. Capacity, in the disaster context, as defined by the UNISDR in 2017 "refers to all the strengths, attributes and resources available within a community, organization or society to manage and reduce disaster risks and strengthen resilience"[132]. Consequently, building capacity should not involve just the provision of various types of training and learning, but should also encompass strengthening of institutions, raising of political and citizen awareness, and development of a wider and more enabling environment for quick disaster response at both the institutional and individual levels. Preparedness, and the knowledge of 'what to do' just before, during and after disasters was markedly lacking when floods hit Chennai in December 2015. This was true for individuals, the government and non-governmental organisations. Therefore, the challenge is to build capacity specifically around how to anticipate (e.g. raising awareness on risks, risk education, participating in risk assessments, etc.), cope with (e.g. training in first aid, securing homes, learning to swim, etc.) and resist (e.g. designing evacuation strategies, stock-piling emergency equipment etc.) disasters[133].

LINKS TO NATIONAL/ LOCAL POLICIES/ GOALS

National Disaster Management Plan 2016

Prime Minister's 10-point Agenda on Disaster Risk Reduction 2016

Urban Flooding - Standard Operating Procedures 2017

Tamil Nadu State Disaster Management Perspective Plan (TNSDMP) 2018-2030

Chennai City Disaster Management Plan (CDMP) 2018

LINKS TO INTERNATIONAL POLICIES/ GOALS

49
Engage with community-led organisations to act as first responders

TIMEFRAME
Short term

STATUS
Ongoing
(Needs scaling-up)

Local volunteer-led organisations already play a critical role in responding quickly to disasters through rescue and relief efforts. This was evident during the December 2015 floods, when large groups of people collaborated on social media platforms to provide relief, so much so that it caught the attention of several local and international dailies[134, 135]. The city can tap into these existing resources to designate local risk managers who could organise either as individuals or as groups of individuals to act as first responders to assist in search and rescue efforts, transportation arrangements and providing first aid, shelter and relief (food, water and sanitation) and animal rescue. These groups would work with the office of the local district collector and GCC, to coordinate with government and complement their efforts.

KEY PLAYERS

GCC; RWAs, NGOs, Indian Red Cross, District Collector's Office, Bhoomika Trust, Blue Cross of India

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Promotes cohesive & engaged communities;

Ensures continuity of critical services;

RESILIENCE CO-BENEFITS

This project would also help vulnerable communities protect themselves during a disaster (**Disaster Preparedness – Goal 3.2**) and garner citizen engagement in managing the city's disaster risks (**Governance Ecosystem – Goal 4.3**).

50

Disaster warning announcement system

TIMEFRAME
Short term

STATUS
Piloted
(Needs scaling-up)

According to the TNSDMP, the state has a well-equipped State Emergency Operations Centre (SEOC) that gets information on significant events and disseminates information through multiple channels to the districts which in turn alert line departments[136]. However, information does not easily get disseminated to communities, particularly those in remote locations. Therefore, the implementation of a disaster warning announcement system in key locations that are connected to the SEOC and to local emergency control centres will significantly improve communication around threats. Existing flood control rooms can be mandated to carry out this task, irrespective of the disaster.

KEY PLAYERS

State Emergency Operations Centre, District Collector's Office, Revenue and Disaster Management Authority, PWD, GCC, Greater Chennai Police Department, Zonal and Ward Officers, Coast Guard, NDRF, SDRF

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Supports livelihoods & employment;

Promotes cohesive & engaged communities;

RESILIENCE CO-BENEFITS

This project would also help protect vulnerable communities and MSMEs (**Disaster Preparedness – Goal 3.2 & 3.3**).

CHENNAI ASPIRATION:
Ham Radio: Complementing the
Disaster Warning System of Chennai

Amateur radio is a popular service that brings people together from across town and around the world without the internet or cell phones. Not only are HAM radios fun, social, and educational, they can be a lifeline during times of need.

When regular communication channels fail during disasters, HAMs can help public service agencies bolster emergency relief efforts. In fact, with a simple 12.6 D.C. volt car battery, even radio amateurs can establish vital first lines of communication if cellular and online connection is limited. By stringing emergency antennas through trees or other available supports, regular civilians can use HAM radio to keep people connected throughout crises.

For instance, during the Indian Ocean Tsunami, HAM radio operators provided the only means of communication for almost 6 days before regular communication systems were restored. Even during the devastating floods that drowned Chennai in December of 2015, HAMs allowed aid and medical support to reach damaged areas while mobile phones and land lines were broken.

Individuals can interface with other HAMs by using microphones or by linking the radio system to a computer or tablet to send data, texts, images, or Morse code, which remains incredibly popular.

Resilient Chennai hopes to identify a HAM operator for each ward and connect him/her to RWAs in flood prone localities via a two-way long range walkie-talkie. The plan is to also connect HAM operators with the Department of Revenue Admin & Disaster Mitigation, and the Control Room at GCC. This proposal would enable the city to seamlessly intertwine its existing disaster management protocols with its HAM radio network.

A ward map with contact details of HAM Radio operators in flood prone wards is being developed.

51
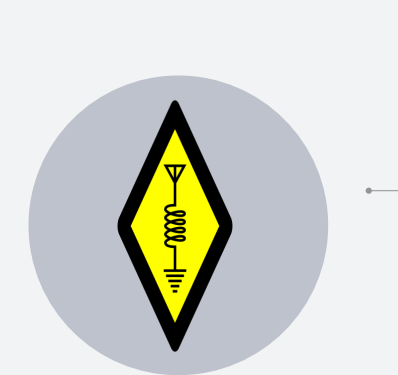
Prepare Chennai—a campaign for awareness on disaster preparedness

TIMEFRAME
Short term

STATUS
New / Proposed

In most cases, communities lack the knowledge required for effective risk reduction. Therefore, a widespread and sustained awareness campaign could be carried out to build community capacity to anticipate and cope with disasters. Campaign elements would include creating awareness on:

a. A range of climate (cyclones, earthquakes, droughts) and non-climate (industrial fires, oil spills, epidemics) risks to the city, with a general understanding of vulnerable areas and communities likely to be at risk;

b. What to do during a disaster, emergency contact information and relief centre locations based on GCC's CDMP 2018;

c. Insurance and economic tools that communities and business can leverage to protect themselves.

The campaign could also cover talks or demonstrations at educational institutions, businesses, social and print media and places where people congregate such as malls and theatres, and will be conducted in Tamil, English and Hindi

KEY PLAYERS

GCC, RWAs, NGOs, Anna University's Centre for Climate Change and Adaptation Research, other academic institutions, industry associations, media groups, the District Collector's office, Indian Red Cross, Bhoomika Trust, Blue Cross of India

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Promotes cohesive & engaged communities;

Ensures continuity of critical services;

RESILIENCE CO-BENEFITS

This project would also help vulnerable communities protect themselves during a disaster (**Disaster Preparedness – Goal 3.2**).

52

Capacity building and equipping disaster response force

TIMEFRAME
Short term

STATUS
Ongoing
(Needs scaling-up)

A State Disaster Response Force (SDRF), consisting primarily of members of the police force already exists. The SDRF has had some training in relief, first-aid provision, and rescue and evacuation operations. In accordance with the TNSDMP, the city will work towards strengthening this capacity by equipping the force with technology such as unmanned aerial vehicles (UAVs) with thermal and LiDAR sensors, high antennas for radio communications, Tethered Drones (HARC-TD) and other mechanisms for communication, technology and transport. In addition, the force would be trained to use these technologies for more effective search, rescue and evacuation operations.

KEY PLAYERS

SDRF, NDRF, the District Collector's office, Coast Guard

RESILIENCE LINKAGES

Promotes leadership & effective management;

Ensures continuity of critical services;

RESILIENCE CO-BENEFITS

This project would help vulnerable communities protect themselves during a disaster (**Disaster Preparedness – Goal 3.2**). It would also help data collection on disaster impact which can be fed into mapping tools for more efficient disaster management, urban planning and governance (**Disaster Preparedness – Goal 3.1 & Governance Ecosystem – Goal 4.1**).

53

Mapping existing community infrastructure and creating new investments where needed

TIMEFRAME
Short term

STATUS
New / Proposed

Communities can equip themselves for effective and quick disaster risk reduction. Key to do this will be investing in community infrastructure that is durable and safe. For example, community halls and shelters on elevated grounds, storage spaces for key assets, maintaining clear escape routes for rescue/relief operations and evacuation. Some of this infrastructure already exists. Therefore, the city could create a comprehensive map of existing community assets to identify locations where new assets are needed, specifically, in areas that are prone to floods and/or storm surges.

KEY PLAYERS

GCC; RWAs, private builders, Bhoomika Trust

RESILIENCE LINKAGES

Promotes cohesive & engaged communities;

Ensures continuity of critical services;

RESILIENCE CO-BENEFITS

This project would help vulnerable communities protect themselves during a disaster (**Disaster Preparedness – Goal 3.2**). It would also help data collection on disaster impact which can be fed into mapping tools for more efficient disaster and urban planning and governance (**Disaster Preparedness – Goal 3.1 & Governance Ecosystem – Goal 4.1**).
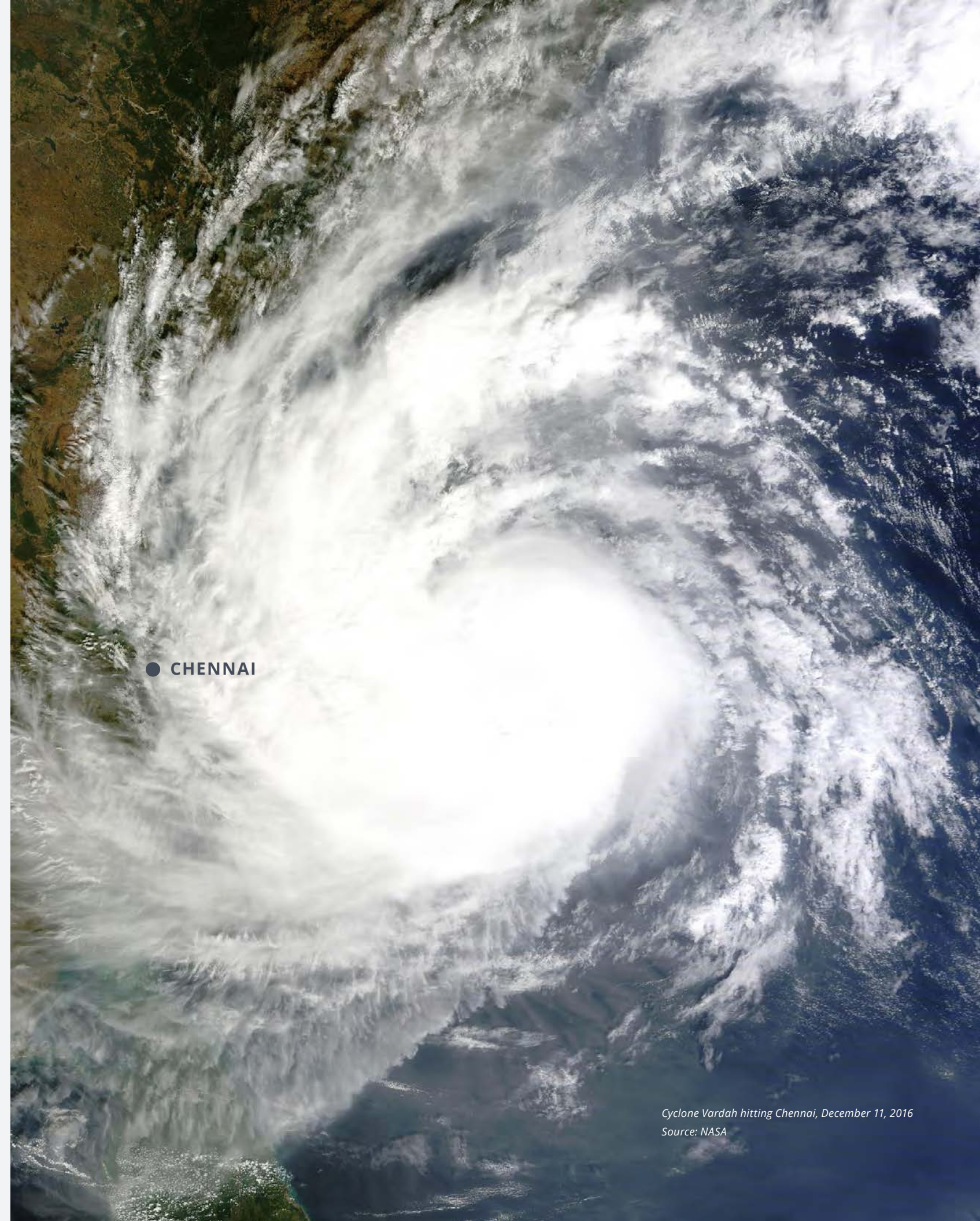
● CHENNAI

Cyclone Vardah hitting Chennai, December 11, 2016
Source: NASA

RESILIENCE PILLAR 4: GOVERNANCE ECOSYSTEM

© PlaneMad/ Wiki – Panoramic view of Chennai from Madras High Court

The ideal city governance machinery is grounded in strong collaboration between public agencies, private entities and citizens. A broad-based participatory and transparent system for making decisions and managing resources is key to safeguarding city resident interests and addressing their concerns. The challenges in Chennai's governance relate not so much to a lack of knowledge or expertise, but rather to poor levels of collaboration within public agencies and across public, private and civic agencies when governing and enforcing laws and rules. While Chennai needs to institutionalize effective channels for broad participation in public decision-making processes, it also needs to raise awareness and willingness among citizens to take responsibility for their actions and the future of their city.

Irrespective of the quality of plans or strategies, citizen support is essential to their effective implementation and enforcement in a city of 8.65 million. In a survey of 478 Chennai citizens, 66% vouched that there is ample scope for citizens to engage with government, while just 23% acknowledged having ever interacted with their local level government officers[xxxvi]. This highlights a need for strengthening social capital and civil society actor capacities and a need for expanding and protecting spaces for people's participation in political and public life. This will lay the foundation for building citizens trust in their government and fostering a more resilient governance ecosystem.

xxxvi Namma Chennai Civic Engagement Survey: https://resilientchennai.com/civic-survey

MISSION 4: Together, we lift Chennai

It is crucial that efforts to transform Chennai and render it more resilient to current and future shocks and stresses are led by government, civil society and industries **together**. The city will strengthen existing means and create new ones to garner buy-in and active involvement from a wide range of stakeholders so that Chennai becomes a truly co-owned and co-managed city. The following goals will help achieve this mission, to lift Chennai together:

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

GOAL 4.1 IMPROVE EFFICIENCY TO HANDLE RESILIENCE CHALLENGES BY ENABLING KNOWLEDGE TRANSFER ACROSS GOVERNMENT AGENCIES.

4 ACTIONS

Chennai's governance structure comprises of multiple agencies, including the GCC, CMWSSB, TNSCB, CMDA, TNHB, CRRT, TANGEDCO and the Revenue Department. This governance system is poly-centric in nature, i.e. according to Pethe *et al.* (2012)[137] it is "multi-level (involving local, state and national agencies within the federal set-up), multi-type (with nested, overlapping and fragmented jurisdictions), multi-sectoral (with various public and private organizations, including civil society and others) and multi-functional (with units performing specific functions)". However, unlike a truly poly-centric system, which allows for cooperation between organisations and encourages competition[138], Chennai's system, with its overlapping responsibilities and jurisdictions among different agencies, actually results in government inefficiencies[139]. Further, while the 74th amendment to India's Constitution formally recognizes Urban Local Bodies (ULBs) as autonomous elected bodies, assigning them certain functions, the state government only devolves limited powers to these ULBs, including to the GCC. In addition, hardly any formal arrangement exists for ensuring coordination (including data sharing) or cooperation between and within multiple organizations working at the same level. For example, Chennai's Public Works Department (PWD) possesses village-level maps on drainage channels and water bodies but these were only recently transferred to the CMDA's Master Plan Unit, who themselves are tasked with planning for the Chennai Metropolitan Area (CMA)[140]. Institutional spaces that facilitate regular meeting and discussion between departments within and across agencies are also missing. Therefore, to facilitate efficient, equitable and effective governance that builds Chennai's resilience, ensuring significant improvement in coordination, communication and data sharing within and across public departments is crucial.

LINKS TO NATIONAL/ LOCAL POLICIES/ GOALS

AMRUT

Chennai Smart City Ltd Programme

Indian Urban Observatory

Open Governance Data Platform

LINKS TO INTERNATIONAL POLICIES/ GOALS

54 ⚑

Create an urban data observatory for better governance

TIMEFRAME
Short term

STATUS
New / Proposed

The Resilient Chennai Team is facilitating discussions between the National Institute of Urban Affairs (NIUA), Chennai Smart City Limited (CSCL), Madras Chamber of Commerce and Industry (MCCI) and Center for Urbanization, Buildings, and Environment (CUBE), Indian Institute of Technology, Madras (IITM) to set up a data observatory that will serve as a repository for accurate and frequently updated, local, spatial and non-spatial data that can be used as a decision support system for Chennai city. The observatory will collate relevant information from all departments involved in Chennai city governance, including the GCC, CRRT, CMDA, CMWSSB and TNSCB, and will consist of both a physical data centre and a virtual platform. The role of the physical centre will include coordination between different stakeholders to collect data, frequently update data, train staff on data management, develop models for scenario planning and develop a learning centre to educate public officials about data-driven planning. The role of the virtual platform will be to analyse and represent collected data through maps, tables and other forms. The virtual platform will also allow users to interact with each other through blogs and discussion forums. All government departments who contribute data will have access to it through the data centre.

KEY PLAYERS

NIUA, CSCL, CUBE, MCCI, Resilient Chennai

RESILIENCE LINKAGES

Fosters long term & integrated planning;

Promotes leadership & effective management;

Promotes cohesive and engaged communities;

RESILIENCE CO-BENEFIT

This action would help prioritise environment issues in urban planning and design (**Healthy Urbanisation – Goal 1.1**), foster responsible water usage and improve coordination between government and non-governmental actors to protect our water bodies (**Water Systems - Goal 2.1 & 2.3**) and facilitate usage of data for better disaster preparedness (Disaster Preparedness – Goal 3.1).

CHENNAI INSPIRATION:
Chennai Scenarios Project

Funded by Tamil Nadu State Planning Commission (Government), Cholamandalam Finance (private sector) and Tata Trusts (Non-profit arm of private sector), Okapi Advisory Services, Centre for Buildings, Urbanization and the Environment (CUBE), IIT Madras and Fields of View have been working on a project to support integrated planning for water, land use, and waste management in Chennai. One of the primary outcomes of this work includes a set of Agent Based Models (ABMs) that function as a platform for relevant government agencies like CMWSSB, CMDA, PWD etc. to store, upgrade, and share data, and use the data to develop different scenarios and compare trade-offs across a series of parameters (such as waste generated, water demand, etc.), to make informed decisions. The ABMs will therefore allow public agencies to better coordinate amongst themselves better and take decisions in a more integrated fashion considering all the interlinkages between water, waste and land use related needs and challenges of the city. By customizing and scaling up this work to include all public agencies involved in the city's governance as part of this integrated planning platform, a more collaborative and well-coordinated city planning process can be supported.

Project kick-off meeting with broad representation from all government agencies

55

Strengthen the role of Chennai Metropolitan Development Authority (CMDA) as a facilitator of government coordination

TIMEFRAME
Long term

STATUS
New / Proposed

The CMDA already coordinates with several government departments and non-government representatives for planning for the CMA. However, the extent and manner of coordination has not been very effective and is often restricted to project-based efforts. Therefore, the city needs to explore ways to ensure sustained coordination between departments that govern Chennai city. For this, CMDA could work closely with the planning department within GCC as facilitators of government coordination and collaboration for all relevant activities. This could be done by:

a. Conducting regular (monthly) meetings between different levels of department staff such as heads of department, superintendent engineers, assistant engineers and line department personnel, etc., so that each is updated on current work and progress. This will also help departments identify projects where they can collaborate;

b. Identifying potential non-state actors that can collaborate with government on research projects as needed;

c. Conducting capacity-building workshops and training programmes for government staff on ways to improve coordination. This will also include training programmes for Information and Technology (IT) cells within each department around the use of technology for data sharing and collection;

d. Highlighting best practices around coordination and collaboration in the monthly meetings.
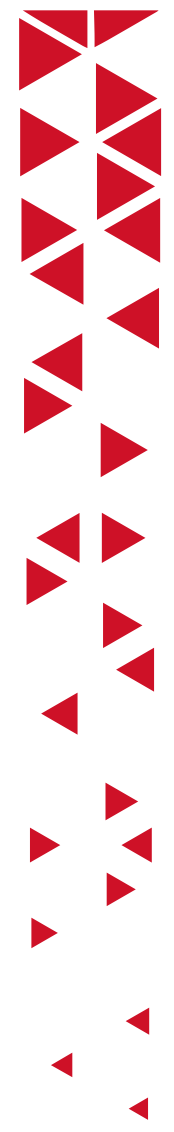
KEY PLAYERS

GCC, CMDA, CMWSSB, PWD, TANGEDCO, TNPCB

RESILIENCE LINKAGES

Fosters long term & integrated planning;

Promotes leadership & effective management;

RESILIENCE CO-BENEFIT

The project would help integrate environment, social and economic development planning which is critical for the city to grow sustainably (**Healthy Urbanisation – Pillar 1**).

100RC INSPIRATION:
Ramallah, Palestine

Acknowledging the complexity involved in fostering participatory decision-making processes in governance, especially in a place like Ramallah, where democratic governance is a relatively new idea, the city has embarked on developing a 10-year plan of action for greater community engagement in government decision-making, initially at the municipal level. This plan would provide a long term roadmap to guide the working relationships, and improve regional collaboration between the municipality and all other stakeholders. This will help the city achieve a collaborative or co-designed future for the city and its surroundings.

The city plans to use international frameworks such as the International Association for Public Participation (IAP2) spectrum, to identify longterm objectives for supporting greater stakeholder participation, and use different methods including surveys, social media, public meetings, focus groups, television advertising and trials of participatory budgeting to reach out to multiple stakeholders, including the most marginalized. While the city identified the need for a longer-term plan to address the complex issue of participatory governance, it has also identified some immediate and tangible initiatives for this cause. For instance, establishing a Resilience Council Advisory Board: this would be a representative group of stakeholders from various sectors who will meet regularly, review municipal projects, plans and developments, and offer their candid suggestions for ensuring greater resilience of these projects.

In addition, Ramallah also highlights the need for a centralize data system with a comprehensive inventory of data that will support evidence-based decisions and promote accountability and transparency in governance.

56

Set up digital display boards for better communication

TIMEFRAME
Short term

STATUS
New / Proposed

In addition to the GCC, multiple agencies (e.g. CMWSSB, CRRT and TNSCB) provide city services, including water supply, sanitation and affordable housing. To help GCC govern better and more holistically, digital display boards can be set up in the different GCC sub-departments (e.g. Parks, Solid Waste Management, Storm Water Drains, Buildings and Schools).

These display boards can share information on day-to-day activities of the various sub-departments within GCC and other government departments including CRRT, TNSCB and CMWSSB. The information could comprise of important meetings, field activities, training programmes etc. which would facilitate better connection, communication and collaboration within and between departments. The board would need to be updated on a real-time basis.

KEY PLAYERS

GCC, CMWSSB, CMDA, CRRT, TNSCB

RESILIENCE LINKAGES

Fosters long term & integrated planning;

Promotes leadership & effective management;

RESILIENCE CO-BENEFIT

This action would support integrated planning between departments especially around environment and water issues (**Healthy Urbanisation – Pillar 1 & Water Systems – Pillar 2**).

179

57

Scorecards for evaluation

TIMEFRAME
Short term

STATUS
New / Proposed

Scorecards can be introduced to assess, monitor and self-evaluate service delivery and department performance within the GCC, to begin with. Maintained by individual departments such as SWM, SWD and Parks, these scorecards will function as continuous trackers and will be reviewed annually. The evaluation exercise will be conducted by independent, non-state evaluators that may include development experts, civil society representatives and ex-IAS officers. This independent evaluation process can be similar to GCC's existing evaluation process for its Urban Homeless Shelter Programme. At the end of the evaluation process, the departments or teams that have high scores will be recognised for their efforts and the evaluation mechanism could be scaled-up to other government departments outside GCC.

KEY PLAYERS

GCC

RESILIENCE LINKAGES

Fosters long term & integrated planning;

Promotes leadership & effective management;

RESILIENCE CO-BENEFIT

The project would help improve coordination between government departments, thereby supporting integrated planning across different sectors (**Healthy Urbanisation – Pillar 1).**

180

MISSION 4: Together, we lift Chennai

GOAL 4.2 STRENGTHEN CURRENT PRACTICES OF ENFORCEMENT AND MONITORING.

5 ACTIONS

The extent of devastation caused by the December 2015 floods proved that unplanned growth and poor enforcement of planning and environmental laws pose a severe threat to Chennai residents. Therefore, it is crucial that government departments take immediate steps to strictly enforce legislation and to protect life, property and natural ecosystems to minimize the impact of future disasters. To do this, government departments must overcome challenges relating to data, technology, finance, capacity and human resources. Groundwater and solid waste management are examples of challenges where monitoring and enforcement are insufficient. In terms of groundwater management, CMWWSB cannot monitor ground water extraction without data on the number of existing household and commercial borewells. Moreover, CMWSSB's "hydrogeology wing" which manages groundwater and rain water harvesting, is short-staffed. GCC faces similar human resource constraints in its SWM department, particularly in terms of the number of conservancy workers tasked for door-to-door collection. Therefore, the city will work towards strengthening its capacity to monitor and enforce laws more efficiently by procuring more data, technology and human resources. While monitoring and enforcement in general require strengthening, specific actions have been formulated in sectors of water and solid waste management, in accordance with Chennai city's resilience challenges.

LINKS TO NATIONAL/ LOCAL POLICIES/ GOALS

Open Governance Data Programme

Right to Information Act, 2005

Solid Waste Rules, 2016

Tamil Nadu District Municipalities Act, 1920

Tamil Nadu Combined Development Regulation and Building Rules, 2018

LINKS TO INTERNATIONAL POLICIES/ GOALS

58

Dedicated funding for SWM monitoring, Operation & Maintenance (O&M)

TIMEFRAME
Long term

STATUS
New / Proposed

Setting aside a portion of the GCC budget for monitoring and enforcement is critical to implement the 2016 SWM Rules and to ensure that existing projects continue. The GCC already sets aside a small amount in its yearly budget for SWM capital expenditure but it has not done so for O&M. Therefore, the city proposes to accommodate SWM O&M under the "revenue expenditure head", in the form of a fund for SWM. This fund can finance operations to monitor and enforce rules related to solid waste generation and help with SWM O&M, including waste segregation, maintaining compost pits, etc. O&M costs can also be covered by user fees and charges from all bulk waste generators.

KEY PLAYERS

GCC

RESILIENCE LINKAGES

Fosters long term & integrated planning;

RESILIENCE CO-BENEFITS

This action would help address the city's solid waste challenges more effectively (**Healthy Urbanisation – Goal 1.2**).

59

Decentralised enforcement cell for SWM and RWH

TIMEFRAME
Long term

STATUS
New / Proposed

Despite legislation which makes solid waste dumping and non-compliance with RWH rules punishable offences under law, there is limited actual enforcement of these laws, primarily because of a lack of human resources for ensuring comprehensive enforcement. Therefore, the city will consider setting up decentralised enforcement cells at the ward/zonal level to enforce SWM and RWH laws. These cells would comprise of dedicated personnel from GCC and CMWSSB to ensure that citizens comply with the laws. The cells can have access to appropriate technology that will help in enforcement, can be empowered to conduct surprise visits in their respective wards to check compliance, and can respond to complaints through telecommunication.

KEY PLAYERS

GCC, CMDA, CMWSSB

RESILIENCE LINKAGES

Fosters long term & integrated planning;

Ensures social stability, security and justice;

RESILIENCE CO-BENEFIT

This action would help address the city's solid waste challenges more effectively (**Healthy Urbanisation – Goal 1.2**) and foster responsible use of water (**Water Systems – Goal 2.1**).

CHENNAI INSPIRATION:
Antariksh SMART Bins

Overflowing bins are a common problem in Indian cities. With a vision to clear every public bin before it overflows, Antariksh Waste Ventures Private Ltd., based in Chennai, has designed and developed AirBin™ - smart Internet of Things (IoT) powered waste bins that are linked with mobile apps. The company's pilot project in Valmiki Nagar, Chennai, involves digitising waste collection, segregation, operations and disposal system. The project leverages the strength of mobile and radio-based technologies such as apps and IoT devices to monitor solid waste levels in the bins.

In Valmiki Nagar, the company has integrated five public bins with its AirBin™ systems, collecting over 1,00,000 data points since initiation. The supervisor of the local sanitation team receives hourly alerts about the levels of solid waste disposed in the bins, and other periodic alerts related to bin repairs, worker attendance summary, etc. Accordingly, if the bins are full prior to the scheduled pick-up time, the supervisor can plan an additional pick-up, thereby preventing overflow of the bin. For accurate data collection, the bin area is marked for precise re-positioning to their designated space, once a compactor truck collects the waste.

This initiative is an example of how technology and data analytics can help municipalities manage day-to-day operations and optimize collection of waste long term. This project was possible with support from Rialto Enterprises Private Ltd., ATOS India Private Ltd., IIT Madras Incubation Cell and initiated by Resilient Chennai.

60

Economic measures for citizen compliance

TIMEFRAME
Short term

STATUS
New / Proposed

Through different government departments, the city could explore introduction of economic measures (negative and positive incentives) to ensure that the public complies with existing rules and regulations. These incentives could include one-time incentives such as fines for non-compliance (e.g. for littering and traffic violations), tax subsidies or rebates (e.g. for consumers who dispose of their waste properly or engage in tree planting activities), low-interest loans for environment-friendly capital equipment (e.g. solar panels) and deposit refund schemes (for e-waste or plastic bottles, etc.). Or other, not one-time incentives like increasing property tax and then providing inducements in the form of tax reductions to home owners who have installed RWH, recycling and/or solar PV systems.

KEY PLAYERS

GCC, Greater Chennai Police department, TNPCB, CMWSSB

RESILIENCE LINKAGES

Fosters long term & integrated planning;

Ensures social stability, security and justice;

RESILIENCE CO-BENEFIT

This action would help address the city's solid waste challenges more effectively (**Healthy Urbanisation – Goal 1.2**) and foster more responsible water usage and water conservation among citizens (**Water Systems – Goal 2.1**).

61

Invest in technology and data for monitoring water management laws

TIMEFRAME
Short term

STATUS
New / Proposed

The city will consider investing in data and technology for more effective water management, and monitoring and enforcement of water related legislation. This can include collating and archiving data on the historical and current status of water bodies in a usable format, which can inform planning and restoration efforts. Or, the O&M wing within CMWSSB can use new user information (collected by the registration department) for monitoring RWH compliance, waste water treatment and dual-piping mandates if they are in an appropriate digital format. Currently, new users must self-declare that they will comply with these mandates when they apply for water and sewage connections with CMWSSB. The registration forms for new connections are manually converted to digital form by the CMWSSB's "Registration Department". Therefore, an electronic management system that allows users to upload necessary documents and pay fees online will help reduce human error in data conversion and can automatically be sent to the O&M wing and the respective ward offices for monitoring. This data can also be fed into the "urban data observatory" that aims to support data driven decision making in the water sector.

KEY PLAYERS

CMWSSB, Rain Centre

RESILIENCE LINKAGES

Fosters long term & integrated planning;

Ensures social stability, security and justice;

RESILIENCE CO-BENEFITS

This action would help foster responsible use of water and induce water conservation (**Water Systems – Goal 2.1**).

62

Link project funding to impact assessments

TIMEFRAME
Long term

STATUS
New / Proposed

Government projects are usually evaluated against project goals that may not be related to social or environmental impacts. While all projects include a mandatory environment and social framework that anticipates impact prior to project implementation, the actual impact often varies, and is not assessed or linked to project goals. Therefore, a more effective means of ensuring that projects don't have high social or environmental costs would be to carry out impact assessments during and after project implementation, with fund disbursements tied to the assessments. Impact assessments should be conducted by a group of independent evaluators from the public, private, civic and academic sectors.

KEY PLAYERS

Funding entities such as the State and Central governments, Tamil Nadu Urban Infrastructure Financial Services, Limited (TNUIFSL), World Bank, Asian Development Bank (ADB), etc.

RESILIENCE LINKAGES

Fosters long term & integrated planning;

RESILIENCE CO-BENEFIT

This project has the potential to ensure that infrastructure projects do not compromise the environment, water resources or needs and concerns of vulnerable communities. (**Water Systems – Pillar 2, Healthy Urbanisation – Pillar 1, Vulnerable Communities – Pillar 5**).

MISSION 4: Together, we lift Chennai

GOAL 4.3 FOSTER AN ENVIRONMENT WHERE GOVERNMENT, CITIZENS AND MARKET INTERESTS CO-BUILD THE CITY'S RESILIENCE.

11 ACTIONS

Participatory governance is vital for making Chennai enlightened, just and integrated. Currently, the extent of engagement between government and non-state actors (citizens, CBOs, industry, academia etc.) is limited. On the one hand, government agencies perceive academic institutions, NGOs and citizen groups as being too critical. On the other hand, Chennai citizens feel that they "do not have the power to make a difference" and that there is a "lack of communication" from the government[xxxvi]. To foster a more inclusive environment for public participation, these challenges need to be addressed. Citizens need to feel valued while also responsible for their actions. Civil society needs to better recognize government limitations, and government needs to be less intimidating and more open to comments, criticisms and feedback from non-state actors. This requires creating spaces and introducing mechanisms for citizen engagement where citizens, communities and industry can actively and systematically interact with government to collectively take decisions that affect everyday lives, and makes citizens aware of their responsibilities and the impact of their actions on the environment, on other citizens and on city infrastructure. Therefore, a set of actions can be organised around:

A. Strengthening means of communication
B. Encouraging citizen engagement
C. Building public awareness

LINKS TO NATIONAL/ LOCAL POLICIES/ GOALS

Open Governance Data Programme

Indian Urban Observatory

LINKS TO INTERNATIONAL POLICIES/ GOALS

xxxvii Resilient Chennai Citizen Perception Survey:
https://resilientchennai.com/citizen-perception-survey/

63

Strengthen the "Namma Chennai" app

TIMEFRAME
Long term

STATUS
New / Proposed

The Namma Chennai mobile application was launched by the GCC in the beginning of 2018, essentially as a means for systematic grievance redressal where government can track and respond to citizen complaints on civic issues. At present, the app also includes services such as viewing birth and death certificates and status of property tax collection and important civic news. GCC and Chennai Smart City Ltd (CSCL) can collectively explore improving the app and consequently the manner in which GCC communicates with its citizens. Specific improvements can include: creating a space in the app for GCC to communicate specifically with RWAs, providing information around existing rules such as the plastic ban and links to relevant agencies, uploading videos and documents of important announcements in sign language and in braille for persons with hearing and visual disabilities respectively and providing details about upcoming public meetings. Finally, more awareness would have to be created among city residents about the app and its functions.

KEY PLAYERS

GCC, CSCL

RESILIENCE LINKAGES

Fosters long term & integrated planning;
Empowers a broad range of stakeholders;

Ensures social stability, security and justice;

RESILIENCE CO-BENEFITS

This action, could strengthen the public consultation process, consequently enabling more participatory planning and governance in the city (**Healthy Urbanisation – Goal 1.3**), help address solid waste related challenges more effectively (**Healthy Urbanisation – Goal 1.2**) and be a more inclusive city (**Vulnerable Communities – Pillar 5**).

CHENNAI INSPIRATION: #VoiceofPeople

Ward 181 in Zone 13 under Greater Chennai Corporation, is fairly well-governed. However, 'governance' in the ward is restricted to a reactive process where citizens complain to local authorities if there is a disruption of services such as electricity, solid waste collection or water. Further, like most other wards in the city, Ward 181 has not seen sustained or future-proofed development and its residents are unaware of their rights or responsibilities. This has resulted in reduced interaction with and expectations from the local government, with both groups at continual tension with each other.

This situation drove the citizen-led group #VoiceOfPeople (#VoP) to 'reclaim their ward' by exercising their right as citizens to interact with the governing body in a positive manner, to bring about change in their living environment. As a starting point to understand the demographics of ward administration, citizens' expectations from administrators and the government, and the mechanics of delivery of these expectations, #VOP conducted an extensive survey and several focussed group discussions (FDGs) with ward residents including the lower income group communities. The survey also served as a tool for people to understand their own role in the governance process, and the importance of active participation in the same.

The outcome of these interactions is the creation of a 'citizen manifesto' that details the expectations from government and how ward residents can support and work with the local elected representative to improve conditions in the ward through a participatory and transparent process.

64 ⚕

Strengthen "open governance" data portal

TIMEFRAME
Short term

STATUS
Ongoing
(Needs strengthening)

Currently, the Tamil Nadu state government's e-governance website provides a list of services, including procuring legal heir certificates and income certificates that citizens can access online. The objective of the website is to make government services accessible to all. While this makes it convenient for citizens to collect forms, the e-governance website could also be leveraged to build trust among citizens by keeping citizens informed about other services and by providing access to data. The city can work with the Tamil Nadu IT Department to include the following on e-governance website:

- a list of upcoming public hearings on policies and projects;
- an inventory of government welfare schemes by various departments and details on types of government-owned data that is publicly available and where it can be found.

The city can also create awareness about this portal on other regularly-accessed government websites such as the portals for payment of electricity, water and property tax, booking metro water tanks, etc.

KEY PLAYERS

IT Department, Tamil Nadu e-Governance Agency, National Informatics Centre

RESILIENCE LINKAGES

Fosters long term & integrated planning;

Empowers a broad range of stakeholders;

RESILIENCE CO-BENEFIT

This action could strengthen the public consultation process and enable more participatory planning and governance in the city (**Healthy Urbanisation – Goal 1.3**).

65 ⚕

Better communication between government, corporate actors and citizens to tap Corporate Social Responsibility (CSR) funding

TIMEFRAME
Short term

STATUS
New / Proposed

Chennai Smart City Ltd (CSCL) can lead an initiative to improve communication between government, corporate actors and citizens to enable easier access to CSR funding. This could be done, for instance, by setting up a centre within government to coordinate between a) various departments and the private sector and b) citizens and the private sector. The centre's primary aim would be to coordinate between companies, government departments and citizens to tap CSR funding. The centre will also host a website that provides details of initiatives where CSR funding is being sought, details of how corporate actors can get involved in government activities and how interested citizens can volunteer for projects. Additionally, the city could work with partners in industry such as the Madras Chamber of Commerce and Industry (MCCI) to encourage their members to be a part of this initiative.

KEY PLAYERS

Industrial associations including MCCI, CII, private companies, CSCL, GCC, RWAs

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Promotes cohesive and engaged communities;

RESILIENCE CO-BENEFIT

By involving different actors for funding government projects, the governance process will become more participatory (**Healthy Urbanisation – Goal 1.3**).

66

Student stewardship programme

TIMEFRAME
Short term

STATUS
New / Proposed

The city can tap into existing Indian Administrative Services (IAS) aspirants and other interested students to intern with government agencies such as the GCC, with the aim of giving students exposure to how governments function and their everyday challenges. This effort can provide students and future IAS officers with a first-hand experience of their expected work, while also providing government with eager and dedicated interns to help ease workloads. The programme could involve students assigned to mentors in different departments, for instance within the GCC, for a period of two to three months, and can be scaled up to other departments. Details of the programme and how to apply can be publicized through the Namma Chennai app, the GCC website and social media.

KEY PLAYERS

GCC, Public and Private Schools

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Promotes cohesive and engaged communities;

RESILIENCE CO-BENEFITS

By involving different actors in dealing with day-to-day government issues, the governance process could become more participatory (**Healthy Urbanisation – Goal 1.3**).

67

Civic leadership programme

TIMEFRAME
Short term

STATUS
New / Proposed

The city can explore a partnership with NGOs and academic institutions to conduct a programme on civic issues and leadership, available specifically to citizens wanting to contest in municipal elections. The programme could consist of a comprehensive training module on the Indian constitution, local laws and the governance framework. It could also include activities to build leadership skills such as community mobilisation activities for national/state campaigns.

KEY PLAYERS

NGOs, Resident Welfare Associations (RWAs), GCC, Citizen Consumer and Action Group (CAG), Anna Institute of Management, Rajiv Gandhi Institute for Youth Development

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

RESILIENCE CO-BENEFIT

By involving different actors in dealing with day-to-day government issues, the governance process will become more participatory (**Healthy Urbanisation – Goal 1.3**).

68

Incentives and competitions to induce citizen responsibility

TIMEFRAME
Short term

STATUS
New / Proposed

The city can explore various ways of incentivising citizens to engage in and take ownership of their wards and neighbourhoods. Incentives could be in the form of gift vouchers for citizens who, for instance, plant and maintain the largest number of trees in their neighbourhood or for secondary school children who help direct traffic around their school (if the school is in a neighbourhood with less traffic). Competitions could also be conducted in schools, wards and neighbourhoods including for best street art design, cleanest school or ward, most energy/water efficient school/ ward, etc., to encourage citizens to take greater interest and responsibility managing their own surroundings.

KEY PLAYERS

GCC departments such as SWM and education, RWAs, local NGOs, school authorities

RESILIENCE LINKAGES

Promotes cohesive and engaged communities;

RESILIENCE CO-BENEFITS

This project would help monitor and enforce existing laws around solid waste and water and make the city cleaner (**Governance Ecosystem – Goal 4.2 & Healthy Urbanisation – Goal 1.2**). It will also help foster more responsible water usage and induce water conservation among citizens (**Water Systems – Pillar 2**).

CHENNAI INSPIRATION:
Eyes on the Canal

The 800 km Buckingham Canal, built in phases between 1800 and 1882, is a manmade, saltwater, navigation canal that runs parallel to the Coromandel Coast, connecting the three rivers (Kosasthalaiyar, Cooum, and Adyar) that flow through Chennai. Although the canal was once an idyllic water body with lush, green edges capable of managing floodwaters. Today it faces severe pollution from untreated sewage and solid waste, and has been severely encroached upon, compromising its width and carrying capacity over long stretches within the CMA.

Eyes on the Canal, facilitated by GIZ India and Urban Design Collective, was an exercise in participatory planning to make Buckingham Canal a liveable place for the residents of Chennai. The initiative involved various activities such as awareness walks, community engagement meetings and an open-ideas competition to generate interest and ownership of the canal. From November 2018 to March 2019, the three winners of Eyes on the Canal's design competition — Team Sponge, Team Studio POD and Team Blank Slate — developed project proposals through a series of stakeholder engagements. Their concepts have been compiled into three reports, which will inform future efforts to revive 3.5 km of Buckingham Canal.

Development Scenarios
Multiple pathways to rejuvenate the canal

TEAM SPONGE

1. Short Term
Sponge Infrastructure upgrade to streets

PWD · Chennai Corporation

3. Long Term
Resettlement Housing and Canal Front

Land/Property Dweller · Real Estate Developer · THNB, Slum Clearance · Chennai Corporation

2. Medium Term
Water front Plaza / Neighbourhood Park

Neighbourhood Community · CRRT · Chennai Corporation

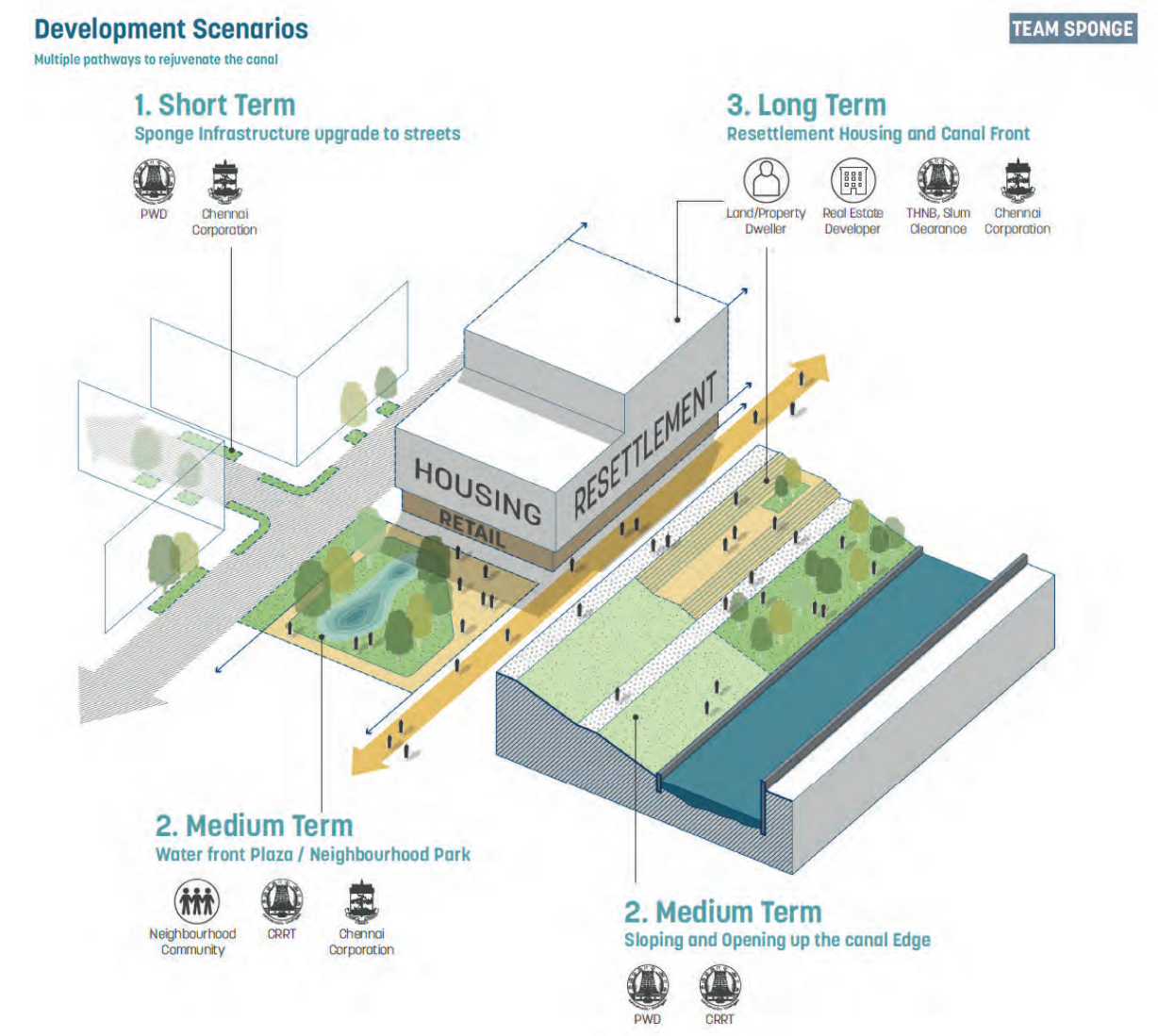**2. Medium Term**
Sloping and Opening up the canal Edge

PWD · CRRT

Figure 20: *Development scenarios for Buckingham Canal rejuvenation*
Source: Team Sponge | Eyes on the Canal

69

Adoption programme

The city will consider instituting an adoption programme which encourages community, private or collective adoption of public spaces such as parks, lakes or roads. This initiative can function like the Vandalur Zoo's "animal adoption" programme, where the interested party pays for operation and maintenance, which in turn is administered by the GCC. Interested parties can also contribute by offering volunteering time, technical skills, equipment, etc.

TIMEFRAME
Short term

STATUS
Piloted
(Needs scaling-up)

KEY PLAYERS

GCC

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Promotes cohesive and engaged communities;

RESILIENCE CO-BENEFITS

This project would help make the city cleaner (**Healthy Urbanisation – Goal 1.2**). It will also help to keep water bodies clean (**Water Systems – Pillar 2**).

CHENNAI INSPIRATION:
Swachh ('Clean') Beach
Project, Thiruvanmiyur

In 2015, New Beach Road, a densely populated area of one sq. km by the Thiruvanmiyur beachfront was chosen by Rialto Enterprises, a Chennai based global business partner of Procter & Gamble Co. for its CSR initiative - the Swachh ('Clean') Beach project. The project aimed to transform the beach front by bringing together the local residents, Greater Chennai Corporation, Ramky Enviro (contracted Municipal Waste Collector), Chennai Traffic Police, Tamil Nadu Electricity Board, CMWSSB and the Forest Department. This project has tackled issues of solid waste management by monitoring waste collection by setting up more bins, and mitigated flooding by redirecting storm and rain water from roads to ground water recharge pits consequently raising the water table. Furthermore, Rialto has, planted hundreds of tree saplings and ornamental shrubs along walk ways, ensured that the area is well-lit by erecting two high-mast lights and replaced LEDs in existing street lamps, and constructed (and currently maintains) two free bio toilets on the beach. At the end of 2015, The Swachh Beach project was recognized by the Prime Minister's Office (PMO) as one of the 'six most dynamic Swachh Bharat citizens' projects'. Further, in 2017, a team from the PMO paid another surprise visit to the area and reported that not only was the project alive, it had grown even more robust since the team's first visit, two years earlier.

70

Creating awareness around civic issues

TIMEFRAME
Short term

STATUS
Ongoing
(Needs strengthening)

A city wide awareness campaign will be launched to raise awareness on important civic issues such as rainwater harvesting (RWH), using non-motorised modes of transport, sustainable solid waste management and the ban on plastics. Innovative methods will be used to reach out to and raise interest among a wide audience. These methods will include:

a. Developing digital and outdoor public service announcement (PSA) campaigns to increase awareness around water conservation in Chennai. These campaigns will include evocative posters on why water conservation is important, pasted to the back panels of buses and other spaces;

b. Leveraging radio and social media to disseminate information to the public, put up ads and understand people's opinions through listener polls;

c. Introducing advertisements in Tamil and English on popular TV channels and in cinema halls, including announcements in sign language wherever appropriate;

d. Putting up posters in different parts of the city, and especially in prime locations (e.g. beach, signals, malls, temples) on the plastic ban, along with fine amounts;

e. Conducting cultural programmes such as 'theru koothu' (street dramas) and music and dance concerts to mobilise people and make them think about how they contribute to and can impact city problems.

KEY PLAYERS

GCC, Resilient Chennai, Ogilvy, Tinacca Media and Rubecon Communications, CAG

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Promotes cohesive and engaged communities;

RESILIENCE CO-BENEFITS

This action can help make the citizens more responsible for keeping the city clean, reducing their water usage and abiding by rules and regulations (**Healthy Urbanisation – Goal 1.2, Water Systems – Pilar 2, Governance Ecosystem – Goal 4.2**).

CHENNAI INSPIRATION:
Work by Citizen consumer and civic Action Group (CAG)

CAG is a non-profit, non-political and professional organization that has been "protecting citizens' rights in consumer and environmental issues and promoting good governance processes including transparency, accountability and participatory decision making" in Chennai, since 1985. Their focus areas are, electricity governance, environment and climate change, water, sanitation and drainage, solid waste management, sustainable transport, informal settlements, consumer protection, and city governance. Some of their early achievements include, cleaning the Adyar river in 1988; creating a Joint Action Forum for Safety on Roads in 1989; and stopping development of the East Coast Road as it involved cutting trees in 1993. While, more recently, they have (among other things), conducted public campaigns to urge vehicle owners to check emissions; conducted environmental impact assessments of thermal power plants; developed draft rules to curb promotional practices of pharma companies under the Drugs and Cosmetics Act and launched a 'right to the city' movement. Further, in May 2019, CAG conducted a wide spread door-to-door campaign in three areas of the city –Adyar, Anna Nagar and Royapuram– to convince to residents to segregate their waste, in association with GCC.

CAG
Citizen consumer and civic Action Group

71

Introducing community service in school curricula

TIMEFRAME
Short term

STATUS
Ongoing
(Needs scaling-up)

The city can work with private and government schools to get children more involved in street and community activities. This could include fostering collaborations with local NGOs who can guide children in their activities. Such activities could include campaigning for water conservation or a clean city, conducting blood donation camps, planting trees in neighbourhoods, or street cleaning. These community service activities can be organised by school "interact clubs".

KEY PLAYERS

Educational institutions, Rotary and Lions clubs, GCC

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Promotes cohesive and engaged communities;

RESILIENCE CO-BENEFITS

This project can help make the city cleaner (**Healthy Urbanisation – Goal 1.2**). It can also help foster more responsible water usage and induce water conservation among citizens (**Water Systems – Pillar 2**).

72

Platform for collective-action best practices

TIMEFRAME
Short term

STATUS
Ongoing
(Needs strengthening)

A website can be developed to highlight best practices around participatory governance and collaborative efforts around Chennai city civic issues. This website will act as a repository of best practices, categorized according to specific themes such as water, waste, disasters and responsible citizenship. The website will be linked to water sensitive urban design[xxxviii] website and the urban data observatory.

KEY PLAYERS

CSR, NGOs/civil society organisations, GCC

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

RESILIENCE CO-BENEFITS

This action could potentially encourage more coordination and collaborative governance across sectors such as water, transport and solid waste (**Water Systems – Pillar 2, Healthy Urbanisation – Pillar 1**).

CHENNAI ASPIRATION: Chennai Against Plastics Website (CAPS)

The CAPS website was launched in January 2019 to create awareness about the impact of unsustainable solid waste management practices and how citizens can do their bit to contribute to a greener future. However, thus far, it has generated little interest among city residents, as it lacks information on ongoing efforts and how citizens can reduce their solid waste footprint. Therefore, CityWorks (Resilient Chennai's implementation partners) will collaborate with the founders of CAPS to strengthen the existing website. It will do so by not only bridging the gap between citizens who want to make a change in SWM but lack the the knowledge or know-how to do so, but also help citizens realize that resources and knowledge base already exist in the city, and that with the help of these resources, small steps can be easily taken to address the challenge. This project will be facilitated by Resilient Chennai, and is likely to begin soon.

www.chennaiagainstplastics.com

xxxviii Action 35, Goal 2: Giving primacy to water related challenges in urban designing efforts, Resilient Pillar: Water systems.

73 💡

Expand reach of the Joint Secretary Programme to build government capacity

TIMEFRAME
Long term

STATUS
New / Proposed

The central government's Joint Secretary Programme allows for the appointment of professionals outside the government as joint secretaries[xxxix]. The aim of the programme is to bring in experts from varied sectors and with different experience to help with decision-making and provide innovative, out-of-the-box ideas for complex governance issues. The city could work with the State Government to introduce this programme for the Chennai Metropolitan Area. These outside experts would represent different fields, such as the corporate sector, and will hold a joint secretary position to Indian Administrative Service officers. The role of joint secretaries would be to assist secretaries in their functions, including advising elected representatives (ministers) on all matters of policy and administration pertaining to their department. The programme would enable creative exchange of ideas while also making experts understand challenges associated with governance.

KEY PLAYERS

GCC, HUD, Municipal Administration and Water Supply Department

RESILIENCE LINKAGES

Fosters long term & integrated planning;

Empowers a broad range of stakeholders;

Ensures social stability, security and justice;

RESILIENCE CO-BENEFITS

This project could potentially involve different actors from private sector and civil society in the governance process, thereby making it more participatory (**Healthy Urbanisation – Goal 1.3**).

xxxix The central government has appointed 9 professionals from fields including aerospace, energy, agriculture and financial services to join respective ministries on a contractual basis, to bring in a fresh perspective on policy making.

© Cynthia van Elk | Water as Leverage

RESILIENCE PILLAR 5: CHENNAI'S VULNERABLE COMMUNITIES

© Resilient Chennai – Aerial view of Srinivasapuram

While vulnerable communities in Chennai represent a range of different groups defined by factors including economic condition, age, gender, physical ability and profession, the most visible among them are the poor who live in informal settlements. These settlements are often situated along city waterways, and they often have limited access to basic amenities. Almost 30% of Chennai residents live in such settlements[141]. While a large part of this population contributes significantly to the city's economy, it remains vulnerable as a result of tenure insecurity, susceptibility to eviction, poor infrastructural facilities, sub-standard, often unhealthy, living conditions and stigmatization. While local bodies hesitate to invest in infrastructure such as drinking water, sewage or even roads within informal settlements, residents are themselves also reluctant to invest in home improvements, for fear of being evicted and losing the investment. Furthermore, a Chennai vision to transform into a slum-free city has devolved into a program that predominantly involves formalising city housing through large-scale, often involuntary,

relocation of slum-dwellers or other vulnerable residents to resettlement colonies which themselves are mostly located in ecologically fragile lands outside or on the peripheries of the city.

That said, the Tamil Nadu government appears to increasingly recognize the problems with this approach and has demonstrated a willingness to learn from past and present experiences and from local and international examples.

As such, the following are being identified as opportunities to ensure vulnerable communities' resilience so they have access to both decent living conditions and urban livelihood opportunities:

1. The decades-old Madras Urban Development Project (MUDP) sites and services model of formalizing informal settlements; and
2. Contemporary international guidelines for a more humane resettlement policy and adequate housing.

MISSION 5: Valuing the city's vulnerable

Chennai must value its vulnerable communities by planning and managing the city in a way that specifically addresses their needs and concerns. This includes all vulnerable populations, including those defined in terms of their socio-economic attributes and those defined by other attributes including age, gender, profession or physical ability. This will be crucial for building resilience equitably. Three specific goals will help achieve this mission:

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

GOAL 5.1 BRING DIVERSE VULNERABLE COMMUNITIES INTO MAINSTREAM POLICY MAKING BY IDENTIFYING THE DIFFERENT GROUPS AND THEIR NEEDS.

3 ACTIONS

Chennai city survives and thrives on informal and cheap labour of working-class populations across sectors. Much of these populations live in slums within and outside the city where they face a range of challenges from tenure security to accessing affordable and quality housing, education, drinking water, sanitation, health care, and so on. This makes the residents vulnerable to shocks and stresses. Investments have been made and are ongoing in recognising and addressing the problems of residents living in informal settlements. However, they don't consider the needs of other segments of vulnerable populations who face similar problems and who remain largely invisible in the policy-making process. These other population segments can be categorised in terms of age, gender, disability, sex, occupation, caste, etc., and include pavement dwellers, migrant workers, sub-sections of destitute groups (such as abandoned elderly, the mentally ill, sexual minorities, etc.) and people who are vulnerable as a result of their occupations (for instance manual scavengers, graveyard workers, small business owners etc.). The primary reason these groups are currently invisible is because there is a lack of comprehensive and disaggregated data about them. Government documents such as the 'TN Vision 2023' already call for recognizing vulnerable communities in housing and shelter policies[142]. This goal will help set that vision into motion; it will work to reduce inequalities by gathering richer and more nuanced data which will aid policy-making around these vulnerable groups.

LINKS TO NATIONAL/ LOCAL POLICIES/ GOALS

Deendayal Antyodaya Yojana-National Urban Livelihoods Mission

TN Vision 2023

LINKS TO INTERNATIONAL POLICIES/ GOALS

74

Resource centre on the invisible to inform policy

TIMEFRAME
Short term

STATUS
New / Proposed

A resource/research centre can be set up to collect and analyse data, and monitor trends around the entire range of vulnerable populations. The centre would create a comprehensive database around vulnerable populations including their demographic details, location, the socio-economic challenges they face and accessibility of basic services. This data centre would offer policy recommendations and help the multiple government departments co-ordinate and converge on existing schemes such that they address the needs of all vulnerable groups.

KEY PLAYERS

Madras Institute of Development Studies (MIDS) and other research institutions, TNSCB, GCC, TNHB, Department of Welfare for the Differently-Abled, IRCDUC, Spastics Society and Vidya Sagar

RESILIENCE LINKAGES

Fosters long term & integrated planning;

Empowers a broad range of stakeholders;

Ensures social stability, security and justice;

RESILIENCE CO-BENEFIT

This project would help government agencies come together on addressing needs of homeless people, consequently making the city more inclusive (**Governance Ecosystem – Goal 4.1**).

75

Awareness drive on programmes for the vulnerable

TIMEFRAME
Short term

STATUS
Ongoing
(Needs strengthening)

Potential beneficiaries of existing local, state and national schemes, programs and incentives for vulnerable population groups often don't know about these programs available to them. To ensure that they do, and that programs are used by those who need them, TNSCB and GCC—the two key government organizations dealing with vulnerable groups—can partner with locally active NGOs, activists and local councillors to facilitate an extensive outreach and awareness program. This could consist of campaigns in multiple languages, disseminated by radio, street plays, door-to-door efforts within vulnerable communities and talks in public spaces. A community member could also be trained and equipped with relevant information around other government and non-governmental schemes to act as a community resource person.

KEY PLAYERS

TNSCB, GCC, NGOs such as IRCDUC, *Uravugal*

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Promotes cohesive & engaged communities;

RESILIENCE CO-BENEFITS

This project would help make the city more inclusive by sensitising its residents and participatory by including vulnerable communities in decision making (**Governance Ecosystem – Pillar 4, Healthy Urbanisation – Pillar 1).**

76

Strengthen the Urban Homeless programme

TIMEFRAME
Short term

STATUS
Ongoing
(Needs strengthening)

The GCC has been implementing a "Shelter for Urban Homeless" initiative since 2013. It is based on a set of Standard Operating Procedures (SOPs)[xl]. The initiative includes an effort to maintain a database that tracks progress, independent evaluations and special shelter homes for women, the disabled and the elderly. Strengthening the programme through the following mechanisms would ensure higher impact:

a. Launching an information campaign for the homeless to generate awareness. This will include information about the location of shelters and helpline numbers where the public can report the location of homeless persons in distress;

b. Acquiring equipment and training personnel (including women) to perform rescue operations during disasters;

c. Designing shelters better so as to accommodate differently-abled, transgender populations and other population segments with special needs to reduce their exposure to disasters;

d. Providing homeless people with access to entitlement schemes such as pensions, Public Distribution System, assistance with identity documents and micro financing;

e. Providing information on livelihood opportunities and affordable housing schemes at the shelters to help homeless people improve their standard of living.

KEY PLAYERS

GCC, NGOs

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Fosters long term & integrated planning;

Meets basic needs;

Supports livelihoods & employment;

Ensures social stability, security and justice;

Promotes cohesive and engaged communities;

RESILIENCE CO-BENEFIT

This project can help address challenges faced by homeless people living in disaster prone areas (**Disaster Preparedness - Goal 3.2**).

xl These Standard Operating Procedures are a set of instructions on how the initiative should be run including instructions on design of the shelters.

MISSION 5: *Valuing the city's vulnerable*

GOAL 5.2 ENSURE THE INTEGRATION OF VULNERABLE GROUPS INTO THE URBAN FABRIC, WHILE MEETING BASIC NEEDS FOR ADEQUATE HOUSING.

6 ACTIONS

Neither states nor markets have been able to provide housing at the scale and adequacy required to accommodate Chennai slum-dwellers and homeless populations. While the number of housing units has increased, many of those houses are merely four walls and a roof, and are often cut off from employment opportunities, health care, schools and other facilities including access to safe and affordable drinking water, sanitation, energy and security of tenure. Further, despite many state-provided incentives and mandates[xli, 143], private sector participation in the affordable housing sector has been minimal. In light of these realities, communities should be empowered to meet their own housing needs. This means addressing structural challenges in formalising informal housing. It also means diversifying the housing market by thinking beyond ownership models and single-family units to allow for flexibility of location for those who cannot afford to buy.

However, just bridging housing gaps will not be sufficient to ensuring better living standards and improved resilience among low income and other vulnerable communities. This is primarily because resilience is rarely achieved at an individual or household level, but rather at the local, social and collective scales of neighbourhoods. Building this resilience therefore requires that vulnerable communities be integrated into urban fabrics rather than relocated to sites that are far-removed from already established networks and ties. It requires that in-situ redevelopment be prioritized over resettlement by addressing problems associated with land availability and ownership within the city, and other challenges such as uneven development of spaces and lack of direct engagement of residents, settlers and owners of informal settlements over time.

LINKS TO NATIONAL/ LOCAL POLICIES/ GOALS

Rajiv Awas Yojana

Pradhan Mantri Awas Yojana—Housing for All (Urban)

TN Vision 2023

Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013

Tamil Nadu Regulations of Rights and Responsibilities of Landlord and Tenants Act, 2017

Tamil Nadu Combined Development Regulation and Building 2018

LINKS TO INTERNATIONAL POLICIES/ GOALS

xli For instance, the new Tamil Nadu Combined Development and Building Rules (2019) states that, "in any development proposed, where the Floor Space Index [FSI] area (build up area) exceeds 4000 sq.mts either the applicant shall provide housing for lower income groups for an extent of 10 % of Floor Space Index area with dwelling units not exceeding 40 sq.mts in carpet area or pay shelter charges as prescribed in the Tamil Nadu Town and Country Planning Act, 1971 (Tamil Nadu Act 35 of 1972). The rate of shelter charges payable shall be 1% of the Guide Line Valve [GLV] of the FSI area exceeding 4000 sq.mts".

77

Regularisation and in-situ upgradation of informally-built housing stock wherever possible

TIMEFRAME
Long term

STATUS
New / Proposed

The affordable housing gap in Indian cities is not so much about a lack of houses or widespread homelessness but rather about a large volume of self-built housing that falls short of adequacy standards. In Chennai, this sector comprises of households, communities, and local contractors that have built the largest housing stock in the 'below INR 0.4 million' category[144]. This category of housing, built with investments from communities themselves, is typically perfectly placed—within the city and with the advantage of being suited to resident needs and resources, allowing for incremental expansion and improvements. Therefore, wherever possible, the city will consider regularising and upgrading this existing stock of informally built housing (barring developments on disaster prone or ecologically sensitive areas) to bring the existing affordable housing stock up to adequacy by providing legal tenure and property titles.

KEY PLAYERS

HUD, TNSCB

RESILIENCE LINKAGES

Fosters long term & integrated planning;

Meets basic needs;
Supports livelihoods & employment;

Ensures continuity of critical services;

RESILIENCE CO-BENEFITS

This project can help make Chennai more equitable by ensuring that urban growth caters to the need of all its citizens (**Healthy Urbanisation – Pillar 1**).

CHENNAI ASPIRATION:
Resilient Housing & Habitat Development for Vulnerable Communities

Nearly 29% of Chennai's population live in informal settlements due to lack of housing and infrastructure. Since a large part of these informal settlements are around water bodies, this increases the vulnerability of this population to floods. Currently, the Tamil Nadu Slum Clearance Board (TNSCB) is working towards rehabilitating 65,000 families living in informal settlements along our waterways. The rehabilitation of at-risk families will be funded by the World Bank/ ADB.

The stated government intent of achieving Chennai's slum-free vision is to prioritise and implement in-situ upgradation where possible, or proximate resettlement (within 5km) in locations where in-situ upgradation is unfeasible. In this effort, challenges such as shortage of land, finance, poor capacity in facilitating people's participation, and lack of durable, affordable, resilient design need to be overcome.

As a follow up from the Addis Ababa workshop organized by 100RC to enhance the dialogue for building a "global network" that will address slum upgrading / development, Resilient Chennai, in collaboration with TNSCB, has decided to engage in a pilot Resilient Housing & Habitat Development project as a flagship initiative of Chennai's Resilience Strategy.

The initiative will build TNSCB's capacity to undertake improvements to informal housing in an inclusive manner through developing a pilot engagement. It will aim at repositioning informal settlements and slum upgrading and development as part of building city, community and household resilience; as well as highlight the importance of an integrated citywide approach that puts people at the centre of policies, strategies and projects.

78

Augmenting land availability for affordable housing in the city

TIMEFRAME
Long term

STATUS
New / Proposed

One of the most frequently cited deterrents for not relocating slum dwellers within the city is a shortage of available land. To address this issue, a systematic study to identify and map all vacant lands—public and private, large and small—is crucial. Therefore, an effort is needed to first map existing vacant lands (e.g. by using ISRO[xlii] satellite imagery) and then employ innovative measures to increase land availability for affordable housing. These methods may include:

a. Integrating land augmentation mechanisms into state housing policy;

b. Introducing reforms around land reservation for affordable housing projects and strengthening state authorities to enforce such reforms;

c. Regularising state land pricing by using existing "guidelines values" or other means;

d. Including affordable housing as a priority land use for land acquisition along with other projects such as roadways expansion, flyover construction and Chennai Metro;

e. Making public land available for slums through policies that prioritise land use allocation for affordable housing;

f. Introducing innovative revenue-generation schemes (social rentals, transferable development rights) that are available to Urban Local Bodies (ULBs) to make land available;

g. Taking economic and legal measures such as offering incentives and imposing taxes or financial penalties on private vacant land owners so that the government can buy back such vacant lands for the development of affordable housing.

xlii Indian Space Research Organisation

KEY PLAYERS

HUD, the Land Administration Department, the Revenue Department, CMDA, DTCP

RESILIENCE LINKAGES

Fosters long term & integrated planning;

Ensures continuity of critical services;

RESILIENCE CO-BENEFIT

This project showcases how data and technology can support governance (**Governance Ecosystem – Pillar 4**). It can also support more equitable growth by freeing up land for affordable housing projects (**Healthy Urbanisation – Pillar 1**).

79

Flexible tenure security arrangements

TIMEFRAME
Long term

STATUS
New / Proposed

Access to basic services within informal settlements is linked to tenure security, i.e. there is either no access to services in the absence of formal tenure or temporary solutions serve the purpose, as arranged by communities with the help of ULBs (e.g. water tanks supplying limited amounts of water). National programmes such as the Rajiv Awas Yojana, Jawaharlal Nehru National Urban Renewal Mission, and National Sanitation Mission already seek to provide slum dwellers with equitable and universal access to basic services, irrespective of the legal status of land they are living on. Building on these programmes, the city may first consider trying to offer tenure security to those not living on ecologically sensitive areas, through formal titles or alternative methods such as long-term community leases and no-eviction guarantees. Second, irrespective of tenure security, the city can consider providing basic urban services such as water, sanitation and electricity to all informal settlement residents.

KEY PLAYERS

HUD, TNSCB, the Land Administration Department, the Revenue Department

RESILIENCE LINKAGES

Fosters long term & integrated planning;

Meets basic needs;

Supports livelihoods & employment;

Ensures social stability and justice;

Ensures continuity of critical services;

RESILIENCE CO-BENEFITS

This effort would be critical to help make Chennai a more equitable city (**Healthy Urbanisation – Pillar 1**).

80

Community-led planning for informal settlements

TIMEFRAME
Short term

STATUS
New / Proposed

Planning for all projects in and around informal settlements that affect residents should include their voices. Therefore, a participatory and community-led planning process needs to be prioritized by means of various mechanisms and processes. For instance:

a. Encouraging all consultants to partner with communities when preparing Detailed Project Reports (DPRs) for TNSCB vulnerable group housing projects. The role of the community here should be of project designers rather than subjects;

b. For projects that might impact vulnerable communities and/or informal settlements, public planners and consultants should arrange to reach out to them where they live and work. This can be done, for instance, by organising workshops, conducting door-to-door surveys, and having field workers meet them to gather their inputs using online tools/apps such as the Vulnerable Capacity Assessment tool used by Red Cross.

KEY PLAYERS

TNSCB, TNHB, international financial institutions, multilateral and bi-lateral organisations, NGOs

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;

Fosters long term & integrated planning;

Meets basic needs;

Supports livelihoods & employment;

Promotes cohesive and engaged communities;

RESILIENCE CO-BENEFITS

This would help encourage a more multi-stakeholder driven, participatory urban planning process (**Healthy Urbanisation - Goal 1.3**). It will also help foster an environment where government, citizens and private sector can co-build the city's resilience (**Governance Ecosystem - Goal 4.3**).

CHENNAI ASPIRATION:
Chitra Nagar

As part of the 'Water as Leverage' project, the team 'City of 1,000 tanks' will work to retrofit a low-income housing settlement–Chitra Nagar–located in the heart of the city and on the banks of the Adyar River. The team has already actively engaged with the local community to understand and incorporate their views and vision for the proposed project. These interactions highlighted water and sanitation issues, unhealthy environment, poor housing quality and design–which is inaccessible to pregnant women, disabled and elderly–and flooding as major issues that need to be addressed. Therefore, these issues form the core of this team's intervention in Chitra Nagar and will include the following elements: developing constructed wetlands for sewage treatment between blocks; maximising water collection on the roof and water storage; setting up a solid waste management centre; providing safe sanitation facilities that are accessible to all; strengthening the river bund through natural means; and creating reforested streets to act as water run-off buffers.

© City of 1000 Tanks | WaL – The Future of Chitra Nagar

81

A city-wide, slum-free Chennai action plan

TIMEFRAME
Short term

STATUS
New / Proposed

India's Rajiv Awas Yojana's slum free cities action plan, and the more recent Housing for All Plan of Action, highlight a need to integrate the urban poor into urban fabric through in situ upgradation. In line with these efforts, Chennai may formulate a city-wide in-situ upgradation plan that is not project based and involves active engagement and partnerships between communities, NGOs and government. This city-wide upgrading process can make Chennai slum-free while also preventing the unsustainable rise in property values of upgraded sites, which in turn could crowd out vulnerable residents. This could be attempted through:

a. Integrating plans to upgrade slums into larger city development plans;

b. Ensuring community participation in the design, implementation and management of housing upgradation projects by building city-wide federations or networks of CBOs (e.g. the Baan Mankong initiative in Thailand);

c. Fostering partnerships between government, NGOs and communities to implement slum upgradation projects (e.g. the Slum Networking Project (SNP) implemented in Ahmadabad in the 1990s or the Yerawada scheme in Pune in 2009).

KEY PLAYERS

HUD, TNSCB, TNHB, CMDA, GCC, some NGOs, GIZ

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;
Fosters long term & integrated planning;

Supports livelihoods & employment;

Ensures social stability, security and justice;
Promotes cohesive and engaged communities;

RESILIENCE CO-BENEFITS

This action encourages a more multi-stakeholder driven, participatory urban planning process (**Healthy Urbanisation - Goal 1.3**).

100RC INSPIRATION:
Medellín, Colombia

Medellín has become internationally renowned for its Proyecto Urbano Integrado (PUI) urban project upgrading model for multiple reasons. Moving away from past policies focused on clearing slums, this program focuses on addressing the challenges related to the poor, and the informal settlements as an interconnected issue of lack of opportunities, infrastructure, crime, poverty, lack of social services, etc. Therefore, the PUI is driven by the aim to improve the quality of the urban slum environment city-wide, and to raise living standards by integrating physical upgradation efforts with social and institutional programs. Through a participatory planning approach, the PUI program in Medellín customized urban projects for each of the city's major informal settlement pockets based on their respective challenges and assets. Thus, Medellín's approach to handling its vulnerable communities and informal settlements offer a relevant case to highlight the need for a comprehensive and participatory city-wide approach to slums.

Since many of the informal settlements in Medellín are located in earthquake prone hill sides, the city, in conjunction with 100RC Platform Partner Build Change, is working towards reducing the slum dwellers' vulnerability to earthquakes and landslides by improving building safety through seismic retrofits. The organization has also helped Medellín city to develop a manual that includes the technical procedures and guidelines for retrofitting houses for earthquake resilience throughout Colombia. These efforts are expected to lower the risk of economic loss or casualties for the city due to seismic events or landslides.

82

Flexible affordable housing policy

TIMEFRAME
Short term

STATUS
New / Proposed

Approaches to affordable housing have hitherto focused on ownership models and on single family units. However, urban housing needs are actually far more diverse, often depending on income, family size, nature of work, etc. The Tamil Nadu Vision 2023 document already outlines a vision for housing where the single-family unit is not the only form of housing[145]. Keeping in line with this vision, a flexible affordable housing policy could be formulated. Some elements of the policy could include:

a. A range of affordable housing options (e.g. non-family-based housing options like worker accommodations, old age homes, working women's hostels, temporary housing);
b. A rental option explicitly encouraging publicly-built rental housing;
c. Support for worker-led cooperative housing assisted by unions;
d. Incentives or directives for the state and employers to share responsibility for the provision of worker housing (through free land, subsidies) which could be integrated into other non-housing policies such as the National Manufacturing Policy.
e. GIZ is currently formulating a State Housing and Habitat Policy which can effectively incorporate elements of a flexible affordable housing policy to offer a comprehensive and guiding document for ensuring adequate housing for all.

KEY PLAYERS

HUD, TNSCB, TNHB, GIZ

RESILIENCE LINKAGES

Fosters long term & integrated planning;

Meets basic needs;
Supports livelihoods & employment;

Ensures social stability, security and justice;

RESILIENCE CO-BENEFIT

The policy would support planning in such a way that it meets the needs of vulnerable communities while also encouraging a more multi-stakeholder driven, participatory urban planning process (**Healthy Urbanisation - Goal 1.3**).

MISSION 5: Valuing the city's vulnerable

GOAL 5.3 ENSURE A MORE HUMANE PROCESS OF PROXIMATE RESETTLEMENT OF INFORMAL SETTLERS WHEN NO OTHER OPTION EXISTS.

4 ACTIONS

Currently, the predominant pattern in slum resettlement is that residents are moved to mass-scale, high-rise, peripheral, state-built tenements. Since 2000, over 50,000 households have been moved from informal settlements within Chennai city to sites outside the city, and another 30,000 are likely to also be resettled to these sites[146]. This model of mass, large scale resettlement is problematic for a range of reasons including safety, disconnection from previous ties, livelihood opportunities, adequate education and health care, the location of the new tenements on ecologically fragile lands, and so on. Despite these challenges, resettlement of communities from certain locations (e.g. river banks) may be required. Therefore, the process of resettlement can be conducted in a more humanitarian way that is sensitive to vulnerable community needs and challenges. One reason preventing this in the past is a lack of an official Chennai city resettlement policy to govern the process. Therefore, there is a need to provide input to develop this much-needed resettlement policy and ensure its operation through stringent monitoring and evaluation mechanisms.

LINKS TO NATIONAL/ LOCAL POLICIES/ GOALS

Rajiv Awas Yojana

TN Vision, 2023

LINKS TO INTERNATIONAL POLICIES/ GOALS

83

Resettlement & rehabilitation policy

TIMEFRAME
Short term

STATUS
New / Proposed

In situ redevelopment of informal settlements is most preferable for ensuring residents' access to urban amenities and livelihood opportunities. However, where this is not possible, and resettlement is necessary, a detailed set of guidelines and standards that govern Chennai city resettlement processes is needed in order to ensure that resettlement has minimal effect on the lives and livelihoods of those being resettled. These guidelines can be formulated in a Resettlement and Rehabilitation Policy that aims to mitigate the negative impacts of long distance and/or involuntary resettlement. This might include:

a. Restricting the resettlement radius to 5km from current place of residence;
b. Identifying smaller tracts of land within the city for resettlement;
c. Providing land plots instead of flats, giving people the flexibility to construct housing based on their needs;
d. Adopting international guidelines such as International Financial Institution Guidelines that spell out mechanisms for providing/ restoring access to transport, education, health care, livelihood opportunities and other basic necessities in the new site;
e. Engaging the active and continuous participation of resettled populations throughout the entire process;
f. Restoring ecological balance, particularly along waterways, while ensuring sensitivity to communities living nearby;
g. Ensuring that resettlement colonies are not situated on ecologically vulnerable areas.

KEY PLAYERS

TNSCB, HUD

RESILIENCE LINKAGES

Fosters long term & integrated planning;

Meets basic needs;
Supports livelihoods & employment;

Ensures social stability and justice;
Promotes cohesive and engaged communities;

Ensures continuity of critical services;

RESILIENCE CO-BENEFITS

This action encourages a more multi-stakeholder driven, participatory urban planning process (**Healthy Urbanisation – Goal 1.3**). It will also help foster an environment where government, citizens and private sector can co-build the city's resilience (**Governance Ecosystem – Goal 4.3**).

84

Reviving the Sites & Services model

TIMEFRAME
Short term

STATUS
Piloted
(Needs scaling-up)

The Sites and Services model implemented under MUDP I & II offered many advantages. For instance, providing beneficiaries with plots of land that they can develop according to their needs, providing space to set up small businesses and catering to mixed socio-economic groups. The city can consider reviving this programme wherever land is available. Under the revived project, the resettlement sites should be developed not more than 5 km from the city, and should contain associated services such as roads, drainage and individual water supply and sewage connections. The objective of the model would be to ensure that resettled sites are well integrated into the urban fabric and include mixed-class neighbourhoods; have access to public transport systems; have a flexible built form more suited to the needs of low-income households; integrate livelihood activities and spaces into the residential neighbourhood and allow for strong and self-sustaining resident associations to be built.

KEY PLAYERS

HUD, TNSCB, TNHB

RESILIENCE LINKAGES

Empowers a broad range of stakeholders;
Fosters long term & integrated planning;

Meets basic needs;
Supports livelihoods & employment;

Ensures social stability, security and justice;
Promotes cohesive & engaged communities;
Fosters economic prosperity;

RESILIENCE CO-BENEFIT

This effort would be critical to help make Chennai a more equitable city (**Healthy Urbanisation – Pillar 1**).

85

Case-based Resettlement Action Plan

TIMEFRAME
Short term

STATUS
New / Proposed

Each informal settlement is different; each is occupied by different types of people, and involves different resources and challenges. The TNSCB will work closely with each community on a case-by-case basis to formulate a case-specific resettlement action plan in partnership with the people who will be resettled. While this action plan follows the resettlement and rehabilation policy, it will help avoid one-size-fits-all solutions, and will offer targeted approaches for a shared plan of action.

KEY PLAYERS

TNSCB

RESILIENCE LINKAGES

Fosters long term & integrated planning;

Meets basic needs;

Ensures social stability and justice;

Promotes cohesive & engaged communities;

Ensures continuity of critical services;

RESILIENCE CO-BENEFITS

This recommendation would encourage a more multi-stakeholder driven, participatory urban planning process (**Healthy Urbanisation - Goal 1.3)** and would foster an environment where government, citizens and private actors work together to co-build the city's resilience (**Governance Ecosystem - Goal 4.3**).

86

Case-specific resettlement advisory body for monitoring resettlement efforts

TIMEFRAME
Short term

STATUS
New / Proposed

To ensure that resettlement processes are on track and follow all policy guidelines and case-specific resettlement action plans, an advisory body can be constituted at the outset for each resettlement process. This advisory body can also play a significant role initially in formulating the case-specific and participatory resettlement action plan and then remain engaged throughout the entire project cycle to monitor and evaluate progress and impacts on the community. Members of this advisory body should include a range of experts across government, academia, NGOs and, most importantly, representatives from the community to be resettled.

Recognizing that a participatory or community-driven resettlement/upgradation plan can allow vulnerable populations to influence the outcomes to better match with their concerns related to safety, livelihood opportunities, family structure etc, Resilient Chennai team is planning to support TNSCB by:

a. Developing resilient housing and habitat blueprints for two select sites for upgradation or proximate resettlement along the Cooum River in Chennai with inputs from the beneficiaries through a series of close interactions; and

b. Helping form a consortium of civic agencies, community representatives, academic experts, architects, and 100RC platform experts to play a monitoring and advisory role throughout the planning and implementation of these two cases. This advisory body will shape the plan and monitor the entire process to ensure that the key demands of the beneficiaries are met and the process and outcome of the resettlement effort is more humane.

KEY PLAYERS

TNSCB, community representatives, NGOs, Academia

RESILIENCE LINKAGES

Promotes leadership and effective management;

RESILIENCE CO-BENEFIT

The advisory body will help make sure that due processes around resettlement and rehabilitation are followed and implement the case specific action plan (**Governance Ecosystem – Goal 4.2**).

© Adithya Anand - Makar Sankrati, Festival of harvest dedicated to the sun

CHAPTER 10
way forward

This Resilient Chennai strategy document has outlined a range of actions that can strengthen Chennai city's resilience to cope with the shocks and stresses it faces. Several of these interventions are already underway, implemented by diverse agencies, but can nonetheless be strengthened or scaled up. Others are newer ideas that require detailed planning and resources for implementation.

Over the next three years, the Resilient Chennai team aims to prioritize certain actions partly because of their potential impact on city resilience and partly because of ongoing discussions/traction amongst interested partners. These priority resilience actions are listed in the next few pages. By highlighting these actions, the Resilient Chennai team, along with the city, seeks continued support from government, civic, academic and industrial entities to translate these ideas into reality on the ground.

PRIORITY RESILIENCE ACTIONS

01 **CHENNAI URBAN HORTICULTURE PROGRAMME**

Recognizing the multi-pronged benefits of urban agriculture, the city of Chennai, under GCC's leadership, is planning to build rooftop vegetable gardens in public schools and other buildings across the city with help of Residential Welfare Associations. Select schools in Chennai have already been growing vegetables on their premises to cook food under the Mid Day (Nutritious) Meal Programme. Scaling up this action will enable the city to improve its green cover, better manage its water and wet waste by including aspects of recycling water and composting, supply local food, raise civic awareness and participation, and beautify the city at the same time. Some funds are likely to be available for this intervention through Chennai Smart City Ltd. (CSCL)'s 'Model and SMART Corporation Schools in Chennai' project. In order to scale this up to be a city-wide intervention, additional funds and volunteer support will be needed.

Figure 21: *Urban Horticulture linkages*

ROOFTOP GARDEN KIT

What components should a successful terrace garden kit contain, considering costs, Chennai's climate and rooftop conditions?
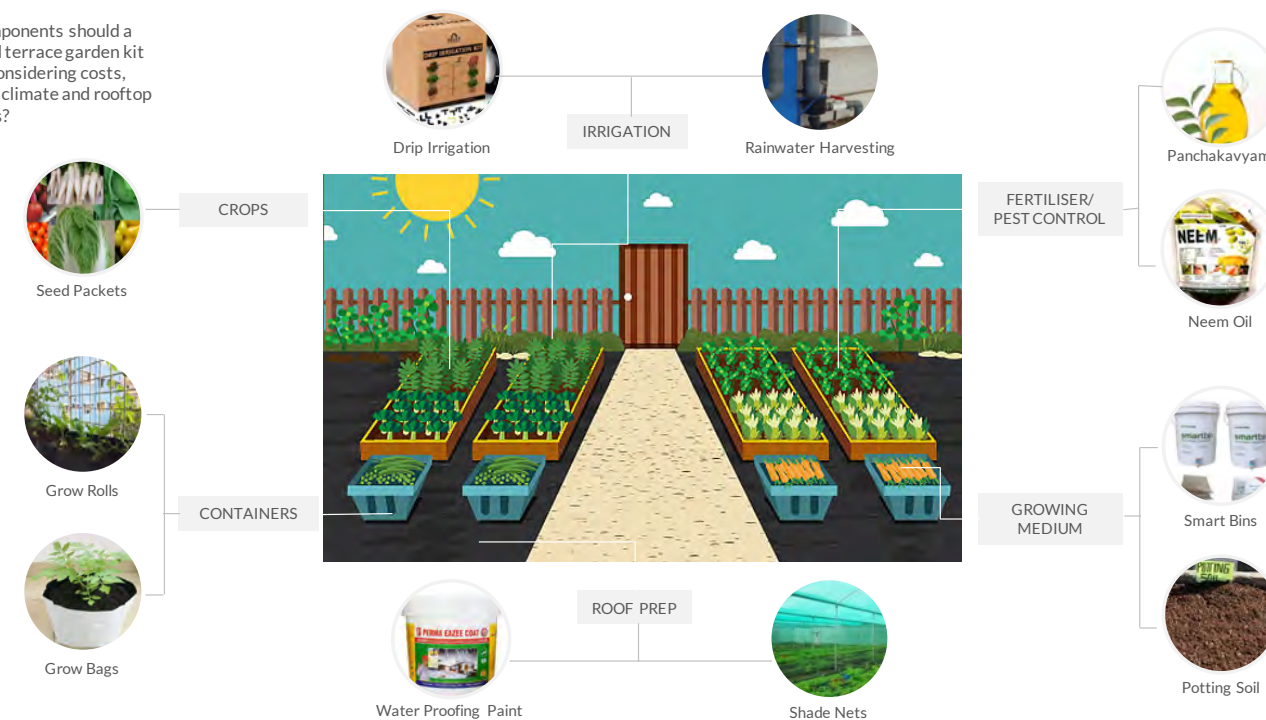

Figure 22: *Rooftop garden kit*

02 WATER AS LEVERAGE (WaL) FOR RESILIENT CITIES ASIA

Spearheaded by the Dutch Special Envoy of International Water Affairs, Henk Ovink, this initiative has brought together a group of international and local partners to co-design climate and water sensitive solutions for Chennai. Multiple project ideas sited across the city have been proposed as part of WaL. For instance, one project aims to restore the vitality of Mambalam Canal and basin area by introducing environmentally sensitive elements—onsite grey water treatment and ground water recharge systems; bridges over the canal to include solid waste collection points; and permeable surfaces and infiltration trenches along the embankments to enable ground water recharge. Other project sites include Muttukadu, Koyambedu, Mylapore, and Chitra Nagar.

Resilient Chennai has facilitated interactions for the two involved teams with various government agencies and departments. The Chief Engineer (Storm Water Drain, Special Projects and Bus Route Road Departments) at the Greater Chennai Corporation serves on the Advisory Board of the Water as Leverage initiative. Mr. Harmander Singh, Principal Secretary, Municipal Administration and Water Supply Department, Government of Tamil Nadu, has assigned the Tamil Nadu Water Investment Company Ltd. to work with the WaL teams to help translate the inclusive and innovative proposals into bankable and implementable projects.

FMO (Dutch Development Bank) and RVO (Netherlands Enterprise Agency) have expressed an interest in providing support for the next steps to bring these into the feasibility and implementation phase. An application for the Green Climate Fund is being processed for the Mylapore project, while the World Bank is considering supporting the Chitra Nagar and Mambalam Canal projects. There are indications of potential support from other financial institutions and multilateral development banks for the other projects as well.

THE FUTURE OF MAMBALAM CANAL – *Rise Chennai*

THE FUTURE OF CHITRA NAGAR– *City of 1000 Tanks*

Water for
as Resilient Cities
Leverage Asia

03 THE DATA OBSERVATORY

A number of agencies, including the National Institute of Urban Affairs (NIUA), CSCL, the Centre for Urbanization, Buildings and Environment/Indian Institute of Technology Madras (CUBE/IIT Madras) and MCCI, are in discussion to develop a Data Observatory to support coordinated and data-driven decision-making in Chennai. Initially, the observatory will focus on water-related challenges and collect, analyse and present relevant data to address these challenges. Chennai is developing an Integrated Command and Control Centre (ICCC) to help manage the city's traffic and disasters. The Data Observatory in Chennai can work in conjunction with the ICCC to support the city government and stakeholders to identify their decision needs, utilize data and improve service provision, alleviate day to day stresses and use real time data to manage shocks as they emerge.

05 A CLIMATE CHANGE ADAPTATION PLAN

Chennai needs a comprehensive action plan or strategy to help adapt to climate change. This will make Chennai resilient to climate threats and hazards by reducing exposure, pooling resources, transferring and sharing risks, increasing capacity to cope and by responding effectively to unforeseen events. This Adaptation Plan will be based on the Tamil Nadu State Action Plan on Climate Change currently being revised by the Government of Tamil Nadu in consultation with GIZ.

04 ADVISORY CONSORTIUM FOR CO-BUILDING RESILIENT RESETTLEMENT PROCESS/PLAN

Tamil Nadu Slum Clearance Board is seeking to form an advisory body with representatives from the community, and local and international experts for its resettlement/in-situ slum redevelopment efforts along Chennai's waterways. This resettlement/in-situ redevelopment effort is likely to be funded by the World Bank. The plan is to form a consortium of partners with community representation to ensure a) a blue-print for resilient homes that meet community needs and can better withstand future disasters is designed and b) that the whole process from planning to implementation is well monitored with community consultation at every critical phase.

06 RESETTLEMENT AND REHABILITATION POLICY

Wherever resettlement is necessary due to ecological limitations or other constraints, a detailed set of guidelines and standards that govern the resettlement process is needed in order to ensure that resettlement has minimal effect on the lives and livelihoods of those being resettled. These guidelines can be formulated in a Resettlement & Rehabilitation Policy for the state that aims to mitigate the negative impacts of long-distance and/or involuntary resettlement. The Housing and Urban Development Department could lead the development of this policy.

07 CAPACITY BUILDING OPPORTUNITIES

A series of knowledge sharing products or learning sessions and awareness building programs have been prioritized by city stakeholders during the strategy development process and listed in this strategy. Resilient Chennai team intends to work with relevant public, private, and civic partners to develop these capacity-building actions.

Ogilvy Chennai

Tinacca Media

Rubecon
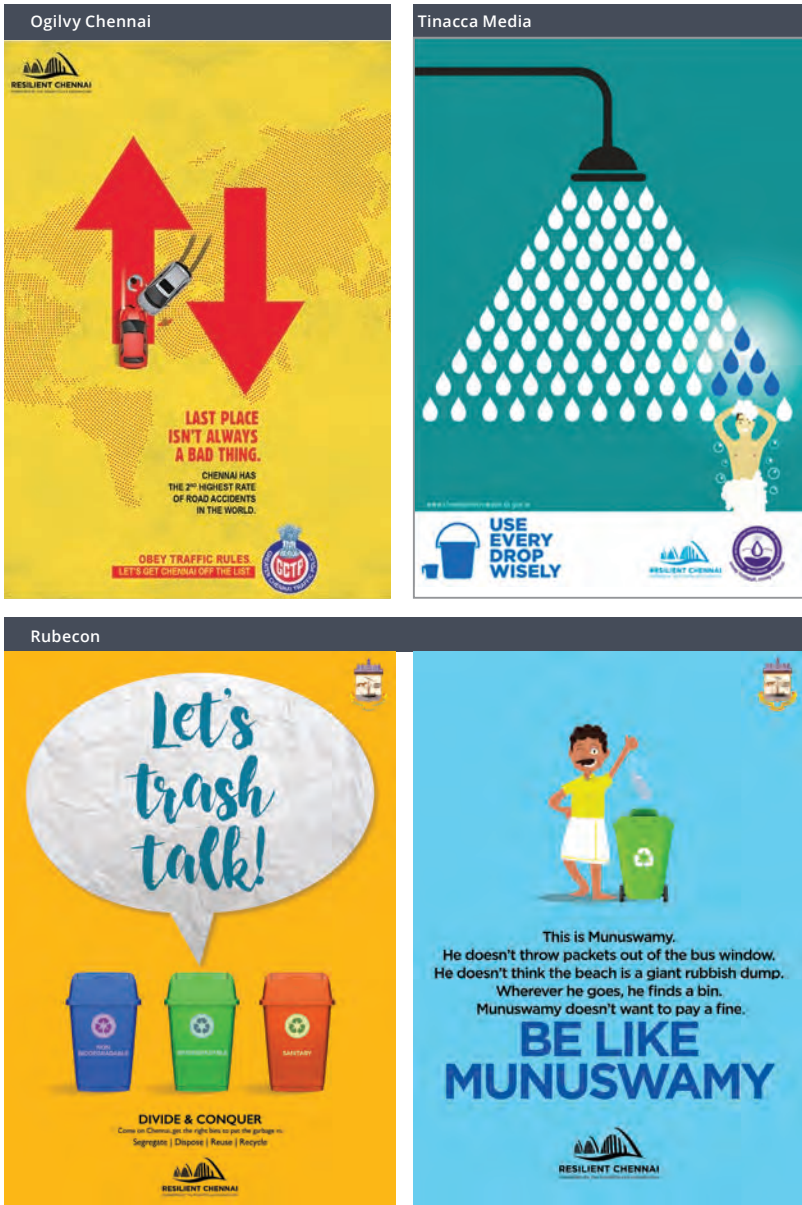
07a AWARENESS CAMPAIGNS

Public Service Announcement Campaign: The Resilient Chennai team has initiated a city-wide digital and outdoor public service announcement campaign to raise civic awareness on a range of key issues relevant to the city, including water conservation, solid waste and road safety. This campaign will involve the design of an evocative series of posters which will be circulated in social media, and select schools, colleges, and public spaces. Three among the top creative agencies in the city, namely, Ogilvy, Rubecon and Tinacca are working on these pro bono. Such efforts will support existing Information and Education campaigns by GCC. Scaling up this effort could initiate:

i *A targeted and sustained awareness programme on waste management* for waste generators and collectors to support sustainable solid waste management;

ii *Rise to recycle water campaign* to raise awareness on the importance of using recycled waste water;

iii *Prepare Chennai*—a campaign for awareness on disaster preparedness, especially for vulnerable communities;

iv *Awareness drive on programmes for the vulnerable* to keep the potential beneficiaries informed about such schemes.

07b TRAINING PROGRAMMES

i *Capacity building for planners and real estate developers around incorporating environment friendly solutions into urban planning:* Chennai's academic institutions and urban design firms with expertise in green and clean infrastructure and design can initiate capacity building programmes to raise awareness and provide technical support for planners and developers.

ii *Capacity building on water-centric design:* A similar training programme that focuses on how to design water-friendly infrastructure can be developed by a consortium of experts from academic and planning institutions or architecture/ urban design firms, to inform planners and designers within government agencies. Such training will be hands-on and give participants an opportunity to design or redesign existing neighbourhoods/wards/ public spaces in the city based on what they have learned by keeping in mind existing constraints.

iii *Children as change agents:* CityWorks is planning to collaborate with Resilient Chennai to sensitise and train school children on the environmental impacts of poor solid waste management practices and encourage them to act as change agents in their families and communities. The programme will initially be implemented in three GCC schools and will use the "Trashonomics" book developed by Solid Waste Management Roundtable (SWMRT), Bangalore. This will soon be introduced in 15 schools.

07c   **KNOWLEDGE-SHARING WEBSITES**

i   *Catalogue on Disaster Resilient Building Material:* A catalogue of alternative and disaster resilient material (e.g. lime, fly ash brick and autoclaved aerated concrete) can be drafted with the help of relevant engineering institutions like CUBE, IITM. This information could be made available on the CMDA, GCC and Indian Institute of Architects websites for raising greater awareness on such sustainable materials.

iii   *Chennai Against Plastics (CAPS):* The CAPS website was launched in January 2019 to create awareness about the impact of unsustainable solid waste management practices and how citizens can do their bit to contribute to a greener future. CityWorks (Resilient Chennai's implementation partner) wishes to strengthen this platform to share knowledge, generate greater interest among city residents on ongoing efforts, and raise awareness about how citizens can reduce their solid waste footprint.

ii   *Web-based platform on water-centric urban design:* A similar online platform can be created for storing information on urban design projects that incorporate water sensitive elements. Targeted towards urban planners within government and interested citizens, this platform could be created by a consortium of architecture/design firms and research institutions, and be hosted by CMWSSB. The website will include links to potential partners/funders looking to collaborate on similar work.

iv   *Platform for collective-action best practices:* A website can be developed to highlight best practices around participatory governance and collaborative efforts around Chennai city civic issues. This website will act as a repository of best practices, categorized according to specific themes such as water, waste, disasters and responsible citizenship.
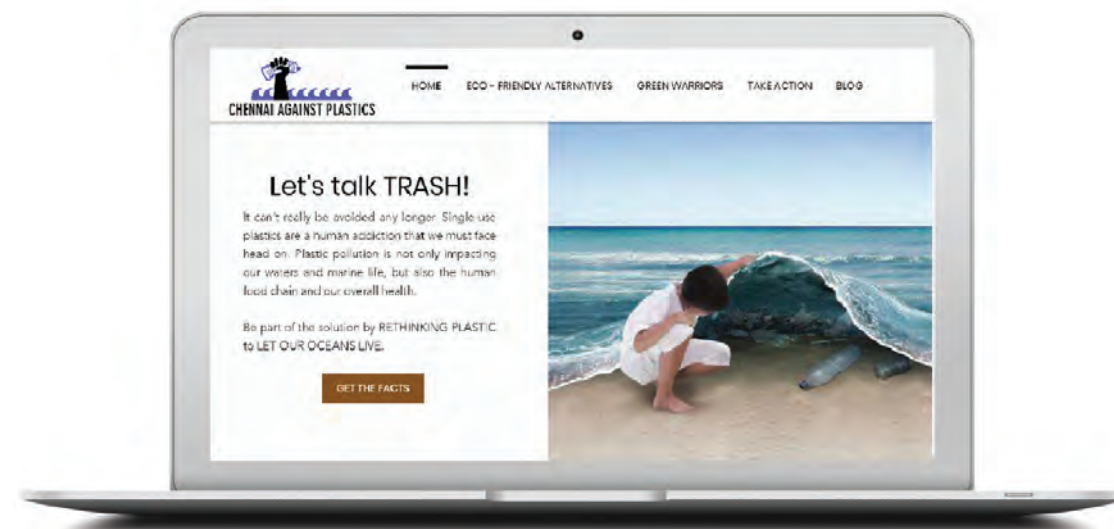
07d   **OTHER KNOWLEDGE-SHARING PRODUCTS**

i   *Lake restoration – A guide book:* Non-profit organizations active in lake restoration efforts and technical experts from academic institutions can develop a lake restoration guidebook to help support more systematic, ecologically sound, and humane waterbody restoration efforts across the city. This document will share details on hydro-geological, economic, ecological, socio-cultural and other factors that need to be considered in the restoration process.

ii   *Resource centre on the invisible to inform policy:* A resource/research centre can be set up to collect and analyse data, and monitor trends around the entire range of vulnerable populations. This centre would create a comprehensive database around vulnerable populations and offer policy recommendations to relevant public departments.

Kanniammanpet Pond Restoration

Pura Kulam Restoration

Before restoration

After bund formation

After restoration

ROLE OF THE RESILIENT CHENNAI OFFICE

The Resilient Chennai Strategy is just the first step towards the path to build Chennai's inner strength. The delivery of the commitments made in this strategy requires undivided attention and targeted efforts to identify and mobilize partnerships between government, civic, and corporate stakeholders. It requires continuous effort to instill resilience thinking amongst the city's leading agencies across all sectors.

Thus, a dedicated Resilient Chennai Office (henceforth the Office) will be established to:

i. foster a deeper understanding and incorporation of resilience in city's functioning and
ii. facilitate multi-stakeholder collaborations to build Chennai's resilience.

The Office will specifically contribute towards the following:

A. Partnerships & Collaborations
B. Mentoring and Capacity Building
C. Funding
D. Monitoring and Evaluation

© Sankarbks – Napier Bridge

A · PARTNERSHIPS & COLLABORATIONS

This strategy and its associated projects are an outcome of the deep stakeholder engagements the Resilient Chennai team has had over the last 22 months. As a next step, the Office will seek to initiate, implement and influence the priority resilience actions identified in this Way Forward section by mobilizing partnerships between relevant stakeholders.

Based on ongoing conversations and emerging partnerships, the Office will be strongly supported in these efforts by government agencies like the GCC, CMWSSB, Department of Housing and Urban Development, CMDA, TNSCB, CRRT, and TWIC. In addition, key stakeholders from academia, civil society and corporations have also shown their support and interest to partner with the Resilient Chennai team and government agencies to implement several of the proposed actions.

This Office will also tap into the extensive expertise and knowledge base from other 100RC network cities and platform partners to inform, influence, and amplify the impact of the proposed actions on the lives and livelihoods of Chennai residents in an inclusive way. It will also leverage the relationships built over the last two years among stakeholder groups to bridge silos, collaborate, converge efforts, and to initiate robust and sustainable actions on the ground.

B · MENTORING AND CAPACITY BUILDING

The list of priority actions outlined earlier has already highlighted the importance of training programmes, knowledge sharing websites, and products for building capacity within public and private sectors, and civil society. This is crucial for developing a thorough understanding of the city's resilience challenges, their interlinkages and possible ways of addressing them. Therefore, building capacity will remain a key focus area for the Office. More fundamentally, to ensure that as a society we recognize the value of resilience thinking and resilience building, the Office will organize Resilience Labs – that would include mentoring sessions accompanied with a resilience tour of the city.

C · FUNDING

The Office will also, where possible, help seek funding for the flagship projects and other priority actions.

The various funding opportunities include partial funding by the Rockefeller Foundation with other foundations, CSR funding, funding by banks focused on infrastructure projects, and funding by venture capital funds that have start-ups in the areas that the city needs to build resilience in. There are examples of funding opportunities already available to address certain actions. For example, CSCL could fund water metering efforts.

To fund the Resilient Chennai Office, one key point of leverage will be the projects that are close to implementation and already have government support. For example, GCC has indicated that they are willing to support the urban horticulture initiative. The Office could use this opportunity to demonstrate how small investments can unlock larger funding and create a greater impact on the ground.

D · MONITORING AND EVALUATION

As the key facilitating agency for Resilience building efforts in Chennai, the Office will closely monitor and evaluate a) the progress of all the projects implemented through the Office and b) the achievements of the Office to translate the Chennai Resilience Strategy into action. Before each project begins, the Office, in conjunction with the involved partners, will agree to performance measures and will monitor and evaluate each project on its impact. In order to monitor its own efficiency, the Office will prepare a quarterly progress report that will be submitted to the funding agencies and made available online on the Resilient Chennai website for all interested government, private, and civic agencies to see.

INSTITUTIONALIZING RESILIENCE WORK IN CHENNAI

In order to carry forward the strategy development work and translate ideas into action, the Resilient Chennai team has explored various scenarios to continue to work with the Government of Tamil Nadu in an impactful manner.

It is important to identify a central institution where the Resilient Chennai Office can be housed. This institutionalization should offer maximum leverage to work with the government departments linked to the key focus areas, namely: water systems, disasters, metro governance, civic engagement, vulnerable and low-income populations, healthy and planned urbanization.

Following are two feasible options:

1

The Resilient Chennai Office could continue to operate out of Greater Chennai Corporation with funds from projects that are linked to the Resilience Strategy Report.

Over the last two years, Resilient Chennai has built relationships with officials within GCC at senior and mid-levels. The team has attempted to cultivate Resilience Champions within GCC to create this relationship. Other organizations such as GIZ, C40, ITDP, and Chennai Smart City Ltd. also work within the Special Projects Department at GCC, under the guidance of the Chief Engineer (Special Projects, Storm Water Drain, and Bus Route Roads). Therefore, the Resilient Chennai Office could continue to build on existing relationships within GCC, collaborate with the other organizations in the Special Projects Department to converge actions, and continue to work with the city to support the implementation of the projects by coordinating effectively with the Government of Tamil Nadu.

Furthermore, citizens engage with GCC on public services and issues such as solid waste, roads, pavements, and public spaces (parks, beaches). Therefore, it would help the Office to continue understanding the priorities of the citizens by working within GCC.

2

The Resilient Chennai Office could be established within CUBE at IIT Madras.

CUBE is a centre of excellence and collaboration between IIT Madras and the Government of Tamil Nadu. The centre collectively leverages the strength of IIT Madras, an institute that is deeply respected across stakeholder groups, including corporates and citizens, and that of government, which has the ability to plan and the power to implement.

The Resilient Chennai Office could thus be housed at CUBE, and work closely with strategy partner, Okapi Research and Advisory, as they would bring a deep understanding of the 100RC strategy process and the associated projects. With such an arrangement, the Resilient Chennai Office would continue to ensure that the projects and recommendations within the strategy align better with the policies at the Central and State levels; the ability to procure funding for the projects would be easier through foundations, corporates and multilateral development banks; and the implementation of these projects would be seamless.

CALL TO ACTION

Enlightened. Just. Integrated.

Going forward, Chennai city leaders and citizens will need to continue to make concerted efforts to translate the Resilient Chennai vision into action. While this strategy identifies potential leading agencies for each of the actions, all interested citizens, community-based organizations, industries and government agencies are invited to come forward and take ownership of these resilience actions.

HERE ARE SOME WAYS ONE CAN CONTRIBUTE TO BUILDING A RESILIENT CHENNAI:

EXPLORE
1 Visit the Resilient Chennai website to learn more about the development work around this strategy and around progress made on current initiatives involving the Resilient Chennai team. *www.resilientchennai.com*

SHARE
2 Share information on ongoing efforts that support, align and add to this strategy. This information will be showcased on the Resilient Chennai website.

SPEAK UP
3 Reach out to Mr. Krishna Mohan Ramachandran, the Chief Resilience Officer (CRO), by email to share your inputs and thoughts on building city resilience. *cro@resilientchennai.com*

COLLABORATE
4 Express interest to collaborate: tell us if you or someone else you know can help initiate certain actions. *cro@resilientchennai.com*

WALK THE TALK
5 As the city incorporates a resilience lens into its planning and actions, we will collectively and individually need to contribute to city resilience by doing our bit, every day. This includes keeping our city clean, abiding by rules and regulations, and protecting our environment—all, while respecting the vulnerable.

THANK YOU FOR MAKING CHENNAI RESILIENT.

acknowledgments

Resilient Chennai – PRA Team

Okapi Research & Advisory – Strategy Team

Release of the PRA chaired by the Commissioner, Dr. Karthikeyan, in February 2018

Commissioner, Dr. Karthikeyan, and DC (Works) M. Govinda Rao at the release of the PRA in February 2018

Mr. Berkowitz, President, 100RC with Mr. Krishna Mohan, CRO, Chennai

Mr. Berkowitz, President, 100RC, launching the PRA with the Commissioner, Dr. Karthikeyan, in February 2018'

Mr. Amit Prothi, Head of India Strategy, 100RC, moderating a special Working Group meeting on Water issues

Mr. Harmander Singh, Principal Secretary, MAWS, addressing participants at the second WaL regional workshop held in Singapore in April 2019

Mr. Harmander Singh, Principal Secretary, MAWS, and Mr. Ashok Natarajan, CEO, TWIC, at the second WaL regional workshop held in Singapore in April 2019

Participants at a WaL workshop in discussion with Mr. Harmander Singh and Mr. Henk Ovink, the Dutch Special Envoy for International Water Affairs

Mr. Henk Ovink, the Dutch Special Envoy for International Water Affairs, and Mr. Krishna Mohan, CRO, Chennai, greeting Commissioner Dr. D. Karthikeyan, at the first WaL workshop held in Chennai in Sep 2018

Government of Tamil Nadu representatives meeting Mr. Henk Ovink and H.E. Marten van den Berg, Ambassador of the Kingdom of Netherlands to India, at the third WaL local workshop held in Chennai in March 2019

Participants at the second WaL workshop held in Chennai in Nov 2018

GREATER CHENNAI CORPORATION

(CE – Chief Engineer; SE – Superintending Engineer; EE- Executive Engineer
AEE – Assistant Executive Engineer; AE – Assistant Engineer; AEO – Assistant Education Officer;)

LEADERSHIP
G. Prakash, I.A.S., Commissioner
Dr. D. Karthikeyan, I.A.S., Commissioner (former)
R. Lalitha, I.A.S., Joint Commissioner (Revenue & Finance)
M. Govinda Rao, I.A.S., Deputy Commissioner (Works)
P. Kumaravel Pandian, I.A.S., Deputy Commissioner (Education)
Mageswari Ravikumar, I.A.S., Deputy Commissioner (Education) (former)
P. Madhusudhan Reddy, I.A.S., Deputy Commissioner (Health)
M. Vijaya Lakshmi I.A.S., Deputy Commissioner (Health) (former)
L. Nandakumar, CE (Storm Water Drains, Special Projects, BRR)

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Jacintha, AE

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D. Vijula, EE
P. Annadurai, EE
P. S. Srinivasan, EE
A.S. Murugan, EE
D. Sukumar, EE
B.R. Saravana Moorthy, EE
C.A. Balamurali, Divisional Engineer
G. Karuppasamy, AEE
G. Vidya, AEE
M. Victor Gnanaraj, AEE
S. Kasiviswanathan, AEE
T. Nalinakumari, AEO
Munian, AEO
R. Muneer Ahamed, Administrative Officer
S. Kirubakaran, Assistant Revenue Officer
B. Thirunavukarasu, Assistant Revenue Officer

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E. Govindasamy, Educational Officer
R. Umapathy, SE (SWM) (Retd.)
P. V. Srinivasan, EE
P. S. Srinivasan, EE
K. Sampathkumar, EE
Sivakumar, EE
K. Nirmala, AEE
S. Tharani Bai, AEE
V. Hemalatha, AEE
S. Muthuselvi, AEE
A. M. Mahathevan, AE
K. A. Mohamed Hussain, AE
S. Uma, AE
K. P. Boopathy, AE
R. Revathi, AE
Sasirekha

SPECIAL PROJECTS DEPARTMENT AND CHENNAI SMART CITY LTD.
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J. Jayakanth, EE
B. V. Babu, EE
Rosline Gnanamani, AEE
M. Manjula, AEE
G. Logeshwaran, AEE
G. K. Babu, AEE
G. Aarthy, AE
B. R. Ramesh, AE
Arun Moral
Athreya Mukunthan
Govinda Agarwal
Nagaraju A
Ram Kumar
Ronak Asrani
Suneel Kareti
Yashaswini K. S.
Sudhakar, GIZ
Daniel, C40
Balamurugan Namburajan, Chennai City Connect

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EXPERTS CONSULTED - PRELIMINARY RESILIENCE ASSESSMENT
A.D. Nundiyny, Uravugal Social Welfare Trust
Ahamad Hanifa, Chennai Trekker's Club
Arun Krishnamurthi, Environmentalist Foundation of India
Aruna Subramaniam, Bhoomika Trust
Ashok Rajendran, Chennai Trekker's Club
Aswathy Dilip, ITDP
Avantika Bhaskar, Care Earth
Balchand Parayath, Chennai City Connect
Bharathan Kandaswamy, Kavithalayaa Productions
Brig. Jyotikumar Dharmadheeran, Blue Cross of India
Dr. Chinny Krishna, Blue Cross of India
Dawn Williams, Blue Cross of India
Dharmesh Shah, Global Alliance for Incinerator Alternatives
Gayatri Doraiswami, Voice of People
Hydwick Rosy, Tamil Nadu Slum Clearance Board
Jaya Arunachalam, Working Women's Forum
Lata Subramaniam, Bhoomika Trust
Manjula Krishnan, Voice of People
Britto, Frontier Lifeline
Sekar Satagopan, Art of Living Foundation
Swaminathan, Frontier Lifeline
Nagalakshmi, United India Insurance
Nikhith Ashok, Re.Creation
Nithyanand Jayaram, Journalist/Social Activist
P. Sugavanesh, United India Insurance
Priya Ravichandran, Kalakshetra RWA
Sandhya Sridhar, Voice of People
Sanjeevi Rajan, United India Insurance
Satyarupa Sekar, Citizen consumer and civic Action Group
Shobha Menon, Nizhal
S. Janakarajan, Madras Institute for Development Studies
S. Viswanathan, Chennai River Restoration Trust
Tahaer Zoyab, Triple O solutions
Vanessa Peter, Information and Resource Centre for Deprived Urban Communities
Venkat T, Tamil Nadu labour blog
Vidya Mohan, Urban Design Collective
Vishnu Venugopalan, I.A.S, CMWSSB

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Mr. M. Govinda Rao, DC (Works) interacting with participants at the second WaL local workshop held in Chennai in Nov 2018

Ms. U Manimekelai, Senior Planner, TNSCB interacting with students from BNCA Pune at Tholkappia Poonga in Feb 2019

Ms. Sandra Schoof, RVO, greeting Mylapore's MLA Thiru. R. Nataraj in Chennai

Planning Studio project discussions with students from BNCA Pune at Tholkappia Poonga in Feb 2019

Participants at the Working Group meeting on Healthy and Planned Urbanisation

Participants at the Working Group meeting on Metro Governance

Participants at the Working Group meeting on Civic Engagement

Participants at the Working Group meeting on Water Systems

Participants at the Working Group meeting on Informal Settlements and Vulnerable Urban Groups

DC (Education) Mr. P. Kumaravel Pandian, Mr. Selvarajan, TNCDW, and Mr. Arjun Bhargava, Resilient Chennai with Ms. Lauren Sorkin, MD Asia Pacific, 100RC, and CROs from Pune and Surat at the AVPN India Policy Forum 2018 in New Delhi

Meeting with Civil society organisations convened by MD TNSCB towards enabling safe Perumbakkam

Community Mapping Process: Mapping of safe and unsafe zones for women and children

Mr. Krishna Mohan, CRO, Chennai, felicitated after an interaction with Cognizant leaders in Chennai. Mr. Muthu Kumaran, senior vice president, Cognizant, is a Resilient Chennai Consultative Committee member.

Mr. Amit Prothi, Head of India Strategy, 100RC on a field visit with a member of the WaL team in 2017

Ms. Nini Purwajati, 100RC, interacting with participants at the regional workshop held in Singapore in April 2019

The Resilient Chennai Team in November 2018

Satish Menon, Resident, Shenoy Nagar, Chennai
Sheela Devi, Horticulture Department
Sivasubramaniam, TN Corporation for Development of Women
Sriram Gopal, Future Farms
V. Jayachandran, Parks Department, GCC
V. Sukumar, Parks Department, GCC
Yogalakshmi, Indra Gardens

WATER AS LEVERAGE FOR RESILIENT CITIES ASIA INITIATIVE
Mr. Henk Ovink, Special Envoy for International Water Affairs
    for the Kingdom of the Netherlands
H. E. Marten van den Berg, Ambassador of the Kingdom of the
    Netherlands to India, New Delhi
Dennis van Peppen, RVO
Sandra Schoof, RVO
Robert Proos, RVO
Daan Stoop, RVO
Vijay Kumar, Special Representative, Chennai, Embassy of the
    Kingdom of the Netherlands (Retd.)
Maya Acharya

PARTNER ORGANIZATIONS
Government of the Netherlands, Asian Infrastructure
    Investment Bank, FMO, 100 Resilient Cities, Partners for
    Resilience, Architecture Workroom Brussels, International
    Architecture Biennale Rotterdam and the Global Center
    on Adaptation, WWF, Pegasys, Water Youth Network, UN
    HABITAT

Supported by the UN/World Bank High Level Panel on Water

Team 1: "Rising Waters, Raising Futures"
Deltares, IGCS, IIT Madras, Care Earth Trust, CUDi (Center
    for Urban Design Innovation, Karlsruhe Institute for
    Technology, Waggonner & Ball, Benthem Crouwel
    Architects, Arcadis and VanderSat.

Team 2: "City of 1000 Tanks"
OOZE VOF, Madras Terrace, Goethe Institut, Ramakrishnan
    Venkatesh, Vanessa Peter, IHE Delft, Rain Centre, Care
    Earth Trust, Paper Man, Pitchandikulam, IIT Madras, TU
    Delft, HKV.

CROS
Addis Ababa - Fitsumbrhan Tsegaye
Cape Town - Craig Kesson
Pune - Mahesh Harhare
Sydney - Beck Dawson
Tbilisi - Ana Ardelean
Wellington - Mike Mendonça

CITIZEN SURVEYS
Preliminary Resilience Assessment: 1,800 respondents
Phase-2: 1,100 respondents

UNIVERSITIES
University of British Columbia
National University of Singapore
Anna University
BNCA Pune
Climate Focus Gap
University of Copenhagen

ADVERTISING AGENCIES & CONSULTANTS

RUBECON (SWM CAMPAIGN)
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Meera Zachariah, Creative Director
Vinod Rajagopalan – *Art*
Nirupama Venkatsubramanian – *Copy*
Adhith S, Brand Management

OGILVY CHENNAI (ROAD SAFETY CAMPAIGN)
Ravikumar Rajagopal, Branch Head
Binu Varghese, Creative Director
Natasha Amrolia, Management Supervisor
Mehernaz Jila, Creative Supervisor

TINACCA MEDIA (WATER CONSERVATION CAMPAIGN)
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Arun Kumarasamy, Creative Director – *Copy*
Babu S.Senior, Vice President Business Planning and Growth
    Strategy
Prem Shankar – *Photographer*

RESILIENT STRATEGY CONCEPTS
Ramesh Ramanathan – Ragam for water
Suguna Swamy – A city for all

MAVENS PROGRAMME
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Prabhakar Sundaraman

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Challengethelimits/Wiki
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CMWSSB
CP Satyajit
CRRT
Cynthia van Elk | Water as Leverage
Deccan Chronicle
DTNext
Greater Chennai Corporation
IndianPostageStamps.gov.in
IndiaTodayImages.com
ITDP
Joe Ravi/Wiki

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Srini G
SWMRT
Thangaraj Kumaravel
The Hindu
The Hindu Archives
The Nature Conservancy
The Online Citizen
TNCDW
United News of India
V Ganesan
Vasistan Shakkaravarthi
Veera Batlu
Veethika/Wiki
Vinoth Chandar
VtTN/Wiki
Yoga Balaji

APPENDIX I : LIST OF ACRONYMS / ABBREVIATIONS

ADB	Asian Development Bank
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
AMR	Automatic meter reading
CAG	Consumer and civic Action Group
CBA	Community Based Adaptation
CBO	Community Based Organisations
CDMP	Chennai City Disaster Management Plan
CII	Confederation of Indian Industry
CMA	Chennai Metropolitan Area
CMWSSB	Chennai Metropolitan Water Supply and Sewerage Board
CMDA	Chennai Metropolitan Development Authority
CMRL	Chennai Metro Rail Ltd.
CREDAI	Confederation of Real Estate Developers Association of India
CRF	City Resilience Framework
CRO	Chief Resilience Officer
CRRT	Chennai Rivers Restoration Trust
CRZ	Coastal Regulation Zone
CSCL	Chennai Smart City Ltd.
CSR	Corporate Social Responsibility
CUMTA	Chennai Unified Metropolitan Transport Authority
DA	Discovery Area
DEWATS	Decentralised Wastewater Treatment Systems
DoE	Department of Environment
DPR	Detailed Project Report
DTCP	Directorate of Town and Country Planning
ECR	East Coast Road
ESF	Environment and Social Framework
EFI	Environmentalist Foundation of India
EPR	Extended Producer Responsibility
FMCG	Fast Moving Consumer Goods
FSI	Floor Space Index
GCC	Greater Chennai Corporation
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GoTN	Government of Tamil Nadu
HD	Highways Department
HUD	Housing and Urban Development Department
IAS	Indian Administrative Service
IGCS	Indo-German Centre for Sustainability
IIT Madras	Indian Institute of Technology Madras
INCOIS	Indian National Centre for Ocean Information Services
INDC	India's Nationally Determined Contribution
ISRO	Indian Space Research Organisation
ISWDP	Integrated Storm Water Drain Project
IT	Information Technology
ITDP	Institute of Transport Development and Policy
IRCDUC	Information and Resource Centre for the Deprived Urban Communities
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
KL	Kilolitre
kfw	Kreditanstalt für Wiederaufbau (German Development Bank)
LIG	Low income groups
Lpcd	Litres per capita per day
m	million
MAWS	Municipal Administration and Water Supply Department
MCCI	Madras Chamber of Commerce and Industry
MIDS	Madras Institute for Development Studies
MLD	Million Litres per Day
MTC	Metropolitan Transport Corporation
MSME	Micro, Small and Medium Enterprises
MRTS	Mass Rapid Transport System
MUDP	Madras Urban Development Project
NCCR	National Centre for Coastal Research
NIUA	National Institute of Urban Affairs
NDRF	National Disaster Response Force
NGO	Non-Governmental Organisations
NRW	Non-Revenue Water
O&M	Operation and Maintenance
OSR	Open Space Reserve
PRA	Preliminary Resilience Assessment
PSA	Public Service Announcements
PWD	Public Works Department
RBI	Reserve Bank of India
RERA	Real Estate Regulatory Authority
RWH	Rain Water Harvesting
RWAs	Resident Welfare Associations
RRC	Resource and Recovery Centre
SaaS	Software as a service
SBR	Sequencing Batch Reactor
SEOC	State Emergency Operations Centre
SOP	Standard Operating Procedures
SPC	State Planning Commission
Sqm	Square meters
STP	Sewage Treatment Plant
SWD	Storm Water Drains
SWM	Solid Waste Management
SMERA	Small and Medium Enterprises Ratings Agency Limited
TANGEDCO	Tamil Nadu Generation and Distribution Corporation Ltd.
TDR	Transferable Development Rights
TN	Tamil Nadu
TNC	The Nature Conservancy
TTRO	Tertiary Treatment Reverse Osmosis
TNCDW	Tamil Nadu Corporation for Development of Women
TNCZMA	Tamil Nadu Coastal Zone Management Authority
TNHB	Tamil Nadu Housing Board
TNSUDP	Tamil Nadu Sustainable Urban Development Project
TNUIFSL	Tamil Nadu Urban Infrastructure Financial Services Ltd
TNPCB	Tamil Nadu Pollution Control Board
TNSCB	Tamil Nadu Slum Clearance Board
TNSCCC	Tamil Nadu State Climate Change Cell
TNDRF	Tamil Nadu Disaster Response Force
TNSDMA	Tamil Nadu State Disaster Management Authority
TNSDMP	Tamil Nadu State Disaster Management Perspective Plan
TWIC	Tamil Nadu Water Investment Company
ULB	Urban Local Body
UNFCCC	United Nations Framework Convention on Climate Change
UAV	Unmanned Aerial Vehicle
WaL	Water as Leverage
WRD	Water Resources Department
100RC	100 Resilient Cities

APPENDIX II : GOVERNANCE ECOSYSTEM

STATE

Municipal Administration and Water Supply (MAWS) — Primary Mandate: Provision of clean urban environment, maintaining public health and provision of core basic services in the state. It is responsible for planning, financing, implementing and monitoring projects which are aimed at attaining service level benchmark.

Tamil Nadu Housing and Urban Development (HUD) — Primary Mandate: To formulate and implement various policies, programmes, and schemes in housing and urban development sector in the state. And also, to coordinate all urban land use, planning, housing and other development related matters.

Tamil Nadu State Planning Commission (SPC) — Primary Mandate: To function as an advisory board to make recommendations to the government on various matters pertaining to the development of the state.

Water Resource Department (WRD)- Tamil Nadu Public Works Department (PWD) — Primary Mandate: Primary activities include impounding of water and its regulation, flood control and management, creation of water resources, rehabilitation and proper upkeep of irrigation infrastructure, coastal protection works, artificial groundwater recharge and interlinking of rivers within the state.

Rural Development and Panchayat Raj — Primary Mandate: Responsible for enabling the various Panchayat Raj Institutions (PRIs) to function as effective units of Local Self-Government.

Revenue Administration and Disaster Management Department — Primary Mandate: Responsible for providing efficient delivery of services of various government schemes, relief and rehabilitation measures for those affected by natural calamities.

Department of Environment (DOE) — Primary Mandate: Responsible for planning, promotion, coordination and overseeing the implementation of all the aspects of environment in the state except those handled by Tamil Nadu Pollution Control Board. The department is also nodal agency for climate change in the State.

Tamil Nadu State Land Use Board (TNSLUB) — Primary Mandate: To conduct a regular meetings of the Board to evolve policy decisions on land-use, watershed management on rain fed agriculture, integrating dry land farming and carrying capacity of land with regard to human and animal population.

Tamil Nadu State Disaster Management Authority (TNSDMA) — Primary Mandate: Responsible for coordinating the response to disasters and to reduce risks. All measures for mitigation, preparedness, response and recovery are undertaken under the guidance and supervision of the department.

Tamil Nadu Pollution Control Board (TNPCB) — Primary Mandate: To monitor and control air, noise and water pollution in the state . It is also a key stakeholder in the issuance of environmental clearances to development projects in the state.

Directorate of Town and Country Planning (DTCP) — Primary Mandate: : Responsible for preparation for various plans like master plan, detailed development plan, regional plan etc. in the State except Chennai metropolitan area. They enforce implementation of various plans by regulating the development and land use through development and building regulations

Tamil Nadu Housing Board (TNHB) — Primary Mandate: Responsible for developing neighborhood schemes, housing schemes and a mega township with all the infrastructure facilities to serve housing needs of people belonging to economically weaker sections and low-income groups, providing accommodation at affordable prices.

Tamil Nadu Slum Clearance Board (TNSCB) — Primary Mandate: To provide slums with liveable housing, basic infrastructure facilities and livelihood programmes to improve residents' living conditions. Further, they also implement various programmes like in situ tenement schemes, in situ plotted and infrastructure development, rehabilitation and resettlement schemes, community development activities, etc.

Commissionerate of Municipal Administration (CMA) — Primary Mandate: To coordinate and supervise various activities of the Municipalities and Municipal Corporations in the state, except Greater Chennai Corporation. The activities include tax administration, financial management, infrastructure development, town planning, urban health, environment management and schemes for urban poor etc.

Directorate of Town Panchayat (DTP) — Primary Mandate: To formulate and implement responsive programmes, services and activities of the Town Panchayats in the state. And also, to ensure responsive, accountable, transparent and people-friendly civic administration.

Tamil Nadu Urban Infrastructure Financial Services Ltd (TNUIFSL) — Primary Mandate: Responsible for the management of trust and other funds. To act as consultants, financial advisers and investment advisers and to render such consultancy, financial and investment advisory services to the local bodies in the state.

Tamil Nadu Urban Finance and Infrastructure Development Corporation (TUFIDCO) — Primary Mandate: To provide financial assistance and guidance to urban local bodies for their development schemes.

Tamil Nadu Water Supply and Drainage Board (TWAD) — Primary Mandate: To provide protected water supply to the rural and urban population as well as underground sewerage schemes on the request of local bodies in the state excluding the Greater Chennai Corporation.

Tamil Nadu Water Investment Company (TWIC) — Primary Mandate: Responsible for developing water projects in the urban water and sewerage systems, desalination, industrial effluent management and recycling.

Chennai Metropolitan Development Authority (CMDA) — Primary Mandate: Responsible for preparation of master plans, detailed development plans and formulation of any other plan or project for the development of the Chennai Metropolitan Area, including their enforcement. They also carry out coordination, supervision, execution, and providing financial assistance for development projects in the metropolitan area.

Chennai Unified Metropolitan Transport Authority (CUMTA) — Primary Mandate: Responsible for integration of public transport modes, promotion of non-motorized transport, and preparation of a Comprehensive Transportation Plan.

Chennai River Restoration Trust (CRRT) — Primary Mandate: To identify, coordinate and manage the restoration activities of ecological conditions of rivers and water bodies within the Chennai Metropolitan Area.

METROPOLITAN

CITY / CORPORATION

Greater Chennai Corporation (GCC) — Primary Mandate: Civic body, that governs the city of Chennai. Responsible for provision of services such as roads, parks, education, health facilities, storm water drain and solid waste management. They are also responsible for the overall management of disasters in the GCC jurisdictions.

Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB) — Primary Mandate: Provision of water supply and sewerage services within the city. It is also responsible for promoting and securing the planned development of water supply and sewerage services, operations & maintenance and creation of the required infrastructure for those.

Chennai Smart City Limited (CSCL) — Primary Mandate: To plan, appraise, approve, release funds, implement, manage, operate, monitor and evaluate the Smart City development projects.

LOCAL BODIES

Urban Local bodies (ULB) – Municipalities/Town Panchayat — Primary Mandate: : Responsible for provision of decentralized obligatory functions that includes public health and drinking water in their local jurisdictions. And also; developing and maintaining of urban infrastructure.

Rural Local bodies (RLB) – Village Panchayat — Primary Mandate: Provision of decentralized obligatory functions in their jurisdictions. It is also responsible for developing and maintaining of rural infrastructure.

LEGEND
- Government
- Para-statal
- HUD Line Departments
- MAWS Head of Departments
- Local Bodies
- Other Line Departments

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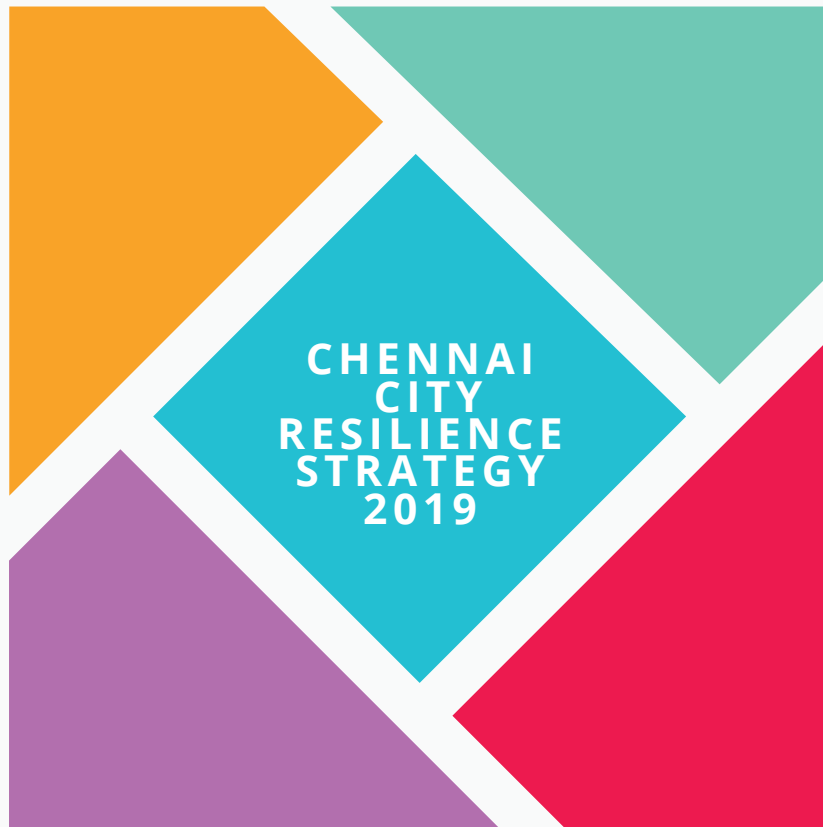*© Niranjan Ramesh, Kapaleeshwarar Temple*

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