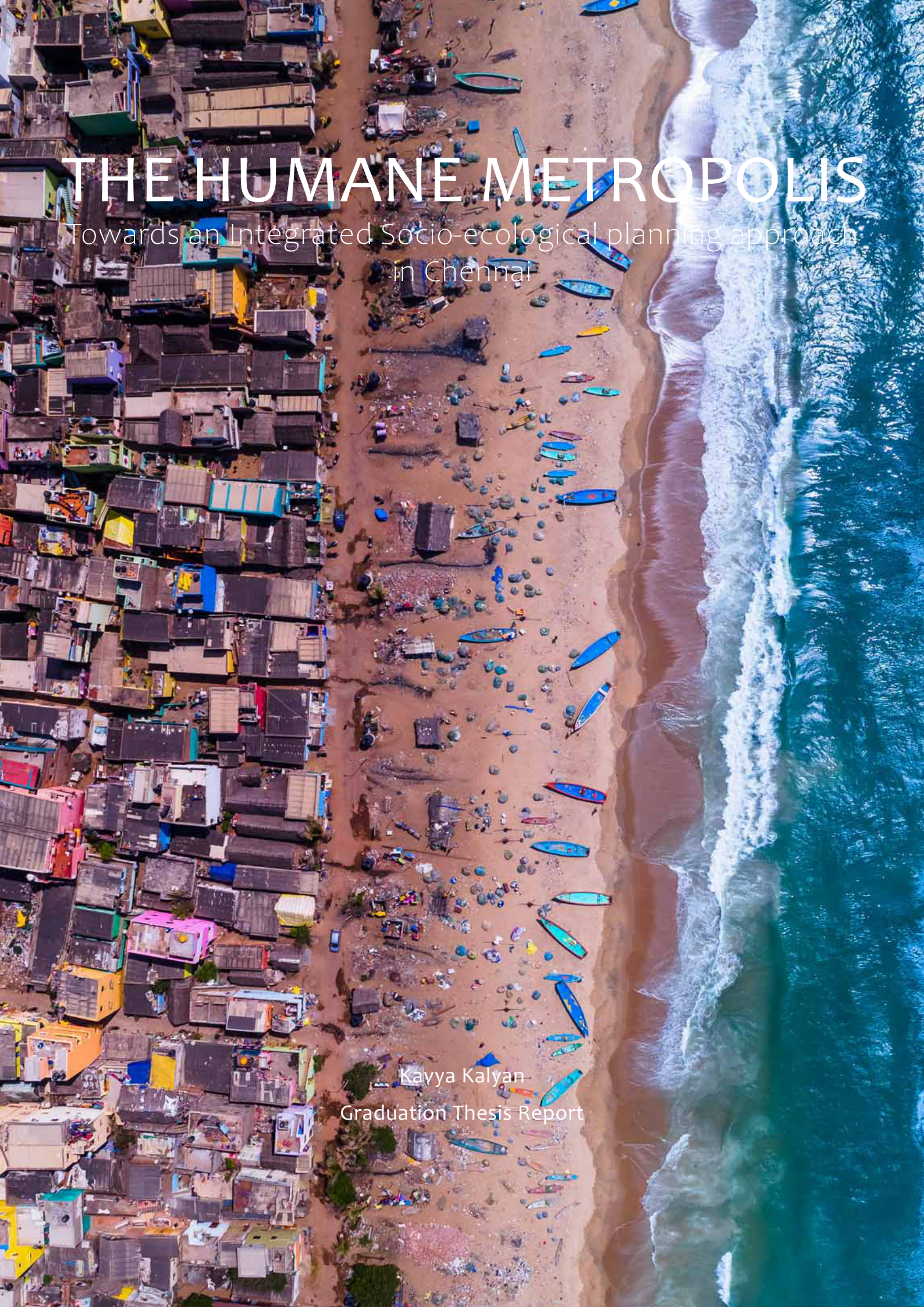




# THE HUMANE METROPOLIS

Towards an Integrated Socio-ecological planning approach  
in Chennai

Kavya Kalyan  
Graduation Thesis Report



# THE HUMANE METROPOLIS

Towards an Integrated Socio-ecological planning  
approach in Chennai

## COLOPHON

The Humane Metropolis  
Towards An Integrated Socio-ecological planning  
approach in Chennai

Master Thesis Report  
MSc Architecture, Urbanism and Building Sciences  
Department of Urbanism  
Faculty of Architecture and the Built Environment,  
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Cover image source: Rakesh Baro. Retrieved from: Google images.

Kavya Kalyan  
Graduation Thesis Report



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## Motivation

The motivation for this project comes from an amalgamation of issues plaguing the city of Chennai today. On one hand, responding to the urgency of climate-related threats, which have intensified over the last decade, affecting every layer of the city, is imperative. On the other hand, the social fabric of the city is in itself fragmented. The growing migration to cities and increasing demand for housing, which is not being met, results in a large number of people living in informal settlements in the crevices of the formal city. This puts a large section of the population at risk, making them the most vulnerable in light of climate-related events. Moreover, in the struggle to make Chennai a 'world-class city', the people of the city have lost their connection with the natural ecology. A city that is known to have a rich natural heritage in the past, is now building over its lakes and rivers, resulting in these entities being in a state of neglect. Having lived in Chennai and called it home for over two decades, this project is close to my heart. This project is my attempt to bring the 'humaneness' back to the way the city is being planned, by putting the disadvantaged first, under the lens of the climate change.



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# 1 Introduction

## Introduction to chapter

This chapter introduces the context of Chennai, with an emphasis on the factors influencing the city growth and its exposure to climate hazards.

By putting a spotlight on the economy-driven development in the city, and the planning and governance factors that contribute to it, the chapter concludes with the premise that there is a misalignment between the current planning process and the climatic exposure of the city, thereby creating problems of congestion and resulting spatial inequalities, that will be further explained in the subsequent chapter.

## Contents

- Context
- Premise



# Context

## Population Growth

Being one of the most densely populated countries in the world, India faces a severe challenge of a lack of space in the ever-growing urban centres. There are many issues underlying the growth of the major cities in the country, but one of the major factors contributing to spatial inequalities is the migration from rural to urban areas, and particularly to the metropolitan cities. This, in combination with poor governance leads to growing populations living outside the system.

## Population Growth

Although the rate of population growth in the world is on the decline, India's population is still one of the highest in the world, thereby putting an increasing amount of pressure on its resources as it struggles to satisfy the needs of its people.

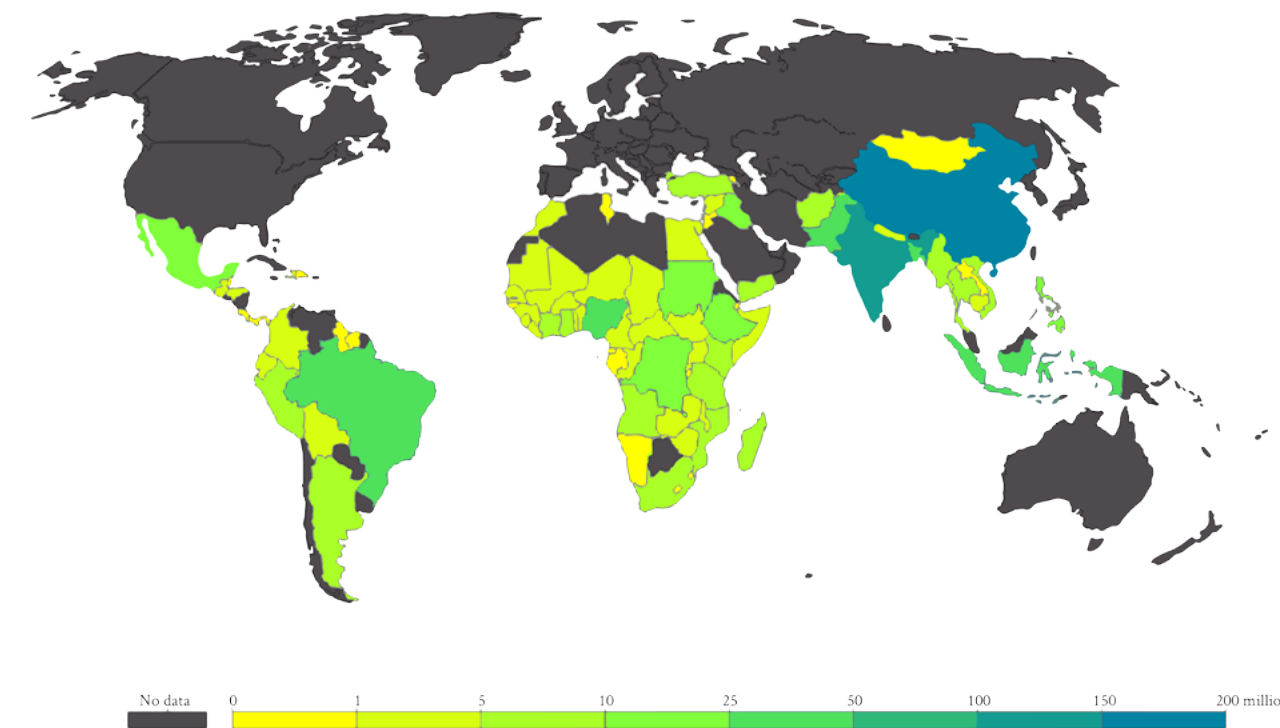
Further, large migration rates from rural to urban areas adds to the pressure on major cities to house such numbers. According to the World Bank, in 2017, the amount of people living in urban areas in India increased to 34%.

## Formation of Slums

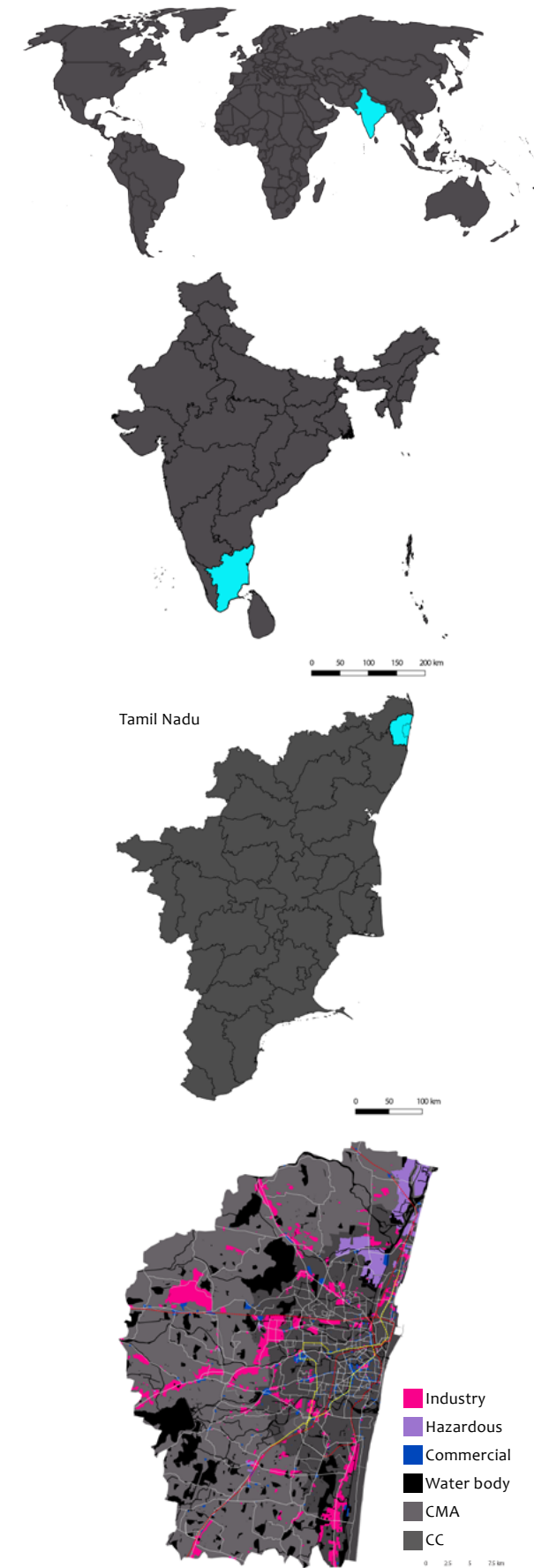
Due to the lack of the city governments in keeping up with the growing population, a significant number of people are left without proper homes, unable to afford property and basic services. This leads to the formation of slums in the urban cores - informal settlements that are often found at the edges of the formal city, in areas considered to be vulnerable to external stresses.

India has a large number of people living in slums. Cities like Mumbai, Hyderabad, Delhi, Bengaluru and Chennai have the highest share of this population.

This project delves into the context of Chennai, and the relationship of the city's vision and planning processes with the informal settlements, and addressing the factors increasing their vulnerability.



Slums in the world. Source: World Bank. Adapted by author.



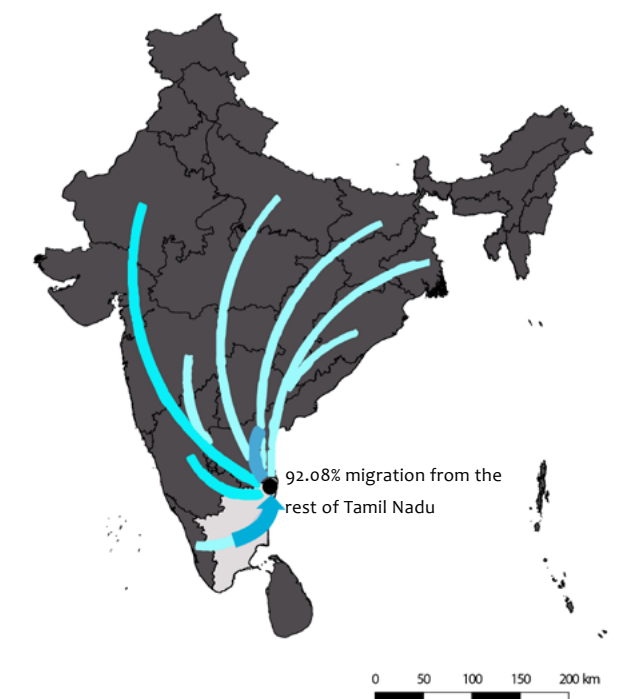
Chennai Metropolitan Area. Data Source: CMDA, Geofabrik

## Chennai

Chennai is the capital of the state of Tamil Nadu in South India. The city is located on the eastern coast of the peninsula, facing the Bay of Bengal.

With a population of over 10 million (Source: indiapopulation.com), the city has seen massive growth over the last few decades, especially attracting people from the rest of Tamil Nadu in search of economic opportunities and quality of life. It also attracts a significant number of people from neighbouring states of Andhra Pradesh and Karnataka.

It is rich in cultural heritage - a home to many historic sites, temples and various art forms. The city was a part of the British empire during the colonial rule and was formerly known as Madras. The city as it stands today, is a rich amalgamation of various kingdoms and cultures.



Migration to Chennai. Source: livemint.com. Adapted by author.



# Context

## Climate in India

With the onset of global warming, the world has seen an increase in temperature and various extremities and uncertainties in climate-related events. India is no stranger to such climate events. The country faces various challenges with respect to climate change.

India has different climatic zones and each of them are affected in different ways. Being a peninsula, a large portion of the country is affected by coastal changes. Extreme and intense rainfall, rising sea levels and increasing temperatures are a few of the challenges that coastal areas face today.

Being a coastal city, Chennai is prone to cyclones and tsunamis resulting in flooding. However, the increasing temperatures also result in drought, due to poor management of water. Chennai, therefore, treads a fine line between too much water and too little water.

## Chennai's link with water

Tamil Nadu has borne the brunt of various hazards in the last few decades, particularly affecting coastal areas like Chennai.

Some of the major disasters that affected Chennai in the last two decades were:

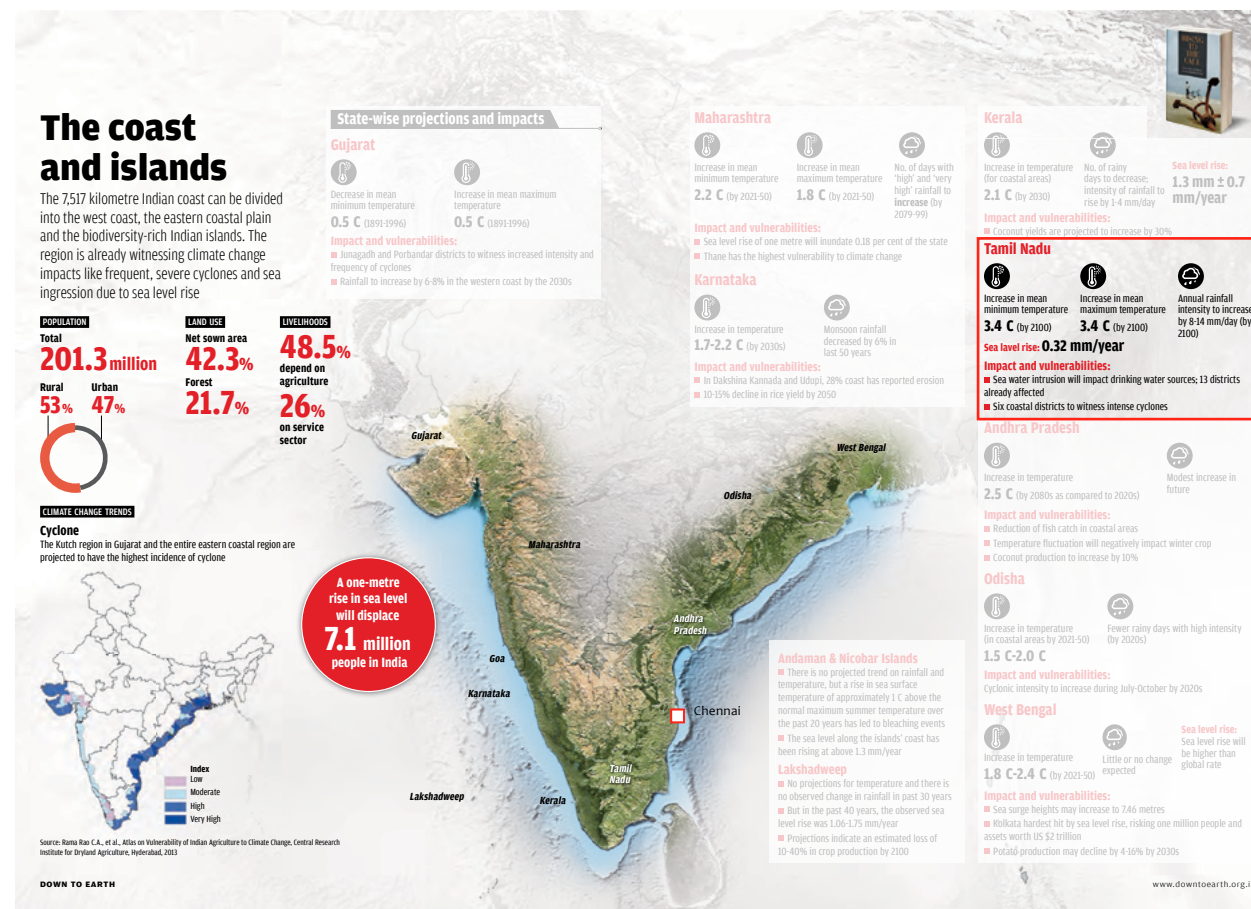
Tsunami - 2004

Floods - 2015

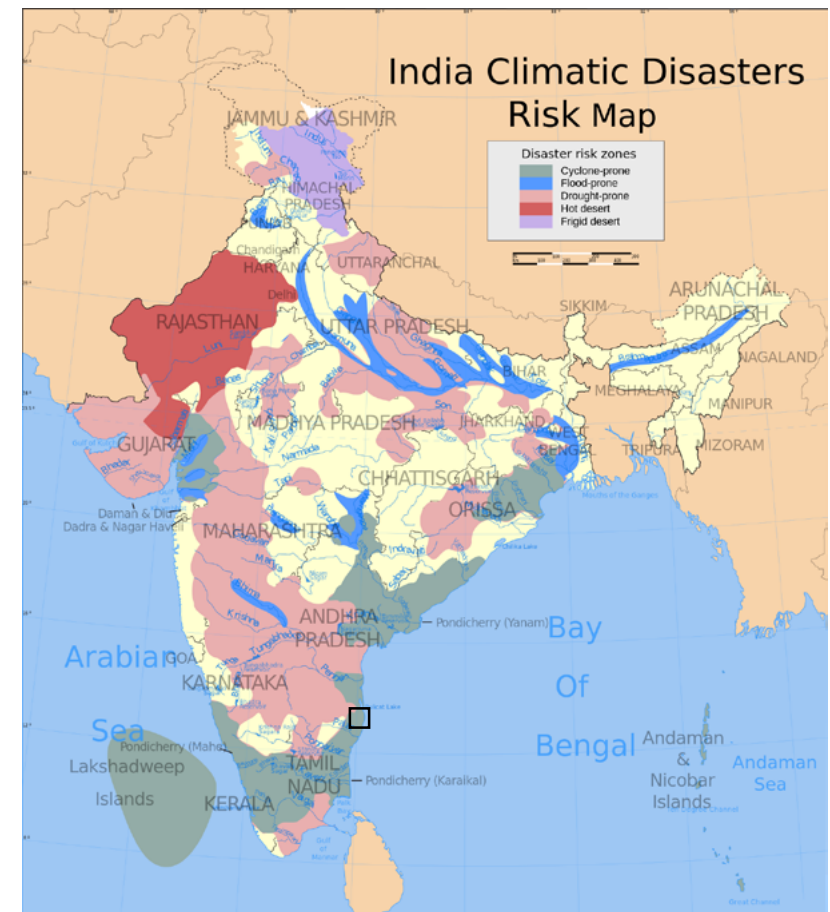
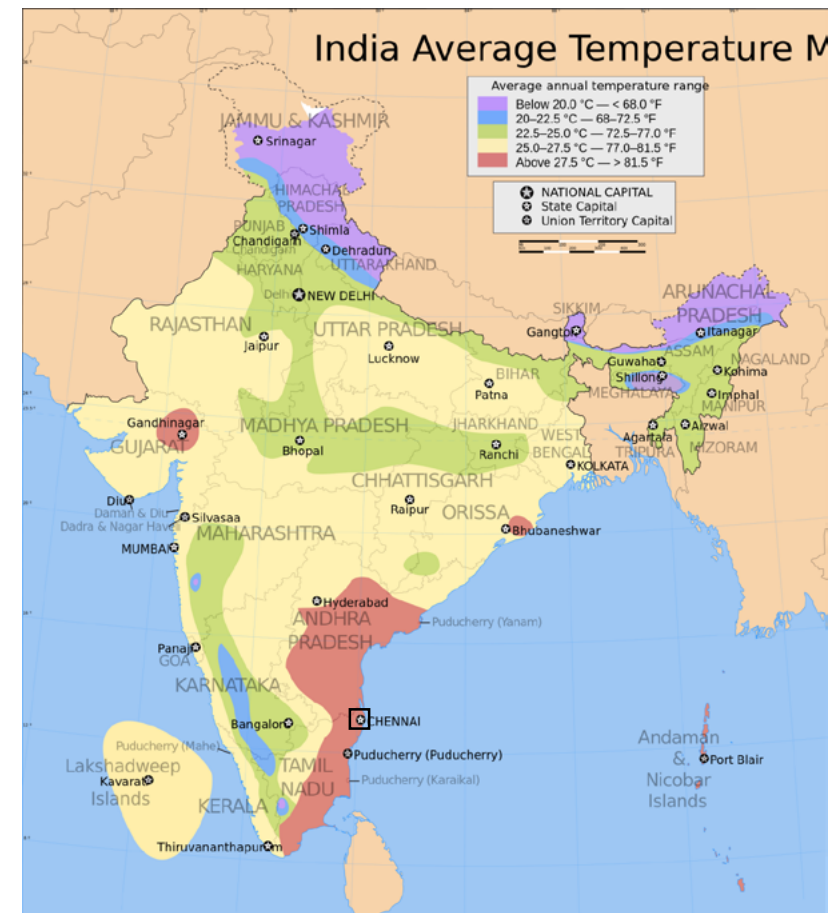
Cyclone Vardah - 2016

Drought and water scarcity - 2019

Being a region that has historically been rich in water resources, with three rivers draining into the sea through the city, it is prone to both pluvial and coastal flooding.



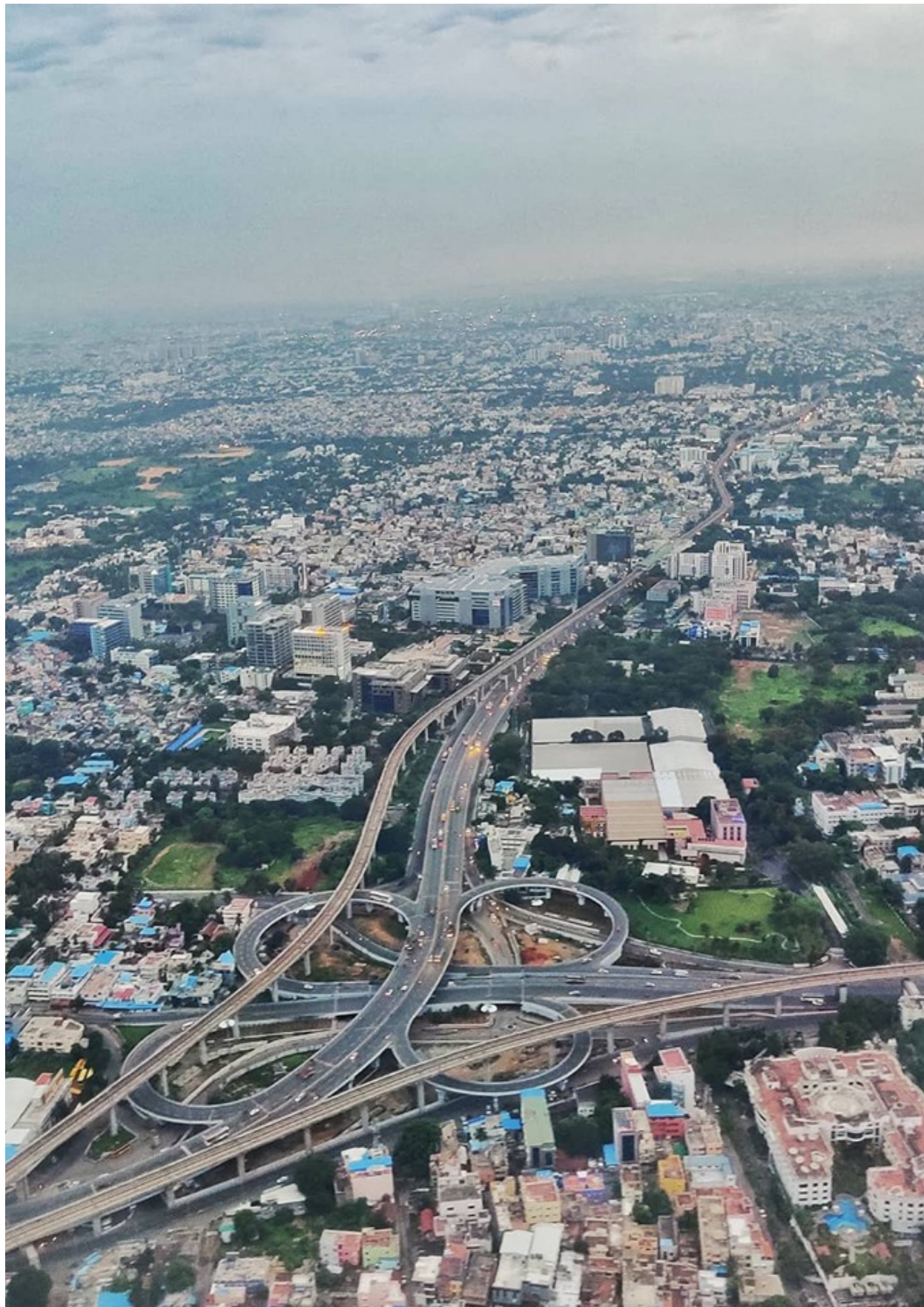
Climate change in the coast and islands of India. Source: Down To Earth. Retrieved from: [www.downtoearth.org.in](http://www.downtoearth.org.in)



Distribution of average temperature and climate disasters. Source: Wikipedia. Retrieved from: [commons.wikimedia.org](http://commons.wikimedia.org)



# Premise

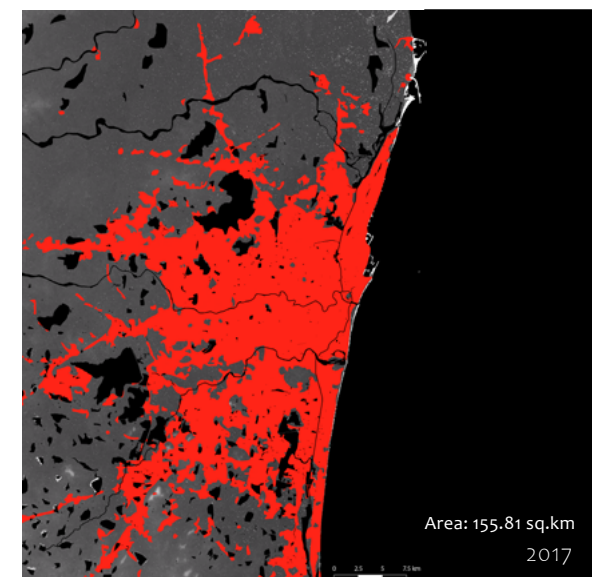
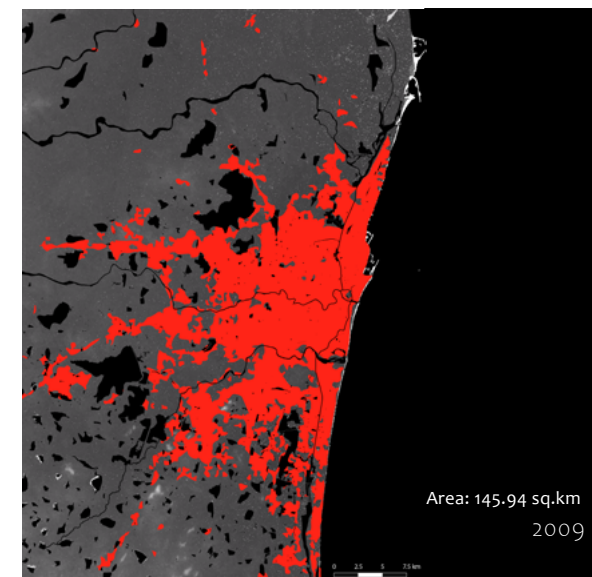
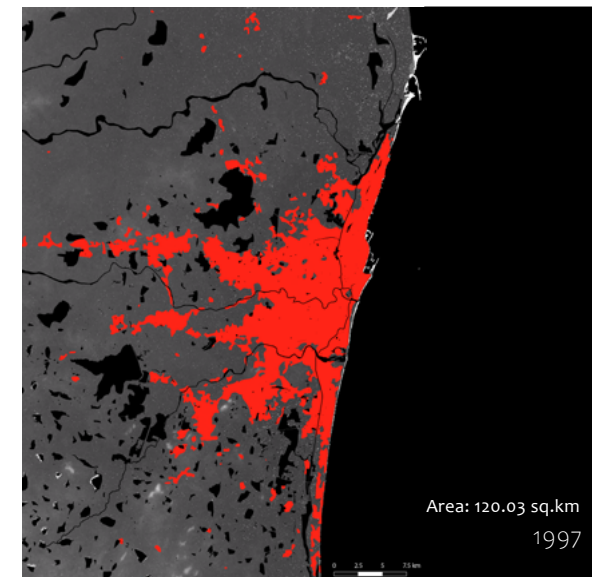


Kathipara. Source: Krishna Narendra. Retrieved from: [www.facebook.com/mycitychennai](https://www.facebook.com/mycitychennai)

## History of urbanisation

The city's growth has been primarily infrastructure-led, growing in a radial pattern along corridors. The origin of the city started from the fort during the British colonial rule, and grew over time to encompass the area that is now under the Corporation of Chennai. The Metropolitan area of Chennai is a larger extent of 1,189 km<sup>2</sup> area, which comprises of the surrounding municipalities, small towns and villages.

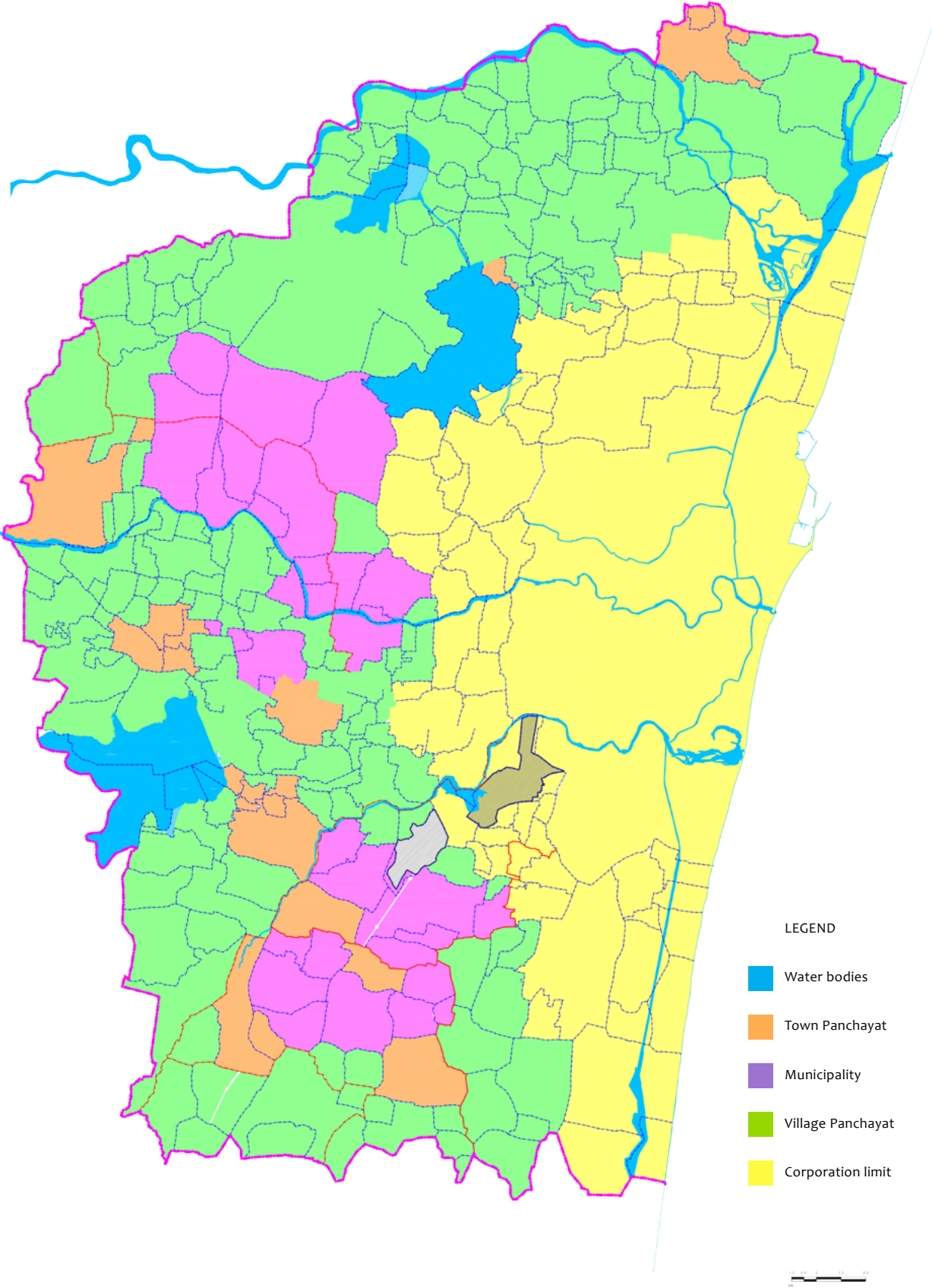
The city is well-connected by public transport with Mass Rapid Transit System (MRTS), Metropolitan Transport Corporation (MTC) bus routes, and the Metro routes. New routes are being proposed for the Metro and the possibility of a Bus Rapid Transit System (BRTS) within the city, owing to traffic congestion, is being explored. While the aim to improve public transport corridors is essential, some of the infrastructure lines have been planned without taking the geographic and hydrological conditions into account.



City growth. Data Source: IIHS







Administrative units. Source: Chennai Metropolitan Development Authority. Retrieved from: cmdachennai.gov.in. Adapted by author.

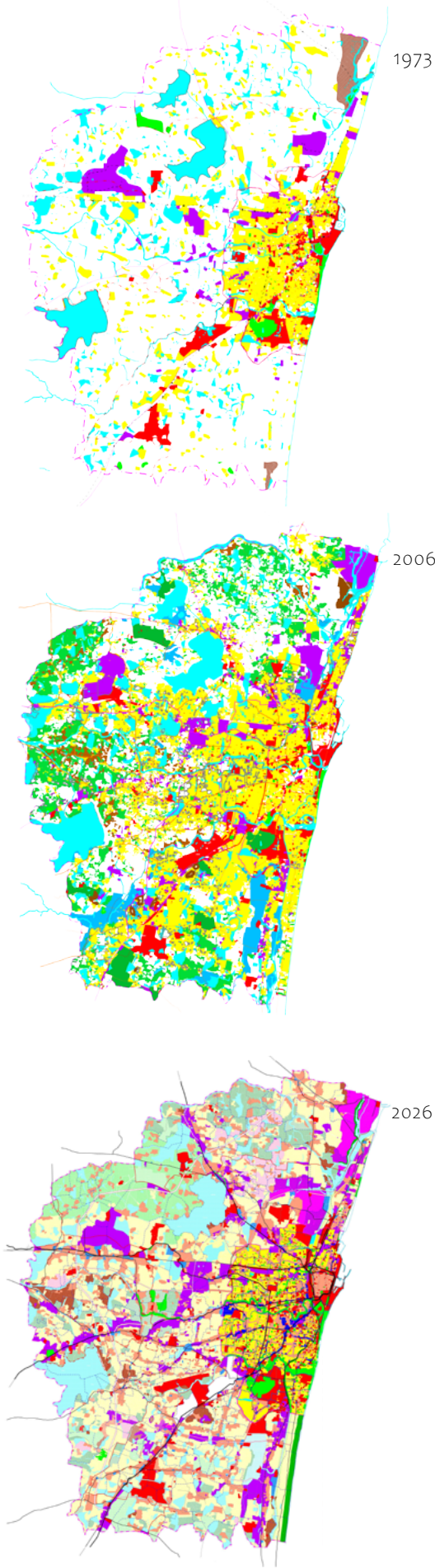
Governance Misalignment

This area is governed by the Chennai Metropolitan Development Authority. The CMDA is in charge of setting out development plans and rules for the metropolitan area. The Chennai Metropolitan Development Area employs Land Use planning as a way to regulate growth within the city. While the land use zoning plan dedicates special areas under ‘Coastal Regulation Zone’, ‘Open Space and Recreational’ and ‘Reserved Forest’ with their own spatial rules, the framework proves to be rigid in adapting to different conditions. In addition, there are areas where adjacent land uses are incompatible, and some functions therefore pose a threat to the environment and people living in these areas. Moreover, even the proposed Master Plans are structured around economic corridors, rather than focusing on preserving ecologically sensitive areas.

The Chennai Corporation area is divided into 15 zones and the rest of the CMA (outside CC limits) is divided into municipalities, town panchayats and village panchayats. Projects relating to preserving ecological structures within the city are often undertaken by the Greater Chennai Corporation (GCC), even though these structures requires a regional perspective and vision, which is lacking in the city.

Conclusion

Therefore the current planning system separates itself from the underlying factors of risk and exposure to climate change, which leads to unsustainable development, by compromising on the quality of the environment and the society.



Land use. Source: CMDA. Retrieved from: cmdachennai.gov.in



# 2 Problem Field

## Introduction to chapter

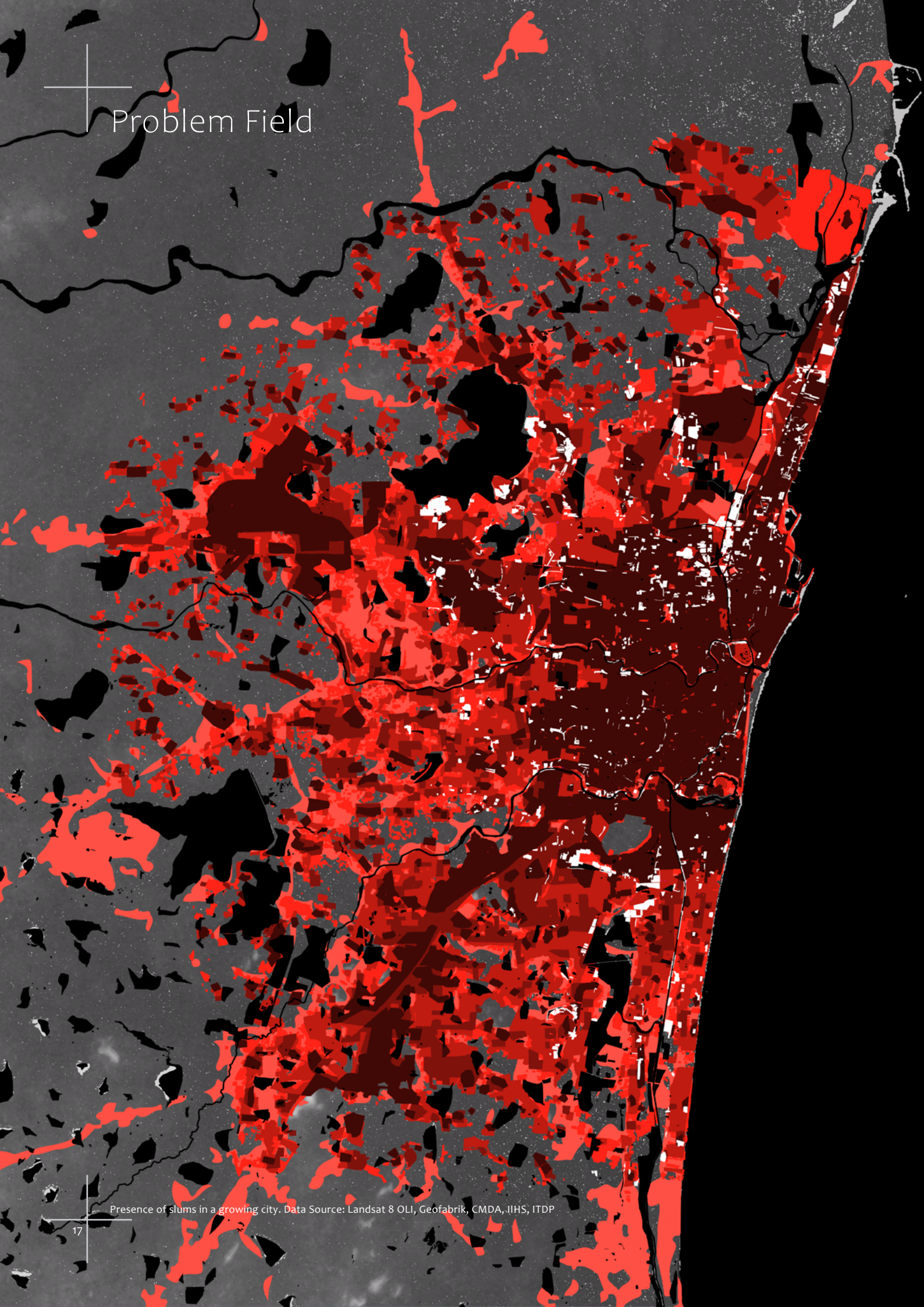
With the context and premise of the project already established, this chapter now reveals the problem focus within this project. By understanding the role of the current growth trend in depleting the ecology, creating socio-spatial inequalities and hence differential exposure and vulnerability to climate hazards, the chapter submits the challenges faced by the current governance and planning processes. It also delves into the deeper problem of perception that has shaped the actions taken to address the issues.

The chapter concludes with an identification of the system at stake, and the domains within which lies the core problem of the thesis.

## Contents

- Problem Field
- Problem Analysis
- Problem Focus





Problem Field

Presence of slums in a growing city. Data Source: Landsat 8 OLI, Geofabrik, CMDA, IIHS, ITDP

#### LEGEND

- Urbanisation - 1973
- Urbanisation - 1980
- Urbanisation - 1991
- Urbanisation - 2006
- Urbanisation - 2006
- Slums within the GCC region
- Water bodies

0 2.5 5 7.5 km

### Slums at the edges of the formal city

There are a number of slums, or informal settlements, present in Chennai, with a majority of them located within the Corporation limits. Most of the slums are located along infrastructural corridors and rivers, canals and coasts.

The older parts of the city, mostly North Chennai, has a larger slum population than the newer areas in the South.

### Rehabilitation process

The Tamil Nadu Slum Clearance Board (TNSCB) is an organisation under the Government of Tamil Nadu (GoTN) that aims to eradicate slums in the state. The Slum Free City Plan of Action published by the TNSCB envisions Chennai to be slum-free by 2023.

The measures taken by the TNSCB are, most often than not, relocation of the slum dwellers living in 'objectionable' areas to multi-storey tenements at the edges of the corporation limits. These tenements are low-cost housing options available specifically for slum dwellers, under schemes such as the Jawaharlal Nehru National Urban Renewal Mission (JnNURM), Rajiv Awas Yojana (RAY) or Pradhan Mantri Awas Yojana (PMAY) schemes.

### Challenge

The strategies do not address all aspects of social life, and focus purely on housing and basic facilities. The development process requires amendments to include the urban poor rehabilitation in a more inclusive and holistic manner.



# Problem Field



Road-side settlement

Source: Wikipedia. Retrieved from: [en.wikipedia.org/wiki/Slums\\_in\\_Chennai](https://en.wikipedia.org/wiki/Slums_in_Chennai)



River-edge settlement

Source: Wikipedia. Retrieved from: [en.wikipedia.org/wiki/Slums\\_in\\_Chennai](https://en.wikipedia.org/wiki/Slums_in_Chennai)



Coastal settlement

Source: Wikipedia. Retrieved from: [en.wikipedia.org/wiki/Slums\\_in\\_Chennai](https://en.wikipedia.org/wiki/Slums_in_Chennai)



View of slum

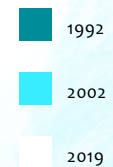
Source: Bhavani Prabhakar. Retrieved from: [chennai.citizenmatters.in](https://chennai.citizenmatters.in)



## Problem Field

Data Source: Landsat 4, 7 & 8

### DEPLETED WATER BODIES



## Growth of Chennai - impact on ecology

Over the years, the urbanisation of Chennai has resulted in severe impacts on its ecology. Depletion of water bodies and wetlands have been caused by an overbearing presence of infrastructure and built areas on natural systems without respecting the natural processes and the hydrological patterns.

The development in the city has been majorly infrastructure-led, with growth that has put economic prosperity over environmental value and social inclusion. Building over lakes, illegal encroachments at the edges of rivers, mobility infrastructure (MRTS) on the canal, the construction of roads and buildings, and the presence of dump yards on wetlands have caused these natural areas within the city to shrink. The lack of sufficient foresight in planning has resulted in cosmetic measures that often result in negative effects on the ecology of the city.

### Challenge

The primary challenge is in aligning city growth within the constraints of ecological capacities and processes, so as to shift to a more sustainable growth model. Currently, efforts are being taken to restore water bodies in the city by the government and some NGOs. While this is a good curative strategy, in order to effect major change, the planning system has to be addressed to prevent further depletion.



1989



2002



2009



2019

Depleted wetland at Pallikaranai. Source: Google Earth



## Problem Field



Airport built over the Adyar river

Source: Google earth



Mobility infrastructure encroaching Buckingham canal

Source: DT Next



Dumpyard over the Pallikaranai wetland

Source: anidiotstraveldiaries.blogspot.in. Retrieved from: <https://tvaraj.com/2015/03/21/pallikaranai-wetland-2-concrete-jungle/>



Encroachments on Pallikaranai wetland

Source: Seekanpaul A. Retrieved from: [www.facebook.com/mycitychennai](http://www.facebook.com/mycitychennai)



## Problem Analysis

Flood inundation (2015) and location of future resettlement areas. Data Source: Landsat 8 OLI, Geofabril, UMDA, ITDP, Care Earth Trust

### LEGEND

- Inundated area - 2015 flood (special instance)
- Urbanisation - 2017
- Land proposed for acquisition
- Land identified for future use
- Slums
- Water bodies

0 2.5 5 7.5 km



## Impacts of climate events

The climate-related events that have occurred in Chennai have affected the city's infrastructure, ecology and its people, particularly the slum population. The city that once celebrated its rich natural history, now suffers because of extreme rainfall, floods, cyclones and even drought caused by the rapid pace of urbanization against nature.

Ecological impacts of events like tsunami, floods and cyclones in the city include coastal erosion, saline intrusion, and loss of biodiversity, which are further enhanced by human activity. Building over water bodies, and cosmetic infrastructural measures further add to the problem. This has cost the city billions in damage, slowing down growth and development of its people, and affecting biodiversity. Owing to this, the relationship between these ecologically sensitive areas and the built environment (and in turn, the humans) has become one of neglect.

Societal impacts of these events are felt in severity by the informal settlements along the water bodies and coasts of Chennai. Loss of physical properties as well as livelihoods due to disruptions to economic activity make the slum dwellers the most vulnerable under these circumstances.

The government attempts to tackle this issue partly through the Tamil Nadu Slum Clearance Board. Most slums in environmentally hazardous areas are termed 'objectionable' and are hence rehabilitated to the peripheries of the city, without addressing the needs of the communities. The Chennai Rivers Restoration Trust, which is a government-owned organisation, has proposed the eco-restoration projects for rivers within the city. In response to the floods of 2015, flood walls, link canals, and conduit systems have been proposed. However, this is at the cost of the livelihoods of the slum people, who are being rehabilitated elsewhere, merely shifting their vulnerability.

This process ends up re-marginalising the poor to the peripheries, further impoverishing them, while encroachments by the government and private players continue to take place along the ecologically sensitive areas.



# Problem Analysis

## The problem in depth

The prevailing responses to climate hazards in the city are analysed under three lenses – perception, action and effects. The reason for viewing it under these lenses is to show the cause-effect relations that they have in policies and space. The effects of the responses pose a direct question to the actions that have been taken to address the issue, and the action in-turn, is shaped by the outlook or perception of society (slums, in this case) and ecology and the relationships are thus a product of many factors that shape the policies.

### Perception

Climate hazards such as pluvial flooding, tsunami and drought are addressed under the umbrella of ‘disaster management’ in the country. The first National Disaster Management Authority (NDMA) was established in 2005, under the Disaster Management Act, 2005, to lay down policies, plans and guidelines for responses to disasters, be it natural or man-made. The Act defines disasters as catastrophes, calamities, grave occurrences or mishaps arising from natural or man-made causes, but fails to mention climate change as a part of this, implying that disasters are primarily sudden events. This does not account for gradual events such as sea level rise. While the State Disaster Management Perspective Plan - 2018-2030 (SDMPP) does acknowledge community knowledge and tradition in responding to disasters, the City Disaster Management Plan (CDMP) refrains from outlining specific roles of non-governmental organisations and civil societies in such circumstances, focusing mostly on government-induced actions to prepare for, respond to, recover from and mitigate disasters. The policies framed are especially not inclusive of the weaker sections of the society, like the slums, in addressing their capacities to recover from disaster effects.

In order to fully understand the current perspective towards mitigation of climate effects in Chennai, it is necessary to also understand the present-day perspective towards slums in the city. Slums, which have always had a mutual dependence with the political parties in the city, relied on them for welfare and protection. However, over time, there has been a shift

in the way slum policies have been formulated. This has been largely due to the viewing of slums as ‘risky’ to themselves and the rest of the city, and ‘at risk’ under the backdrop of environmental concerns (Diwakar, 2019). With the economic neo-liberalisation of India in the 1990s, the city has been striving towards a global city aesthetic with private players entering the housing market. However, this vision did not include slums. The TNSCB envisions Chennai as a slum-free city by 2023, shaping the way policies have been framed in order to satisfy other stakeholders.

### Action

This perception of the management of climate hazards, has shaped the actions that have been taken to mitigate effects. In response to flooding at the peri-urban areas, the measures proposed by the SDMP are in the capacities of infrastructural additions such as flood walls, link canals, and conduit systems. The restoration of two major rivers in Chennai – the Cooum and Adyar rivers, have been proposed. The Integrated Cooum River Restoration Plan, the execution of which started in 2016, outlines measures such as desilting, solid waste removal, treatment parks and fencing, along with rehabilitation and resettlement for slum dwellers along the river to make way for mangrove development, flora plantation, and riverfront development. Similarly, the ecological restoration of the Adyar creek and estuary, which was completed in two phases, has resulted in the creation of an Eco Park with increased faunal diversity and tidal interaction. This project too, has forcefully evicted thousands of slum dwellers to welcome a use that is increasingly seen to align with the image of a ‘world-class’ city (Coelho & Raman, 2010). These projects view settlements along the rivers purely as causes of pollution. While these projects have the potential to address ecological remediation of the rivers, they have significant effects on the evicted dwellers.

Meanwhile, the Chennai Metropolitan Development Authority (CMDA) introduced a Special Transfer of Development Rights (TDR) as a compensation to slum dwellers encroaching waterways and road edges or any other land owned by the government, when the land is claimed back to restore original use (Chennai

Metropolitan Development Authority, 2008). This TDR grants dwellers Floor Space Index (FSI) that could be used to develop houses elsewhere. This required the identification and approval by the TNSCB. Although the guidelines state that the TDR cannot be used in Coastal Regulation Zones, Aquifer Recharge areas and the Redhills catchment areas, a number of the resettled tenements lie in low-lying flood plains of the city.

### Effects

The ecological restoration measures taken so far have not particularly led to a cleaner river or increased protection. Nonetheless, increased biodiversity is a positive sign. In order to determine the effectiveness of these strategies against flood risk, one would have to wait for the next intense downpour or cyclone. However, the effects that forceful eviction and resettlement has on the slums are manifold. The problems faced by the relocated dwellers are captured under different dimensions – geographical, socio-economic, and physical.

**Geographical:** There have been instances of flooding in the resettlement tenements constructed in Semmenchery, and Perumbakkam (see Figure 3) and Ezhil Nagar colonies in Okkiyam Thoraipakkam during the 2015 floods, as they lie on the flood plains in the peripheries of the city (Coelho, 2016a).

**Socio-economic:** Having been shifted to the peripheries, there is an added loss of livelihood due to their increased distance from economic opportunities (see Figure 5), resulting in severe money crunches and prolonged indebtedness (Coelho & Raman, 2010). The displacement also affects social ties and cultural links, intensifying the socio-spatial isolation of these communities, and reduces access to education and healthcare facilities. Further, the tenure security promised by the government requires the dwellers to pay rent to the government for 20 years, after which they could acquire ownership of the land, meaning that there is an increase in living costs after resettlement.

**Physical:** There are multiple examples of resettlement colonies that had inadequate facilities and services even several years after resettlement, like Ambedkar Nagar and Kannagi Nagar. In Ambedkar Nagar, this included basic infrastructure and services like piped drinking water, usable roads, adequate transport, storm water drains and electricity (Coelho, 2016b).

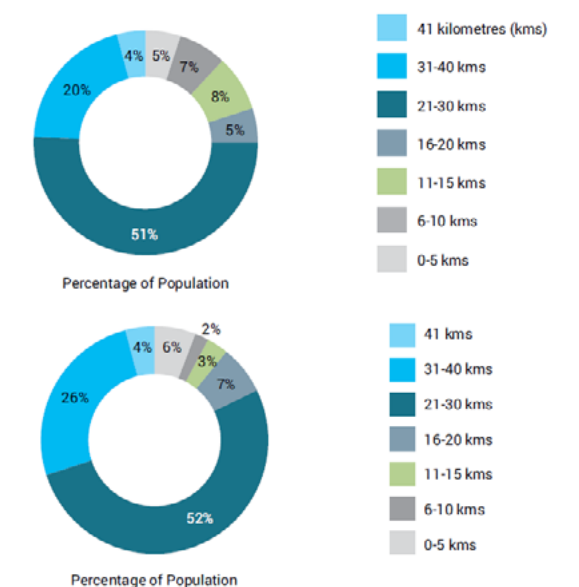
### Conclusion

The perspective that has been adopted by the government and other sections of the society, of

ecological systems as separate entities requiring protection and of the weaker communities as being at risk or causes of pollution, results in measures that do not touch upon the positive relations that these communities have or could have with ecological systems. These measures then, are also not inclusive of these communities, resulting in unjust outcomes for them. However, the government itself plays a big hand in causing climate hazards. There is a need for an integrated perception of the problem that is not one-sided, but views ecology and society as inter-related components in a system. There is a need for policies and planning frameworks to address the resilience of these communities to climate hazards, both short-term and long-term. In addition, these policies and frameworks must be taken by environmentally just means.



Perumbakkam Resettlement Colony (TNSCB). Source: Divya, Annie. Retrieved from <https://www.cag.org.in/blogs/tn-slum-clearance-board-through-lens-cags-audit-report-part-ii>.



Travel distances between resettled locations and work places. Source: From Deluge to Displacement: The Impact of Post-flood Evictions and Resettlement in Chennai, 2017



Reading the problem backwards. Source: Author.

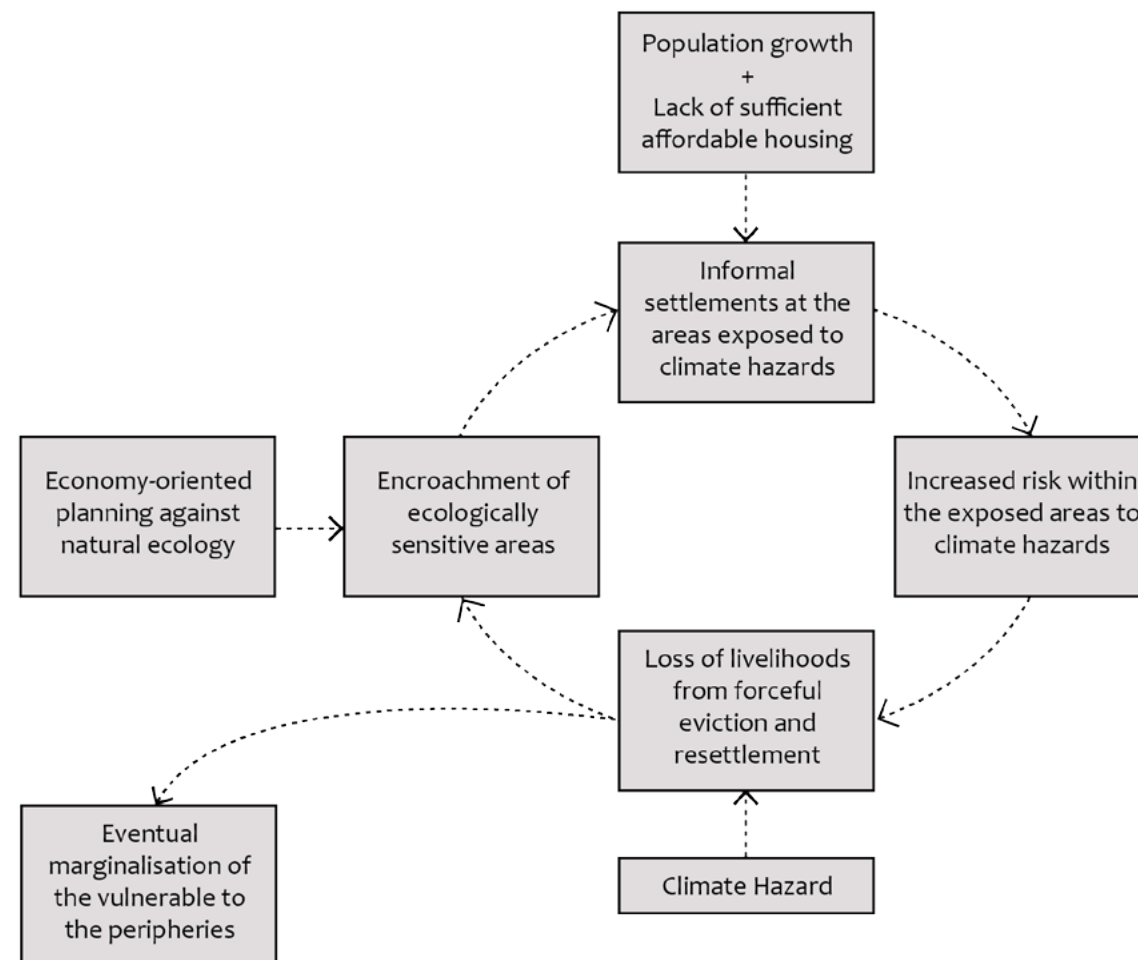


# Problem Focus

## System at stake

Due to being unable to afford homes within the city, the urban poor start to settle along corridors within the city, forming slums in areas that have a higher exposure to climate threats and flooding. In response to past threats, the Tamil Nadu Slum Clearance Board has cleared out slums along the major ecological corridors and rehabilitated them in compact apartments far away from the city, creating a significant impact on their livelihoods and also affecting their social and cultural links. These measures, although in response to flood risk, have viewed slums primarily as causes of pollution, and created unjust outcomes for those who do not have the capacities to respond to significant changes in their livelihoods. Shifting the slum dwellers merely shifts the vulnerability and has not proven to be a significantly safer option for the dwellers.

Owing to the current perception of the slums as being a part of the problem or as areas at risk, and the perception of the climate issue as disaster response, the attempted measures to address the problem has not improved the relationship between society and ecology within the city. Within this system, there is an evident separation of the two components.



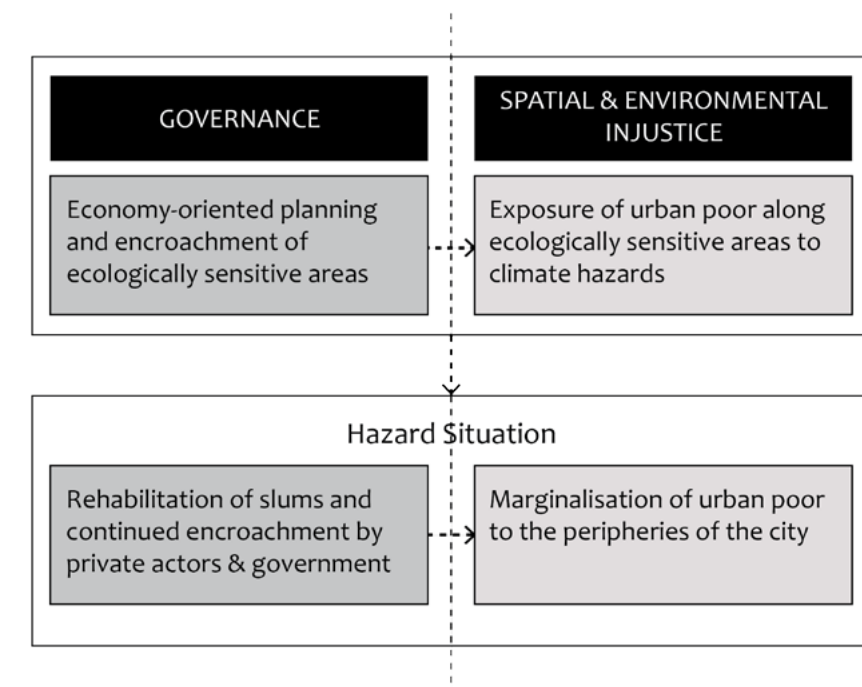
The problem as a system. Source: Author.

## Problem Statement

There is a dichotomy between the agenda of the government and the needs of the people. The government, having complete control over the resources, ultimately wins. The response measures to climate impacts, which are primarily infrastructural and restorative, are not considerate of the social and cultural dimensions of the local people, nor are they inclusive of the voices of all the groups, especially the poor. Hence, the slum population is always disadvantaged - within the city cores and at the peripheries, without being included in the decision-making. This comes from viewing ecological structures as entities that need to be protected from society, and vice versa, resulting in actions that amplify the one-sided perspective.

There is a need to find solutions that cater to diverse interests, through methods that are inclusive of the voices of diverse stakeholders. More importantly, there is a need to identify the potentials within these communities to actively respond to climate effects.

*The measures to rehabilitate the slums in the city lead to further marginalisation of the urban poor, whose voice are not included in the decision-making process, while the current planning processes continue to exacerbate the conditions for climate vulnerability through the encroachment of ecologically-sensitive areas.*



The problem domains. Source: Author.



# 3 Research Approach

## Introduction to chapter

The issue that is presented in this chapter highlights the inadequacy of the planning frameworks and disaster response measures in the city to contribute to mitigation of climate effects, especially for the urban poor living in slums. The chapter sets out the research aims and then presents the theoretical underpinning, followed by the conceptualisation of an alternate framework that addresses the problem discussed in the previous chapter. It elucidates the methods and steps through which the project unfolds.

## Contents

- Research Aims
- Theoretical Underpinning
- Conceptual Framework
- Research Questions
- Methodological Flowchart
- Intended Outcomes & Research Methods
- Framing the Approach





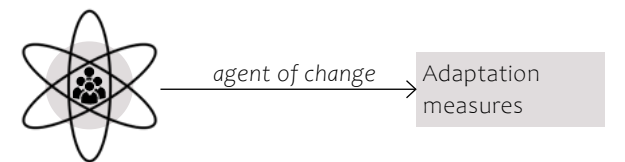
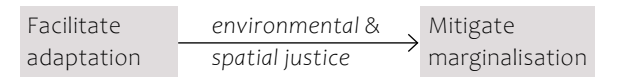
## Research Aims

This project aims to mitigate marginalisation of the vulnerable groups of Chennai through the facilitation of local adaptation to climate change and hazards. In doing so, it aims to postulate strategies which are environmentally and spatially just.

The goal is to take into account diverse interests in the decision-making process, and driving adaptation measures through multiple scales and by diverse actors, making the process more inclusive.

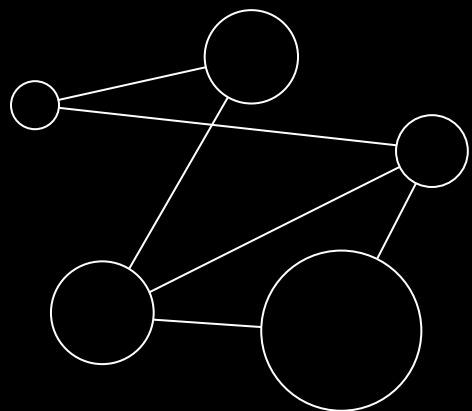
The research intends to explore local culture as an agent of change in informing adaptation measures to climate change and hazards at a planning level in order to achieve climate resilience.

Lastly, the driving force behind targeting the urban poor arises from the need to shift the power imbalance within the current governance system to multi-level and multi-actor decision-making within the metropolitan area. This stems from an understanding of society and ecology as a system, rather than separate entities, that requires adaptive nature-based solutions seen from a long-term perspective.





# Theoretical Underpinning



## Introduction

There is a need to recognise the vulnerable areas through analysis of hazard/event-specific conditions, and socio-economic and institutional factors that contribute to vulnerability.

This determines the adaptation measures that will be defined at multiple scales in order to increase the adaptive capacity of the social group.

Climate change threatens cultural dimensions of livelihoods - such as identity, community cohesion and sense of place (Adger, Barnett, Brown, Marshall, & O'Brien, 2013). Therefore culture plays an important role in situating measures for resilience and adaptation.

The following section will outline the theories that have been employed, following which the relational understanding of the theories in the conceptual framework will be explained.

## Integrated Approach

This project proposes an alternate perspective to view the climate issue, through the adoption of the concept of socio-ecological resilience. The definition of resilience has evolved over time. One of the earliest definitions of the word describes it as "... a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables" (Holling, 1973). However there have been many researchers who have posed alternative definitions of the concept. The definitions range from 'static resilience' to 'adaptive resilience' and 'transformative resilience' (Davidson, et al., 2016). There is a need for resilience by adaptation within planning and disaster response frameworks in Chennai, as will be explained in the subsequent sections, first through the establishment of a theoretical position, and subsequently, through a situated understanding.

## Theoretical standpoint

### Systemic view: Socio-ecological resilience

From a purely ecological point of view, contemporary delineations of resilience have moved to an integrated understanding of the ecological and social dimensions. Here, the term is defined as "... the capacity of linked social-ecological systems to absorb recurrent disturbances such as hurricanes or floods so as to retain essential structures, processes, and feedbacks; ... the degree to which a complex adaptive system is capable of self-organization (versus lack of organization or organization forced by external factors); and the degree to which the system can build capacity for learning and adaptation" (Adger, Hughes, Folke, Carpenter, & Rockstrom, 2005). The essence of socio-ecological systems (SES) lies in the shift from conceiving human-environment relations as separate systems, and towards an understanding that human systems are a part of, and in turn shape, ecological systems (Cote & Nightingale, 2012). Cote and Nightingale argue that it is necessary to delineate system boundaries and define whose environments and livelihoods are to be protected and why, through an analysis of issues of complex rationalities, power and authority. This puts the theory at the centre of the current issues in Chennai of worldviews, power and politics regarding climate hazards and slums. In this research identifying the system at stake, through the lens of the urban poor, helps in bringing it a step closer to defining 'resilience for whom?' and 'at what cost to which others?'.

## From mitigation to adaptation

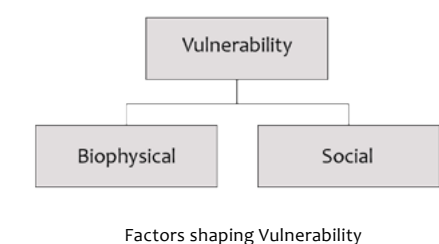
Adger et al. define adaptation as an adjustment of a system – be it social, ecological or economic, in response to perceived or anticipated changes in climate stimuli and their effects in order to 'alleviate adverse impacts of change or take advantage of new opportunities' (Adger, Arnell, & Tompkins, 2005). They argue that this can be done through 1) building adaptive capacity and 2) implementing adaptation decisions. This approach re-iterates the importance of cross-scale dynamics in adaptation. Adaptation requires actions by multiple actors and at scales of governance. Hence, this is an integral part of re-conceptualising the perception of the climate issue in Chennai.

## Identifying vulnerability

As a starting point to facilitating adaptation of a system, it is necessary to identify the factors affecting the vulnerability of that system. The concept of vulnerability as a starting point will be adopted here, by defining the term as the ability or inability of individuals or communities to respond to (cope with, recover from or adapt to) any external stress placed on their livelihoods and well-being (Kelly & Adger, 2000).

**Biophysical:** It is necessary for an assessment of the biophysical factors that shape vulnerability, which are linked with specific hazards. In the hazards-of-place model, the biophysical and social factors contribute to overall place vulnerability. (Cutter, Boruff, & Shirley, 2003). Assessing biophysical vulnerability addresses factors such as elevation, proximity, physical conditions that are naturally vulnerable to a hazard.

**Social:** When it comes to assessing social vulnerability, Kelly and Adger's concept of the 'architecture of entitlements' comes into play. They define these as the various factors that shape the availability of entitlements, or rights/privileges, how they evolved over time and the broader political context that shapes the formation and distribution of entitlements, such as poverty, inequalities and institutional structures (Kelly & Adger, 2000). Therefore, identifying the factors defining vulnerability will help delineate adaptation measures for the communities.

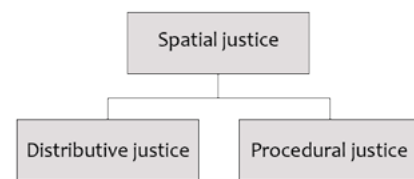




# Theoretical Underpinning

## Bringing justice into the equation

As seen from the overview of the current measures in Chennai, the exclusion of vulnerable groups in the decision-making process has led to unjust outcomes for these communities. This reinforces the notion that procedural justice is as important a factor, if not more, in climate adaptation, as distributive justice. Here, procedural justice refers to ‘fairness in access to democratic decision-making by individuals, groups or nations’ (Adger, Paavola, & Huq, 2006). The value of putting the most vulnerable first and emphasising universal participation are some of the cornerstones, as put forth by Adger, Paavola and Huq, of justice in adaptation to climate change.



Components of spatial justice

## Cultural dimension

Aside from the socio-economic losses that relate to climate change, the intangible aspects of culture, identity, and sense of place are also under threat. (Adger, Barnett, Brown, Marshall, & O’Brien, 2013). The project seeks to take culture as a driver of change in defining adaptation measures at a design and planning level, as cultural values and worldviews of the stakeholders involved determine adaptation decisions. (O’Brien, 2009). In This Must Be the Place: Underrepresentation of Identity and Meaning in Climate Change Decision-Making, the authors state:

“Places are symbols, products, and containers of the various cultures that value them. By culture we mean what people think, what they do, and the material products (and landscapes) they produce; culture is shared, learned, symbolic, cross-generational, adaptive, and integrated.” (Adger, Barnett, Chapin III, & Ellemor, 2011)

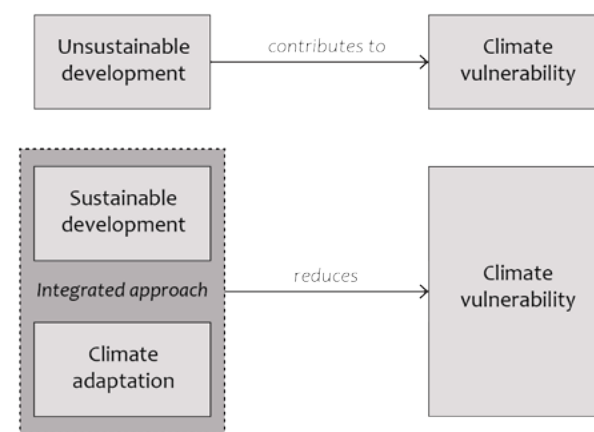
In this narrative, the concept of societies valuing places and their cultures and environments, and these risks are often undervalued in policies involving climate change. The aim is to not just derive costs and benefits of climate change from readily measurable aspects, but also from intangible aspects that are under risk.

Culture and identity, manifest spatially through different realms - private, semi-private and public.

Therefore, it takes the shape of specific environments such as private space or living space, working space or economic space, and collective space or community space. While housing is essential in creating living space, the collective space (public space), is viewed as a space owned by the community. This is essential in building up community cohesion and strong participation in the planning process. The community space is often overlooked in rehabilitation processes, which focus purely on housing. In addition, the economic space, is the infrastructure that facilitates local economy to flourish, the use of spaces for sustaining livelihoods.

## Conclusion

This shift from a point of view that focuses purely on mitigation, persistence and resistance is necessary because this approach views the ecological system as something that must be resisted by the society, and vice versa. This perspective must be replaced by one that recognizes that the social and ecological systems are inextricably linked and always affect and shape one another and that the social system has the potential to be drivers of climate adaptation and mitigation. This approach emphasises the synergistic aspects of climate adaptation and mitigation. In addition, recognising the potential in the most vulnerable sections of society to facilitate adaptation and turn the table, so to say, through just and fair means, seems to be crucial in building resilience to climate change and related hazards. Lastly, the element of culture is essential in adaptation. The integration of spatial forms of culture into adaptation measures, takes into account the social and economic components along with the environmental components, aligning climate adaptation with sustainable development.



Integrated approach to address climate vulnerability

# Conceptual Framework

The conceptual framework adopted in the project views adaptation as a way to address the vulnerability of the social groups to climate threats. Therefore, an assessment of the risk, which is hazard-specific and depends on the biophysical exposure and the socio-economic and institutional aspects that influence vulnerability, is required in order to determine adaptation measures. The social vulnerability is categorised under socio-economic and institutional factors in order to separate the accessibility and availability of resources, from the formal regulations and avenues of control over the space that indirectly affects vulnerability.

Adaptive planning is seen as the framework that addresses the vulnerability through adaptation measures in a multi-actor and multi-level setting, which in turn help build the adaptive capacity of the systems at stake.

Culture is the driver of the adaptive framework and the adaptation measures. The spatial forms of culture that have been considered are:

- living space: housing as an essential component of adaptation
- economic space: integrating the aspect of livelihood sustenance through local economy
- community space: networks of interaction and community cohesion

Therefore, framework is viewed in two ways - one, from a lens of ‘space’, derived from the risk assessment of the geographical area, which has a function and quality; and the other, from a lens of ‘place’, which is derived from the cultural links and values that people have with the space they inhabit and use on a daily basis, and to which they attach meaning.

The framework is thereby a tool to enable just adaptation processes and responses in vulnerable areas, taking into consideration all potential losses, be it tangible or intangible. Therefore, the spatial conditions that contribute to vulnerability determine how people value place, and the positive place identities inform spatial measures to build adaptive capacity of the communities.

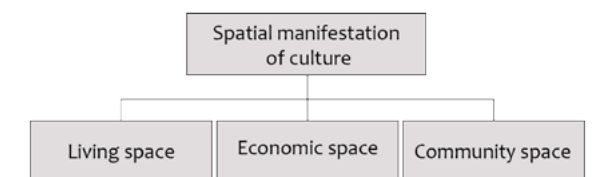
The adaptation measures are implemented through the policy space (planning framework) and the tangible space (spatial design), through processes that are inclusive (diverse actors), multi-scalar (neighbourhood to city level) and temporal (short-term and long-term, proactive and reactive). Here the emphasis is on employing a framework that creates just outcomes in procedure and distribution.



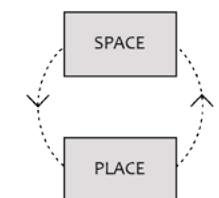
Intersection of hazard, exposure, and vulnerability yields the risk.  
Retrieved from: <https://niwa.co.nz/natural-hazards/hazards/risk-and-vulnerability>



Factors affecting Vulnerability



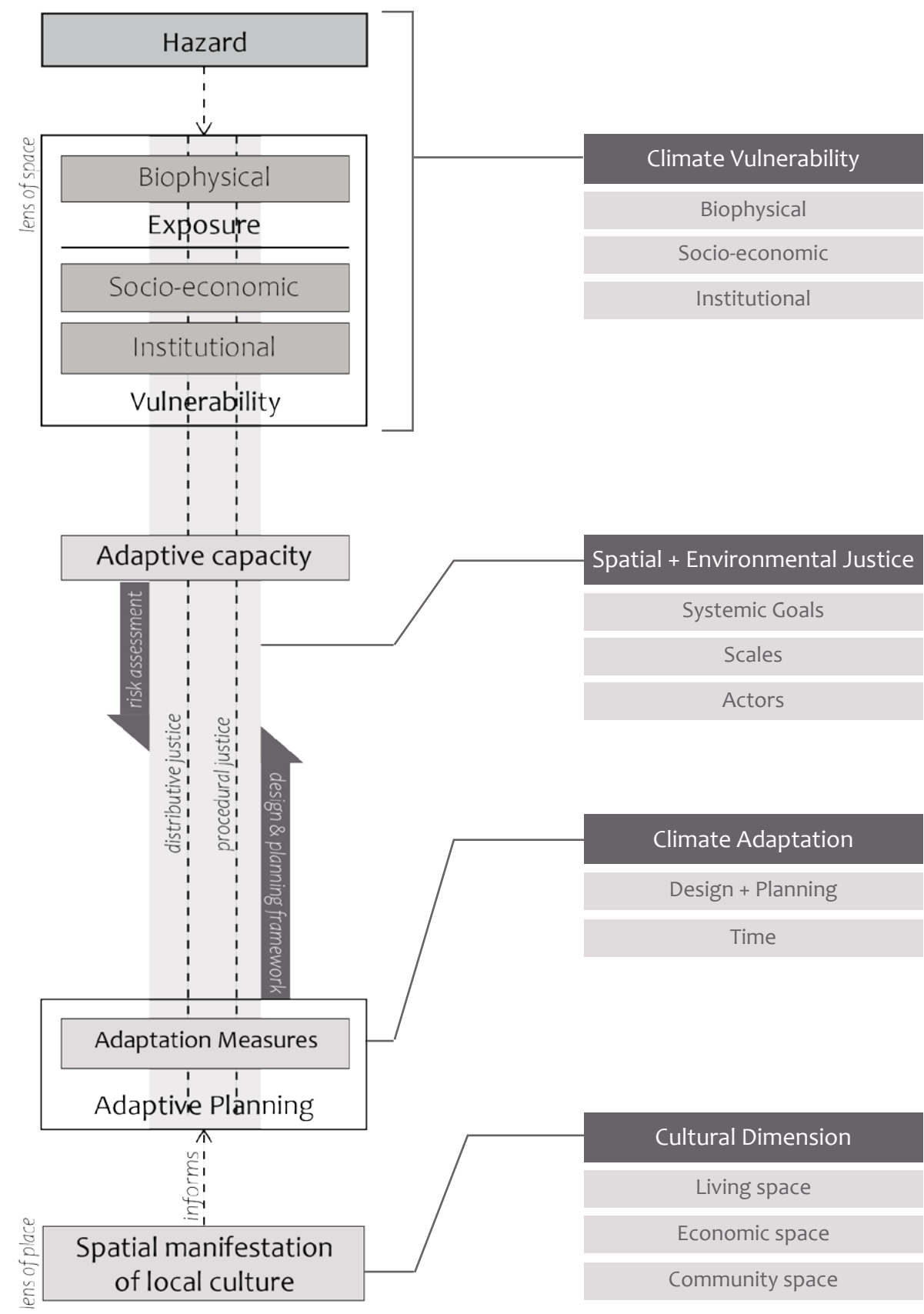
Variables of Culture



Objective + Subjective



# Conceptual Framework



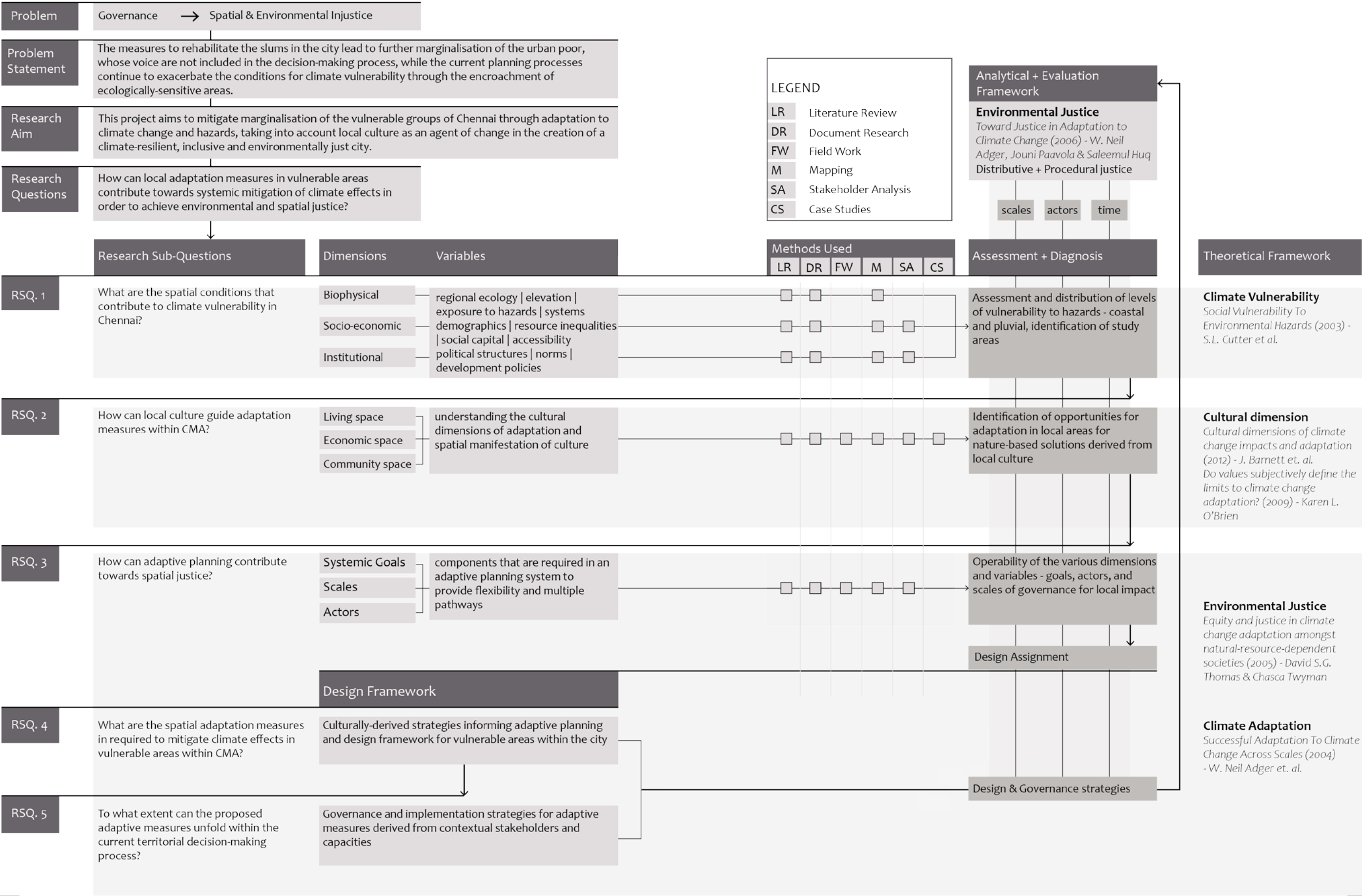
Conceptual Framework

# Research Questions

- Main Research Question**
- How can **local adaptation** measures in **vulnerable areas** contribute towards **systemic mitigation of climate effects** in order to achieve **environmental and spatial justice**?
- Research Sub-Questions**
- RSQ. 1
- What are the **spatial conditions** that contribute to **climate vulnerability** in Chennai?
- RSQ. 2
- How can **local culture** guide **adaptation** measures within CMA?
- RSQ. 3
- How can **adaptive planning** contribute towards **spatial justice**?
- RSQ. 4
- What are the **spatial adaptation measures** required to **mitigate climate effects** in vulnerable areas within CMA?
- RSQ. 5
- To what extent can the proposed adaptive measures unfold within the **current territorial decision-making process**?



# Methodological Flowchart





# Research Process & Approach

## Research Sub-Questions

## Intended Outcomes

RSQ. 1

What are the spatial conditions that contribute to climate vulnerability in Chennai?

Assessment and distribution of levels of vulnerability to hazards - coastal and pluvial, identification of study areas

RSQ. 2

How can local culture inform adaptation measures within CMA?

Identification of opportunities for adaptation in local areas for nature-based solutions derived from local culture

RSQ. 3

How can adaptive planning contribute towards spatial justice?

Operability of the various dimensions and variables - goals, actors, and scales of governance for local impact

RSQ. 4

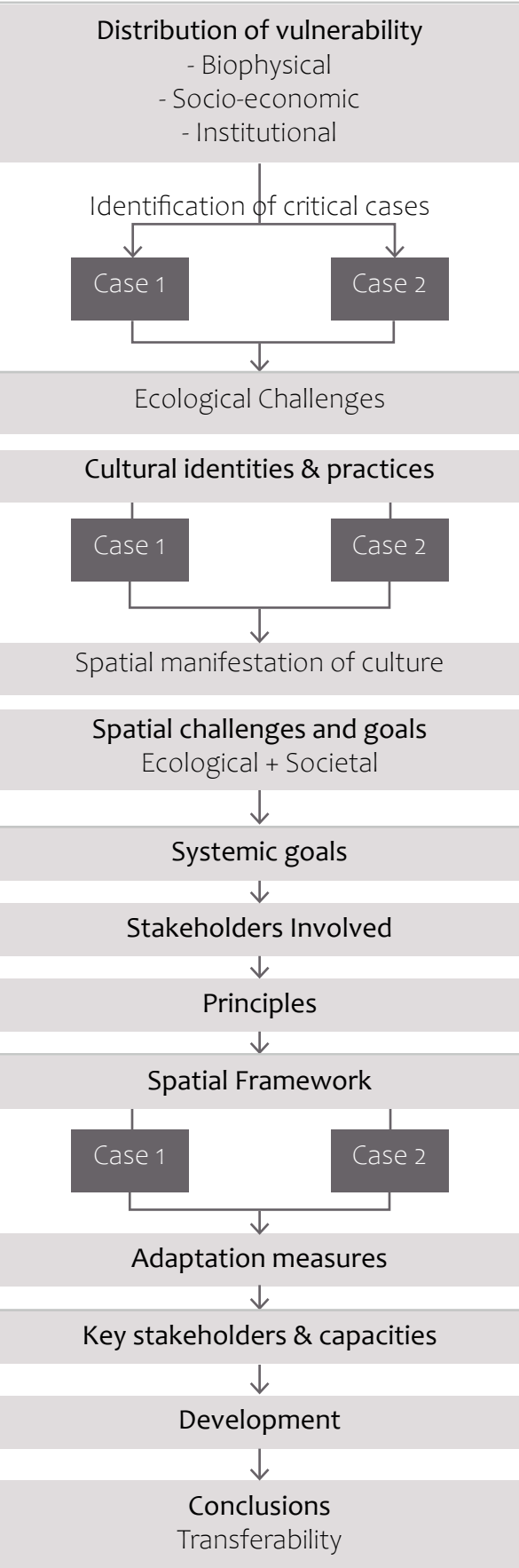
What are the spatial adaptation measures required to mitigate climate effects in vulnerable areas within CMA?

Adaptive planning and design framework for vulnerable areas within the city

RSQ. 5

To what extent can the proposed adaptive measures unfold within the current territorial decision-making process?

Governance and implementation strategies for adaptive measures



## Research Approach

### Mixed (Quantitative + Qualitative)

Since the thesis project deals with adaptive capacities of different communities, qualitative research approaches will be used in combination with quantitative methods to understand the needs and conditions of the demographic. While collecting and analysing empirical data is crucial to define vulnerability levels, qualitative data in the form of cultural links to space and various perceptions about the current built environment and planning processes in the city will be important in order to establish adaptation measures.

### Applied

The approach within this thesis is primarily applied, as the project stems from observations within a specific context. The research carried out will be applied within this context and may be applicable to other similar situations – thereby also carrying some fundamental values and qualities within them that are transferable.

### Deductive + Inductive

The research attempts to establish broad values and positions that are important for the project through an analysis of literature. However, the research will look into site specific attributes and values of different social groups in relation with the built and natural environment, and compare it with definitions from literature. The best approach will then be postulated based on the comparative and derivative analysis from the cases and literature.

### Phenomenological + Positivist

The research aims to look at the current planning process from an objective view, supported by data on planning and its effects on the city, and from a subjective view, by studying various perceptions that different people have of the built environment and their relationships with it. However, in this context, the phenomenological philosophy carries more weight, as the adaptive capacity of different groups with respect to climatic events differs for various reasons.



# Framing the approach

As discussed in the problem analysis, there is a need to change the approach, right from perceiving the problem to developing the actions, in order to get the desired effects.

## Change in perception

The shift from a focus on persistence and mitigation (the static) to the inclusion of adaptation is necessary in order to prevent the shifting of vulnerabilities and other effects mentioned earlier. This requires a change in perception of the problem from the slums as polluters and ‘at risk’ or ‘risky’ to slums being important agents of change in climate adaptation. It is important to recognize the potential and contribution of slum dwellers in the city’s economy. For example, in Chennai, a number of slums are dependent on fishing for their livelihoods. These slums, most often found either in coastal edges or river edges close to the sea, depend on proximity to the sea for survival. While economic contribution is important, the recognition of slum dwellers as people who have the right to space within the city, is an essential starting point for outlining specific measures for these areas. In this regard, cultural links with the place becomes an important role in driving adaptation.

## Why adaptation?

The current processes of urbanization and dealing with climate disasters prove to be unjust, in procedure and outcomes, for the vulnerable sections of the society, especially the slums. Therefore, measures for adaptation to changing climate and related hazards are necessary in order to avoid effects and vulnerabilities created by existing response measures. This must be done by delineating system boundaries, through answering the questions, ‘resilience for whom?’ and ‘resilience of and to what?’. The need for targeting the vulnerable is central in creating just and inclusive frameworks in the city.

## Change in action

The SDMP recognizes the need for resilience in its preparedness measures for disasters. However, it recognizes resilience in the context of mitigation and persistence to hazards, rather than adaptation to hazards. Therefore the specific measures outlined for this are also actions in preparation for disasters, and recovery actions. There is a need to integrate strategies that help build adaptive capacities of the vulnerable communities and identify stakeholders involved in implementing adaptation decisions. However, the CDMP bares no mention of resilience-building for the communities. Currently, there are multiple levels

of disaster management plans (national, state and district/city levels), and each plan maintains a different approach to address climate hazards.

In addition, Chennai joined the 100 Resilient Cities organization as a member city in 2014, and since then a Chief Resilience Officer has been appointed for the city. In June 2019, the Chennai Resilient Strategy was published, an elaborate plan charting out resilience building actions under five pillars – 1) healthy and planned urbanisation, 2) water systems, 3) disaster preparedness, 4) governance ecosystem and 5) Chennai’s vulnerable communities. Tackling the resilience of vulnerable communities, the framework incorporates strategies such as flexible tenure security arrangements, the revival of the Sites and Services model, which was initiated and supported by the World Bank to provide affordable incremental housing, and facilitating in-situ upgradation of slums wherever possible, stressing the importance of inclusive measures. Similarly, addressing the resilience of water systems, measures include water-sensitive design and employing natural infrastructure to buffer coasts. A lot of the actions mentioned in the strategy are inclusive and just, and do indicate links with other actions, and this could act as the initial step to communicate the need for change and mobilise diverse actors to achieve the goals.

Non-governmental organisations play an important role in mobilising resources during hazard situations. This was evident during the 2015 floods in Chennai, when a number of civil societies and NGO’s came out in aid of the affected. These institutions could be used as leverage to decentralize decision-making and facilitate inclusion of various communities, including the very vulnerable.

The presence of numerous documents and plans for the city with overlapping concerns poses a problem of redundancy and effective execution. Therefore, a well-structured, comprehensive plan at the city level is required, incorporating resilience-building as concrete strategies, inclusive of diverse stakeholders. This has to be done by delineating specific systems that are under risk. Currently, the edges of water bodies are places that most people within the city do not often visit due to their polluted state and the perception of slums along these edges as ‘risky’. Therefore, upgrading slum infrastructure, providing basic services, and facilitating mobility and ease of access to the waterfront could potentially restore the ecological value as well as the human-nature interaction within the urban area. The CMDA must be able to coordinate various agencies involved in decision-making at different levels, as they set out development guidelines for the metropolitan

area. This involves strict regulation of development in ecologically sensitive areas and necessary measures to prevent violation of developmental rules.

## Change in effects

All climate hazard-related measures must identify actions for non-governmental organisations, civil society and the most vulnerable, in order to make them truly inclusive. The desired effects of long-term stability and reduced vulnerabilities to climate effects could be achieved through systemic adaptation of vulnerable communities, with the help of flexible frameworks, and governmental and non-governmental support, in order to build resilience. Actions that not only reduce the unfair distribution of burdens and resources, but also reduce the unfair processes involved in making these decisions are bound to have significant effects in reducing the vulnerabilities mentioned in the initial assessment.

## Conclusion and Challenge

It has been shown that the manner of perceiving the problem of climate change and related hazards, of certain sections of society, of what constitutes an ideal city, of ecological values and others, have shaped the way reforms and policies have been framed till date. The emphasis on disaster preparedness and mitigation of effects, without the inclusion of climate-related hazards and their effects in the long-term perspective has meant an over-reliance on government-led institutions in mitigation. Strong political interests, economic concerns, social stigma, and environmental concerns have put the slum dwellers in Chennai in the

most vulnerable position with regard to climate change. However, a change in perception is challenging, and yet, very necessary.

The first step in order to achieve this would be to identify and document all slums, creating a database of these areas and mapping and assessing vulnerability. This is the most important step, as each community is diverse, with different challenges, strengths, weaknesses and potentials. This project first assesses the factors that affect vulnerability - the biophysical, the socio-economic and the institutional.



Urur Olcott kuppam - a coastal settlement. Source: Beema. Retrieved from [www.facebook.com/mycitychennai](https://www.facebook.com/mycitychennai).



# 4 Vulnerability Assessment

## Introduction to chapter

This chapter starts to identify the factors contributing to climate vulnerability within the city. This is grouped under three aspects: Biophysical, Socio-economic and Institutional.

It aims to:

1. Reveal the exposure of slums to climate hazards, through an analysis of the biophysical components.
2. Reveal the socio-economic components that affect vulnerability of slums to climate hazards.
3. Reveal the institutional factors that guide development and hence also play an important role in the vulnerability of slums.

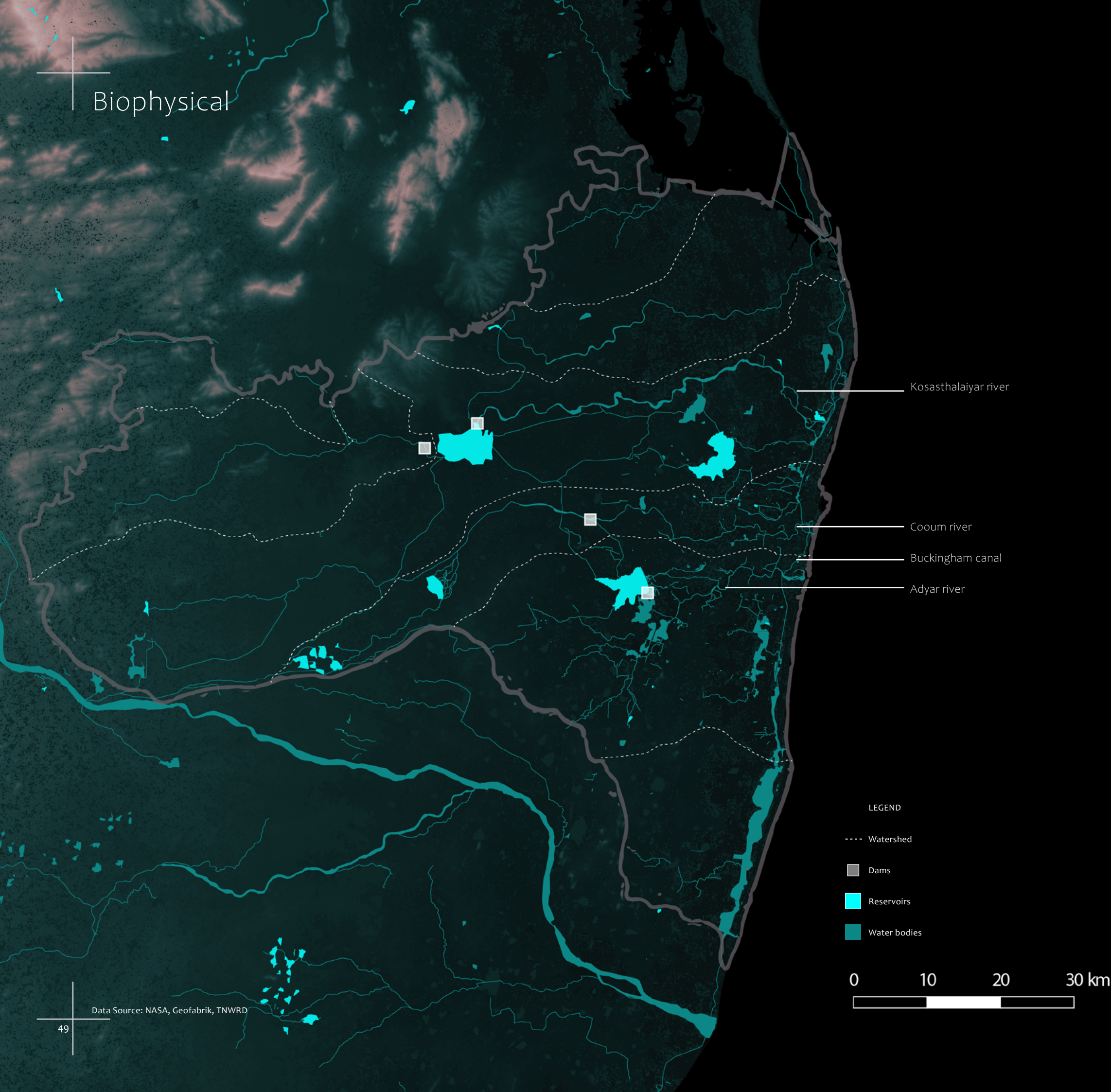
These factors, when viewed together, give rise to different conditions of vulnerability within the city, out of which two critical cases are selected for further study.

## Contents

- Biophysical
- Socio-economic
- Institutional
- Critical cases



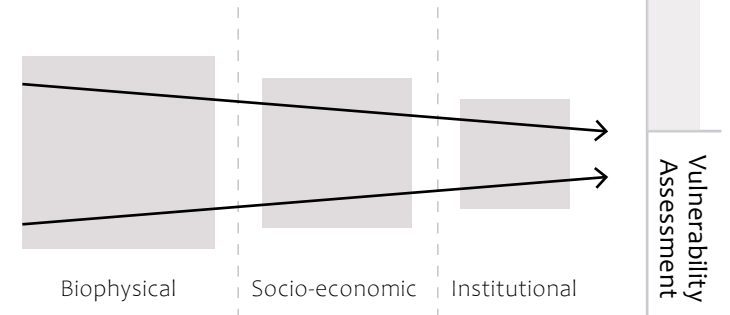
## Biophysical



Data Source: NASA, Geofabrik, TNWRD

## Reading the chapter

The first factor is the biophysical one, which reveals the distribution of the exposure to various climatic conditions. Critical zones along ecological structures identified are then viewed under the socio-economic factors which exacerbate the vulnerability, and finally the institutional factors which directly or indirectly have an influence on the vulnerability. Therefore the critical cases are selected through a filtered approach.



## Assessment - Hydrology

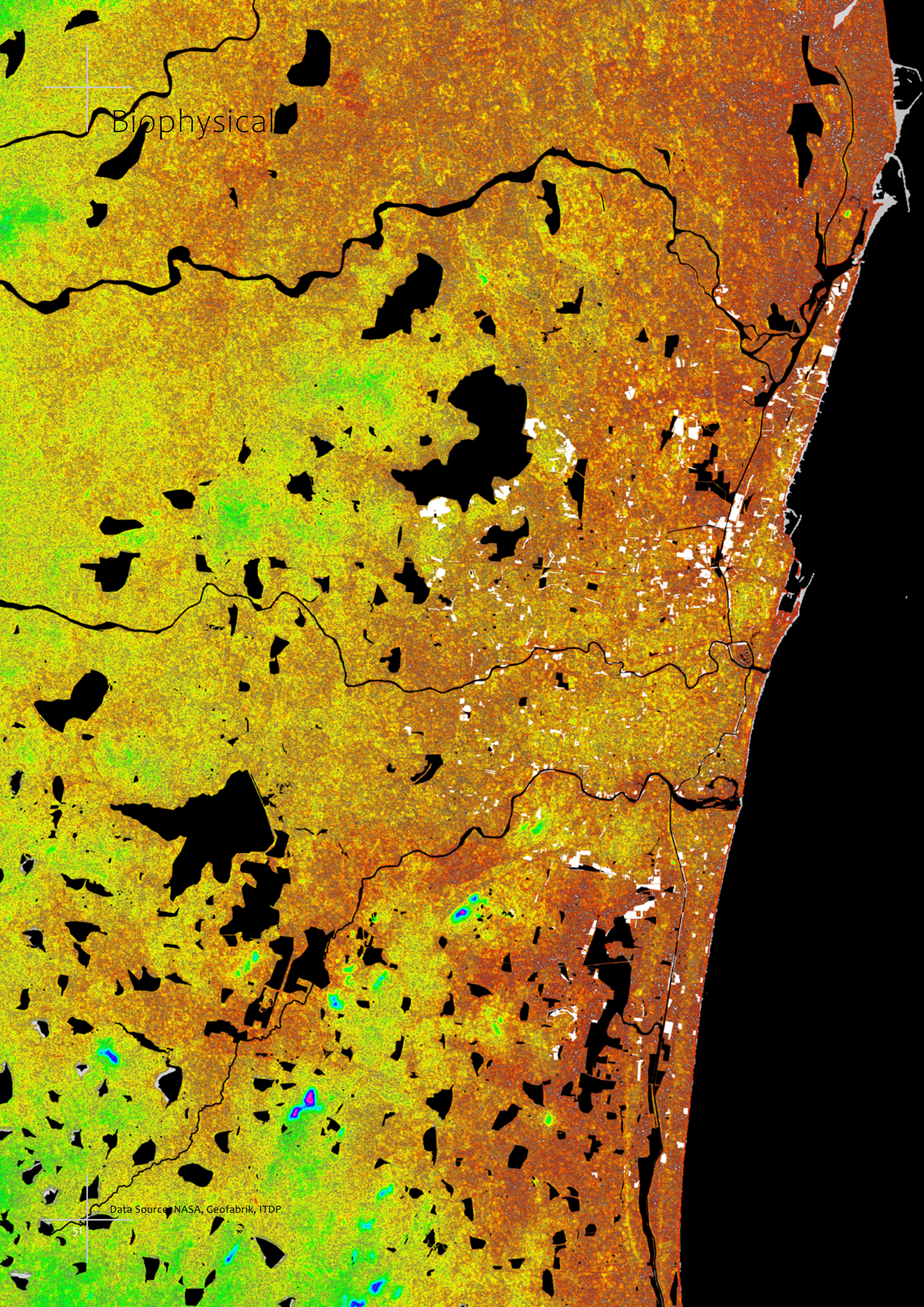
The Chennai region is rich in water resources, with 3 rivers running through the city - the Adyar, Cooum and Kosasthalaiyar rivers.

The city is served by 4 major reservoirs - Poondi, Chembarambakkam, Red Hills, and Cholavaram.

The Buckingham canal is an important freshwater canal running parallel to the coast, which is believed to have saved a number of lives during the tsunami of 2004 in Chennai city. This acts as a protective structure against tsunami and cyclone damage to the coast.

The biophysical factors are based on a regional understanding of the hydrological profile. While identifying the risk areas, it is necessary to scale back up to the watershed/sub-basin scale in order to address the ecological system in totality.



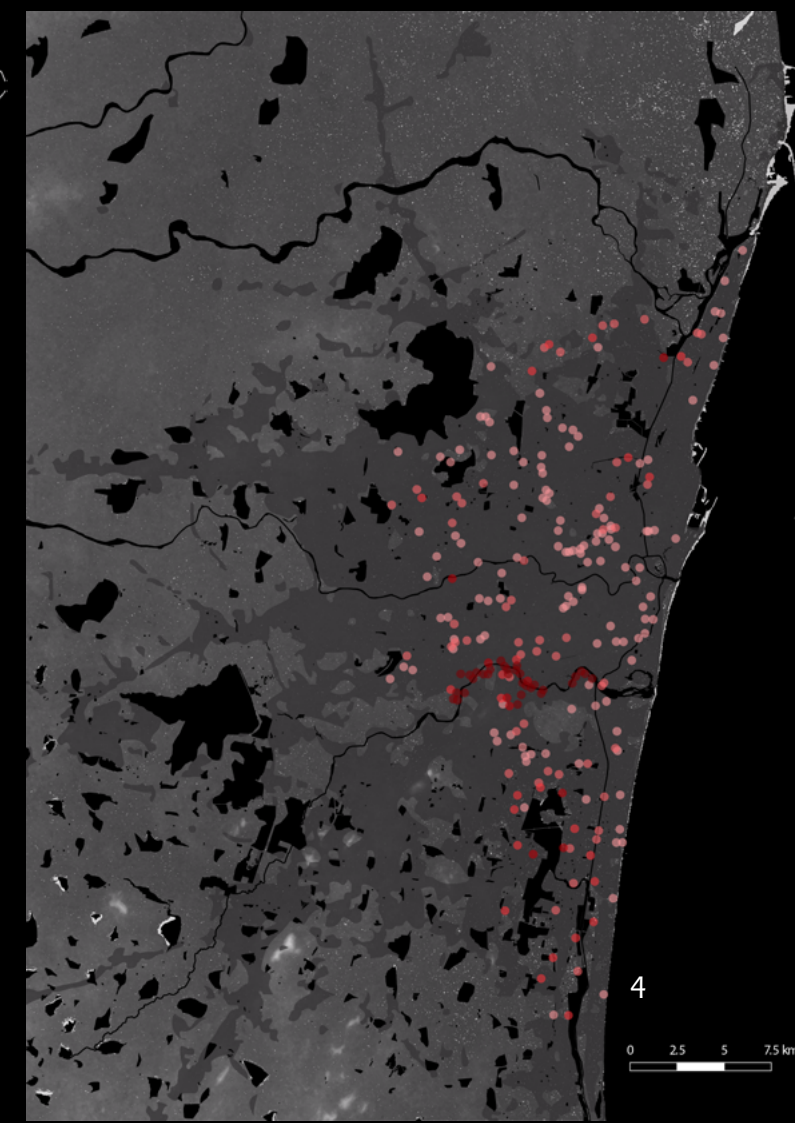
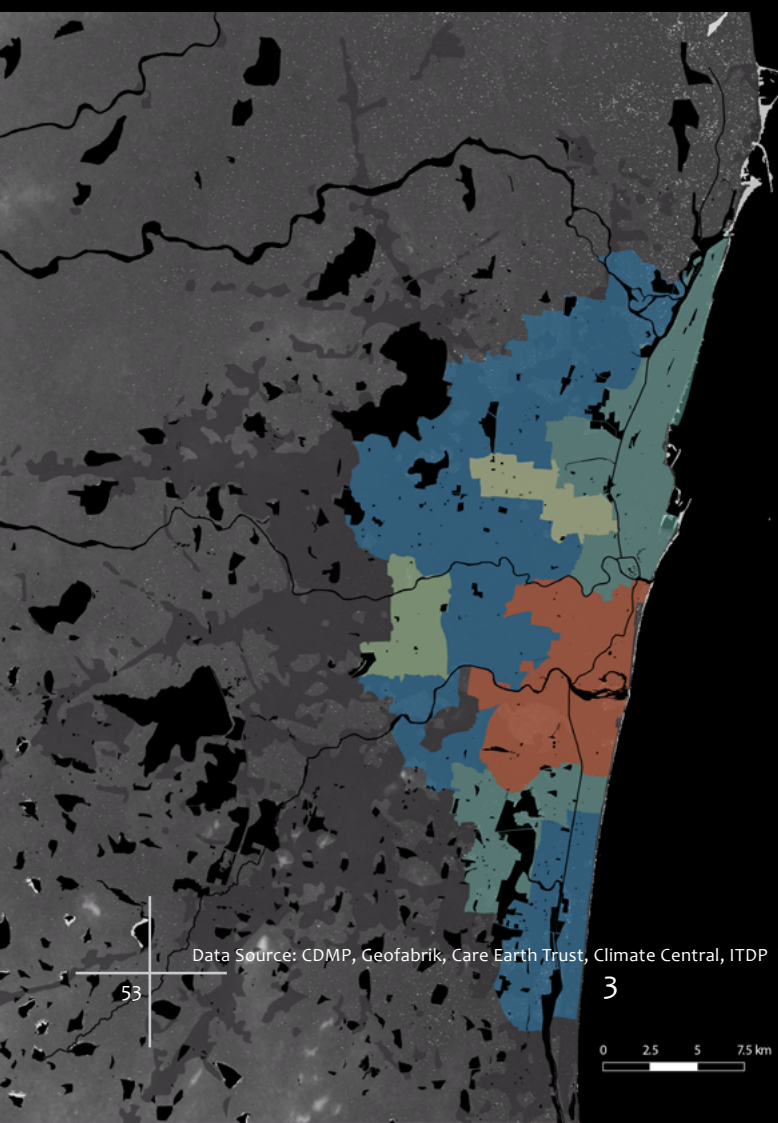
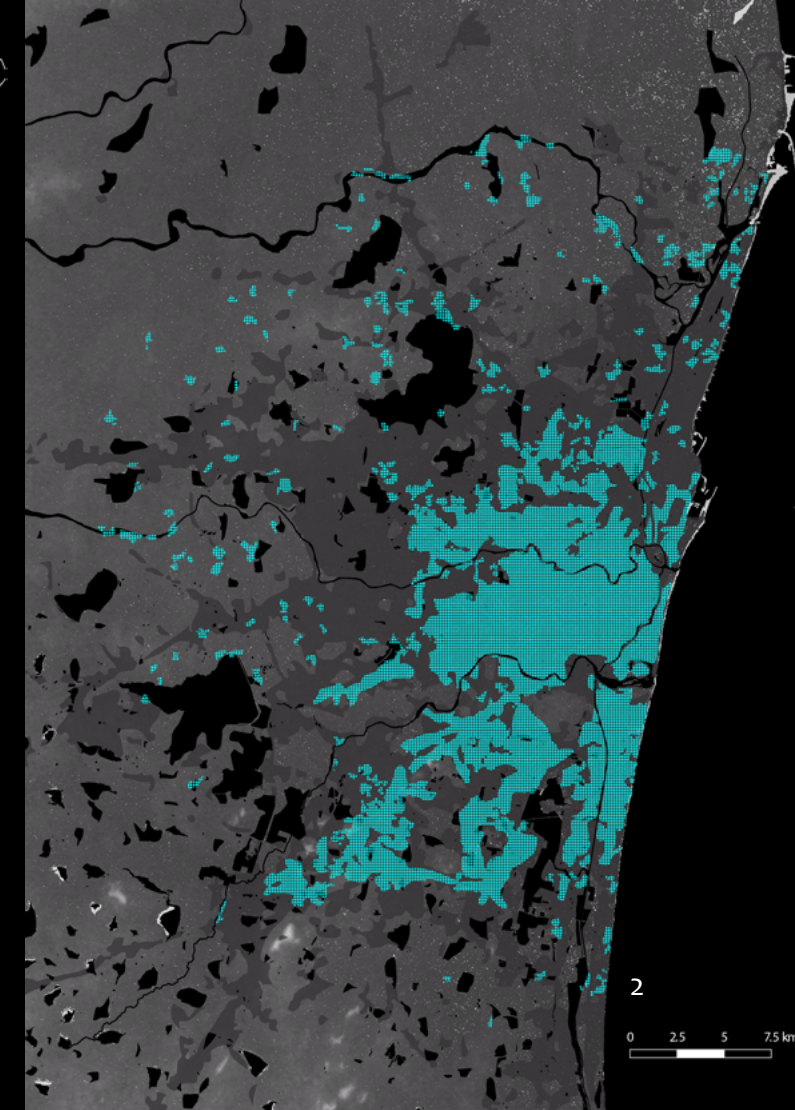
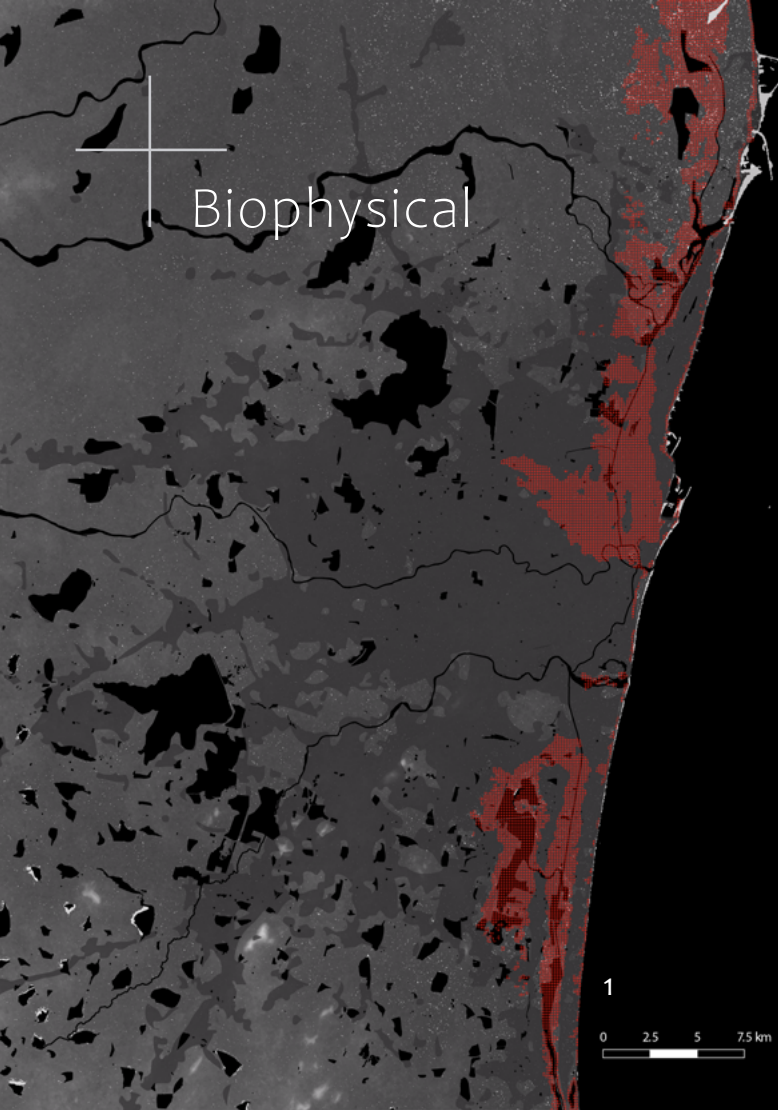


Assessment - Topography

The city has a low-lying terrain, with an average elevation of 6 m above sea level, and the highest point being 60 m. The topographic profile of the city indicates that there are a large number of slums lying on flood plains, making them highly exposed to sea level rise and flooding.

Reading the topography in relation with the water bodies in the city offers an understanding of the critical ecological structures that need to be addressed.





#### MAPS

1. Coastal Flooding projection 2050
2. Inundated areas - 2015 floods
3. Chronic inundation by zone
4. Inundation depth - 2015

#### LEGEND

- Inundation depth - field points (2015)
- < 0.5 m
  - 0.5 - 1 m
  - 1 - 1.5 m
  - 1.5 - 2 m
  - > 2 m
- Zone-wise Chronic inundation locations
- 80
  - 0
- Coastal flooding due to sea level rise - 2050
- 2015 flooded areas
- Water bodies

Source: CDMP, Geofabrik, Care Earth Trust, Climate Central

#### Assessment - Exposure to hazards

An overview of the impact of past events, chronic conditions and future projections are considered in order to have a sufficiently comprehensive understanding of the risk areas. The city, being low-lying in nature, is exposed to sea level rise. According to Climate Central's projection of sea level rise by 2050, the areas that will be affected first are along the Buckingham canal, to the North and South of the city, where the canal and creeks meet the sea, apart from a few coastal areas. The topography of the city reveals a similar picture.

During the 2015 floods, the entire city was affected, with areas around the Adyar river severely inundated.

The City Disaster Management Plan by the Chennai Corporation reveals that Zones IX and XIII - Teynampet and Adyar are more prone to chronic inundation compared to other areas within the city, and the depth of inundation measured during the 2015 event was highest on the banks of Adyar river, making settlements along these areas the most exposed.



## Biophysical

Data Source: CDM, Geofabrik, Care Earth Trust, Climate Central, ITDP

### LEGEND

Slums

Inundation depth - field points (2015)

- < 0.5 m
- 0.5 - 1 m
- 1 - 1.5 m
- 1.5 - 2 m
- > 2 m

Zone-wise Chronic inundation locations

- 80
- 0

Coastal flooding due to sea level rise - 2050

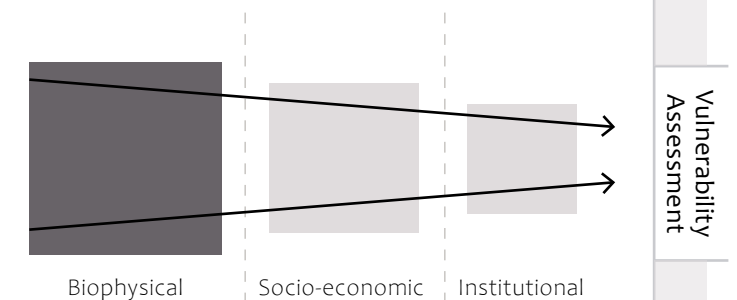
2015 flooded areas

Water bodies

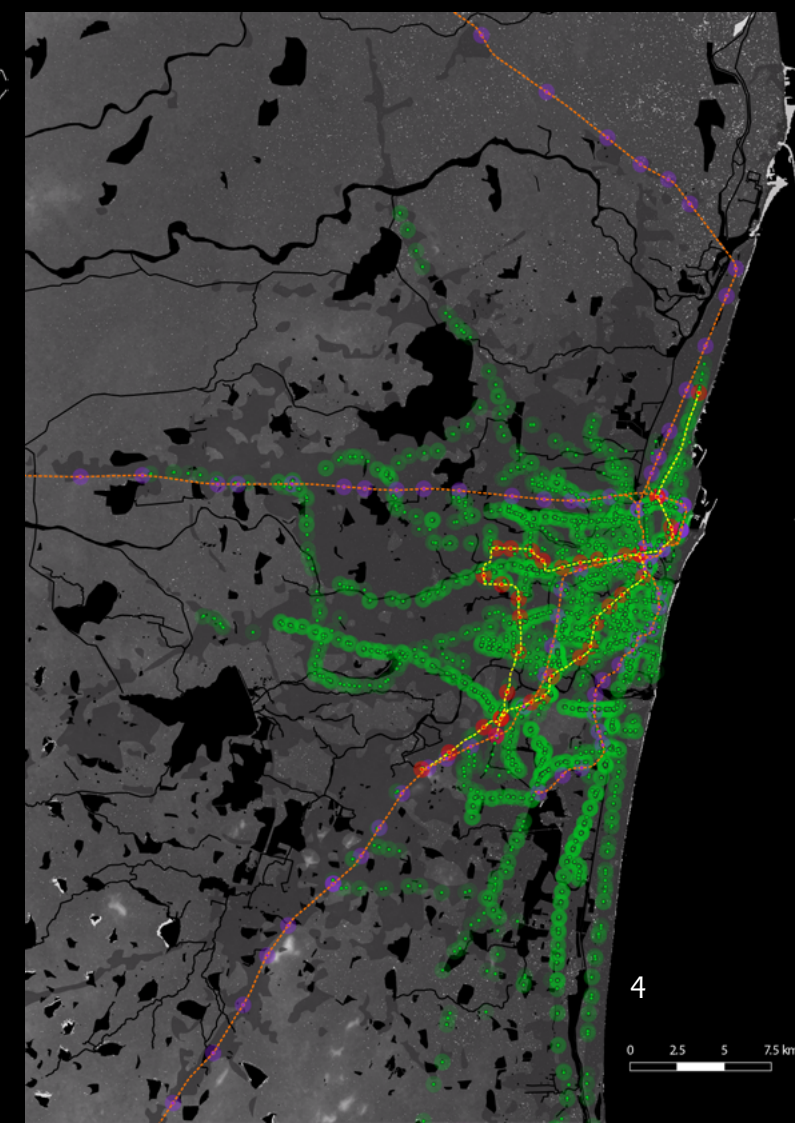
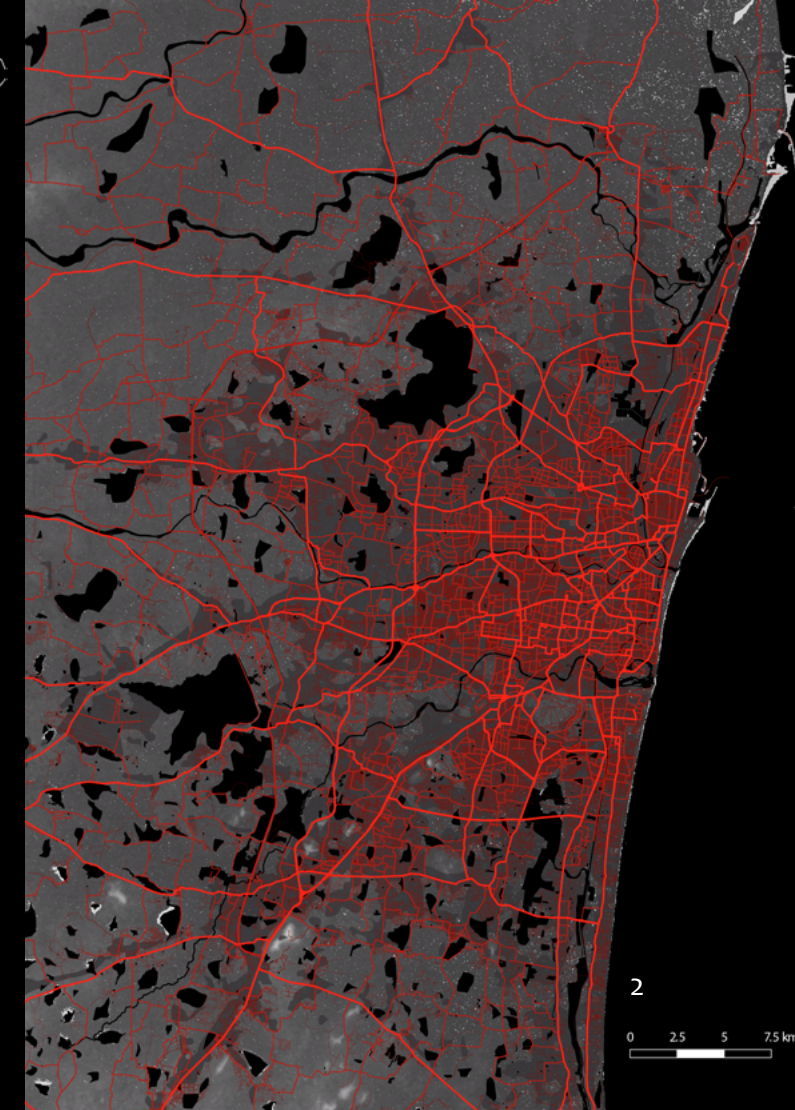
0 2.5 5 7.5 km

## Conclusion

On superimposing the various biophysical factors, some critical areas/structures emerge. The Adyar river, that flows from the inland hills to the sea, and Buckingham canal, which runs parallel to the coast, are the ecological structures that are most exposed to climate hazards, and thereby exposing neighbourhoods in these areas to more damage. In addition, the dependency of the livelihoods on natural resources is an important factor that reveals the values of a particular community.







## MAPS

1. Slum population by zone
2. Road network
3. Employment percentage
4. Accessibility to public transport

## LEGEND

### Employment percentage - slums

- 60 - 70
- 50 - 60
- 40 - 50
- 30 - 40
- 20 - 30
- 10 - 20
- 0 - 10

- Primary, trunk and corridor roads
- Secondary and tertiary roads
- Other roads

- Bus stops
- Suburban rail stops
- Suburban rail
- Metro stops
- Metro line

- Slum population by zone
- Minimum
- Maximum
- Water bodies

Source: Vignesh Radhakrishnan, ITDP, Geofabrik

## Assessment

The zonal population density, accessibility and economic characteristics have been considered in order to have a layered understanding of the entitlements available to the settlement dwellers.

The slum population is densely concentrated within the older city limits. From the perspective of employment, the percentage of people employed in each slum is distributed in such a way that many slums in the central area and in the North are less employed compared to the other areas, thereby also increasing the inherent socio-economic vulnerability.

Accessibility to road network and public transport is also an important variable, as it facilitates mobility and formation of networks. Therefore, slums located in the central areas are clearly advantaged, as the conditions offer multiple opportunities for employment and interaction, when compared to the peripheral slums, especially in the North.



## Socio-economic

Data Source: Vignesh Radhakrishnan, ITDP, Geofabrik

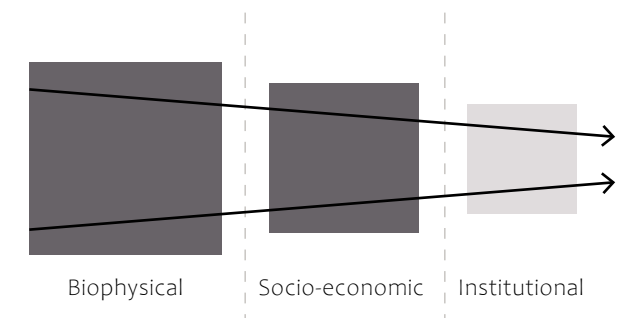
### LEGEND

- Primary, trunk and corridor roads
- Secondary and tertiary roads
- Other roads
- Bus stops
- Suburban rail stops
- Suburban rail
- Metro stops
- Metro line
- Slum population by zone
  - Minimum
  - Maximum
- Water bodies

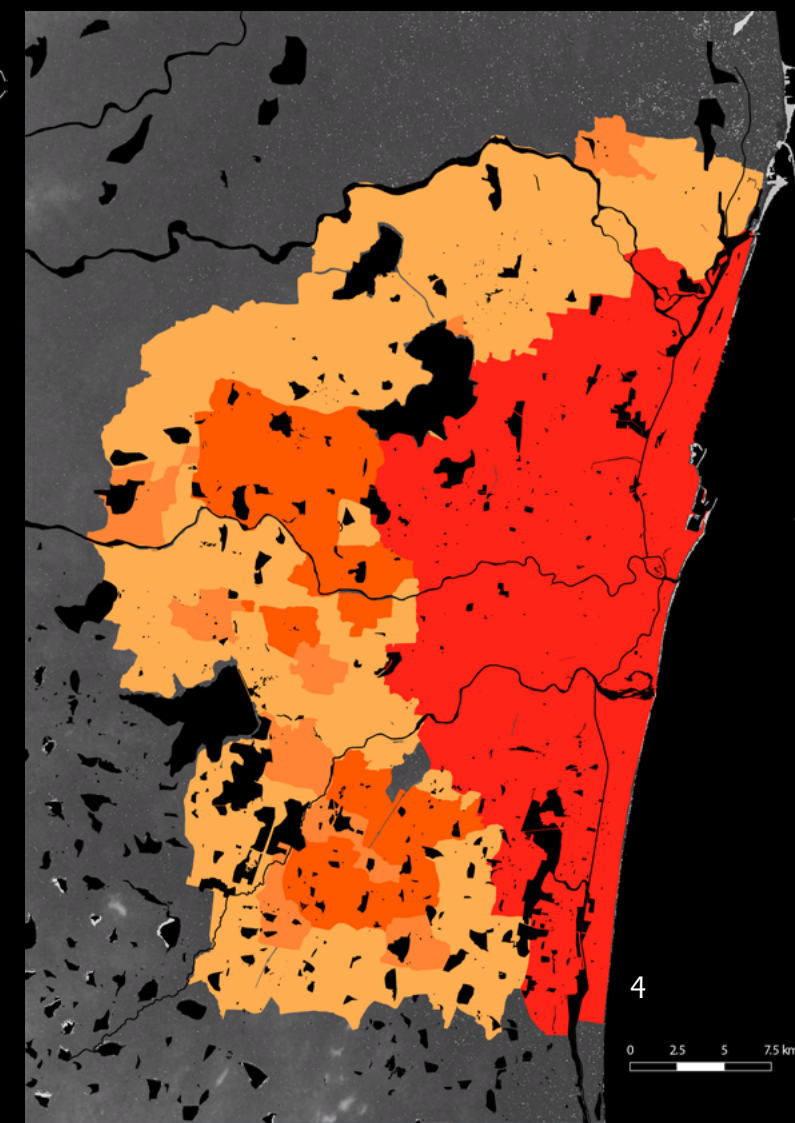
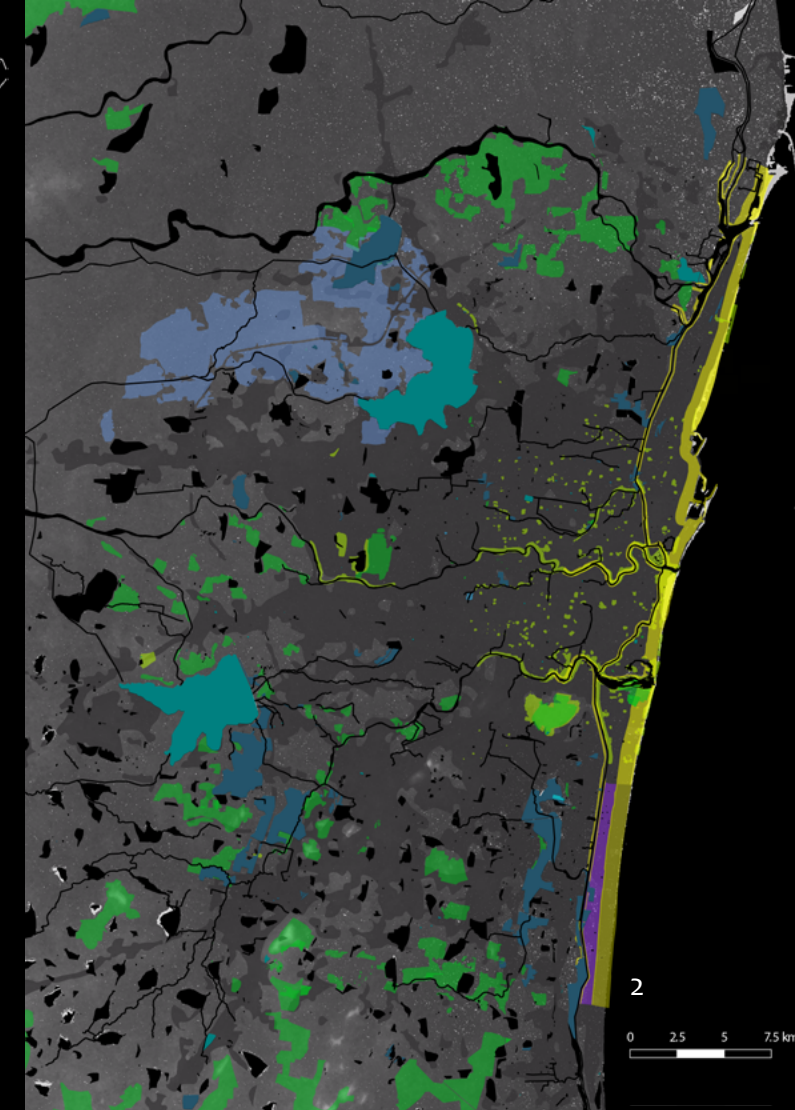
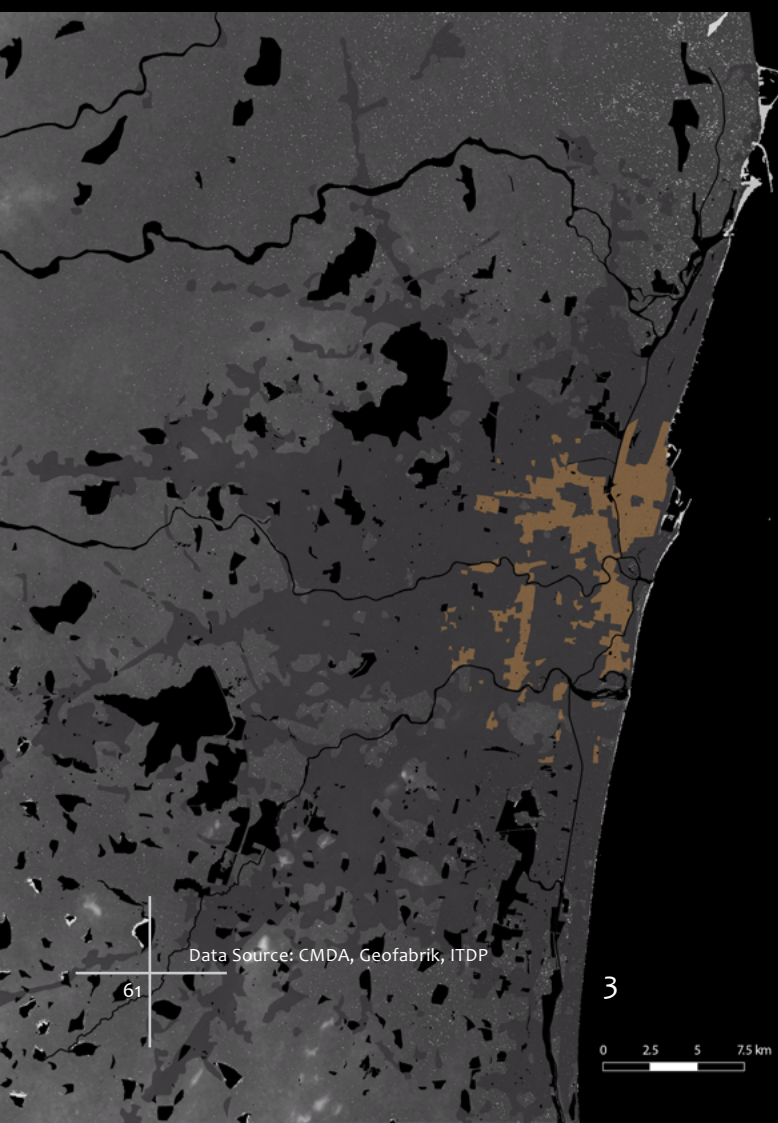
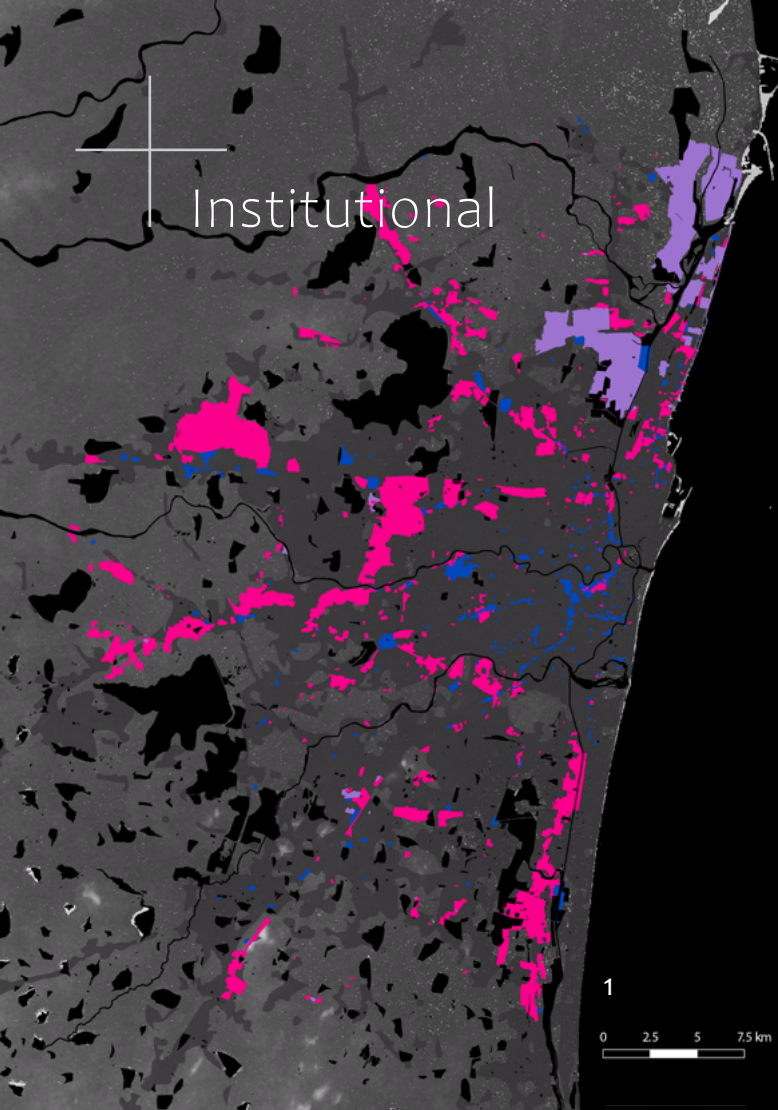
0 2.5 5 7.5 km

## Conclusion

On superimposing the accessibility to mobility infrastructure and the inherent socio-economic characteristics, two contrasting conditions emerge. The vulnerability levels vary socio-economically, between the core areas and the peripheries of the city, making these important variables in distinguishing adaptation measures, as they challenge the self-reliancy and the local economic opportunities and networks within these areas and the contextual values inherent in them.







## MAPS

1. Land use - Developmental
2. Land use - Restricted
3. Continuous Building Area
4. Administrative Boundaries

## LEGEND

- Industrial use
- Hazardous industries
- Commercial use
- Reservoirs
- Wetlands
- Reserved forest
- Redhills catchment area
- CRZ I
- CRZ II
- CRZ III
- Aquifer recharge area
- Open Space Reservation (OSR)
- Continuous Building Area (CBA)
- Village panchayat
- Town panchayat
- Municipalities
- Chennai Corporation
- Water bodies

Source: CMDA, Geofabrik

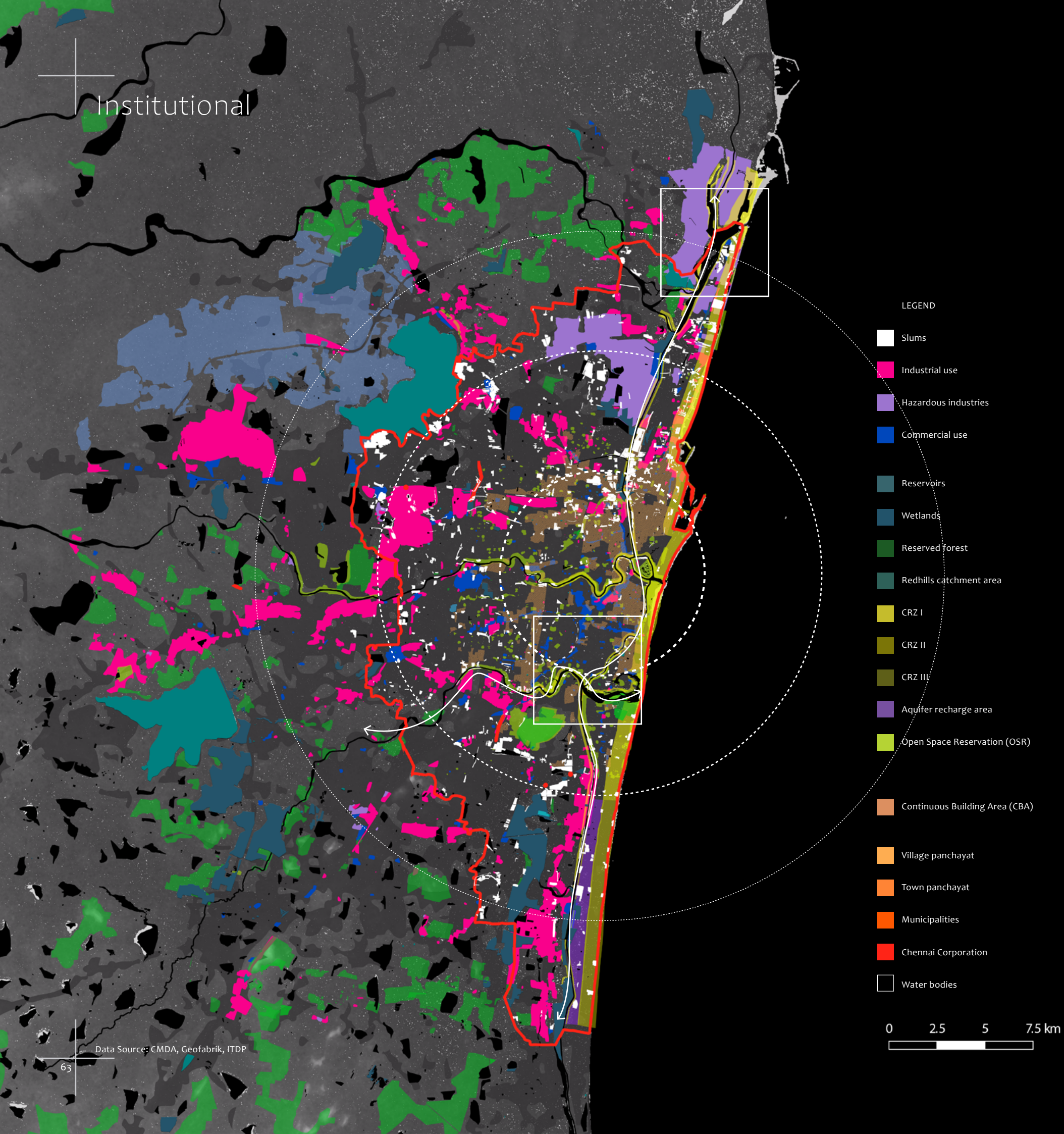
## Assessment

The institutional frameworks, such as administrative boundaries, land use norms and codes play a role in the kind of development that emerges in these areas. Therefore, contextually, these aspects offer different constraints for development, and at the same time, opportunities to build on.

The developmental land use is classified as industrial and commercial areas since these influence and guide other development in the city. The restricted land use is classified as ecologically sensitive areas that pose restrictions in the type of development. This includes Coastal Regulation Zones, Open Space Reservations, reserved forest, catchment area and aquifer recharge area. Some areas witness conflicts of incompatible uses adjacent to one another - with infrastructural and industrial encroachments within ecologically sensitive areas. These increase the vulnerability of settlements in the area.

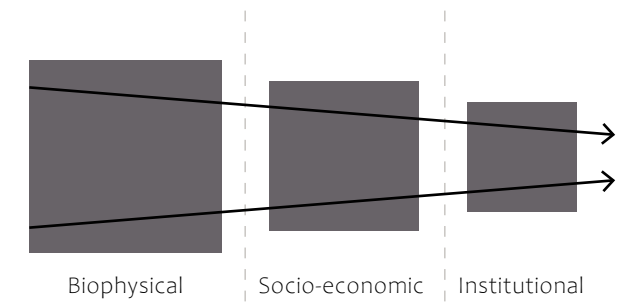
The administrative body of Chennai Corporation which has jurisdiction over the city limits is primarily in charge of overseeing slum policies and development in the city.





## Conclusion

On superimposing the various development controls, areas with conflicting conditions emerge, where there is an industrial or infrastrucural presence in sensitive areas. Therefore, areas that are ecologically sensitive but which are present in different conditions - central high density fabric close to commercial areas within the city, and peripheral low density fabric close to hazardous industrial areas, affect vulnerability of slum populations in different ways. This results in two areas of different conditions of vulnerability.







## Critical cases

### Selection of critical cases

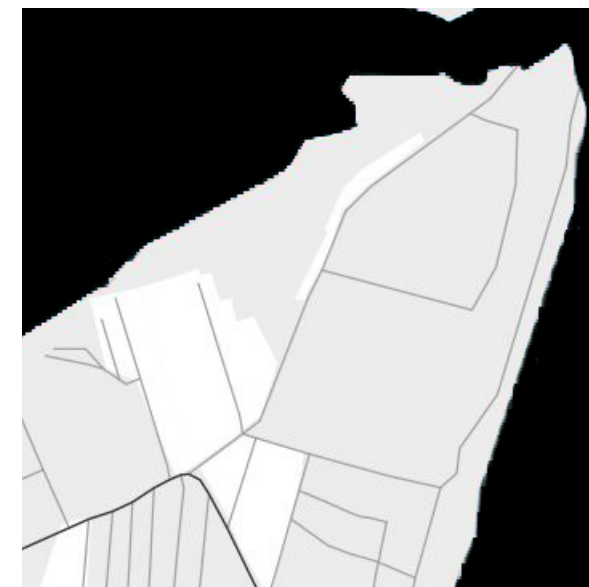
The two cases that have been selected are defined by very different conditions. This has been grouped under differing ecological conditions and urban contexts, and is done so in order to cover a larger variety of contextual and inherent constraints and opportunities that need to be considered while developing adaptation measures.

The characteristics have been presented in a manner that reveals them from the broad generic to the context specific. The actions pertaining to each of these defining characteristics can then be transferred to areas similar to it.

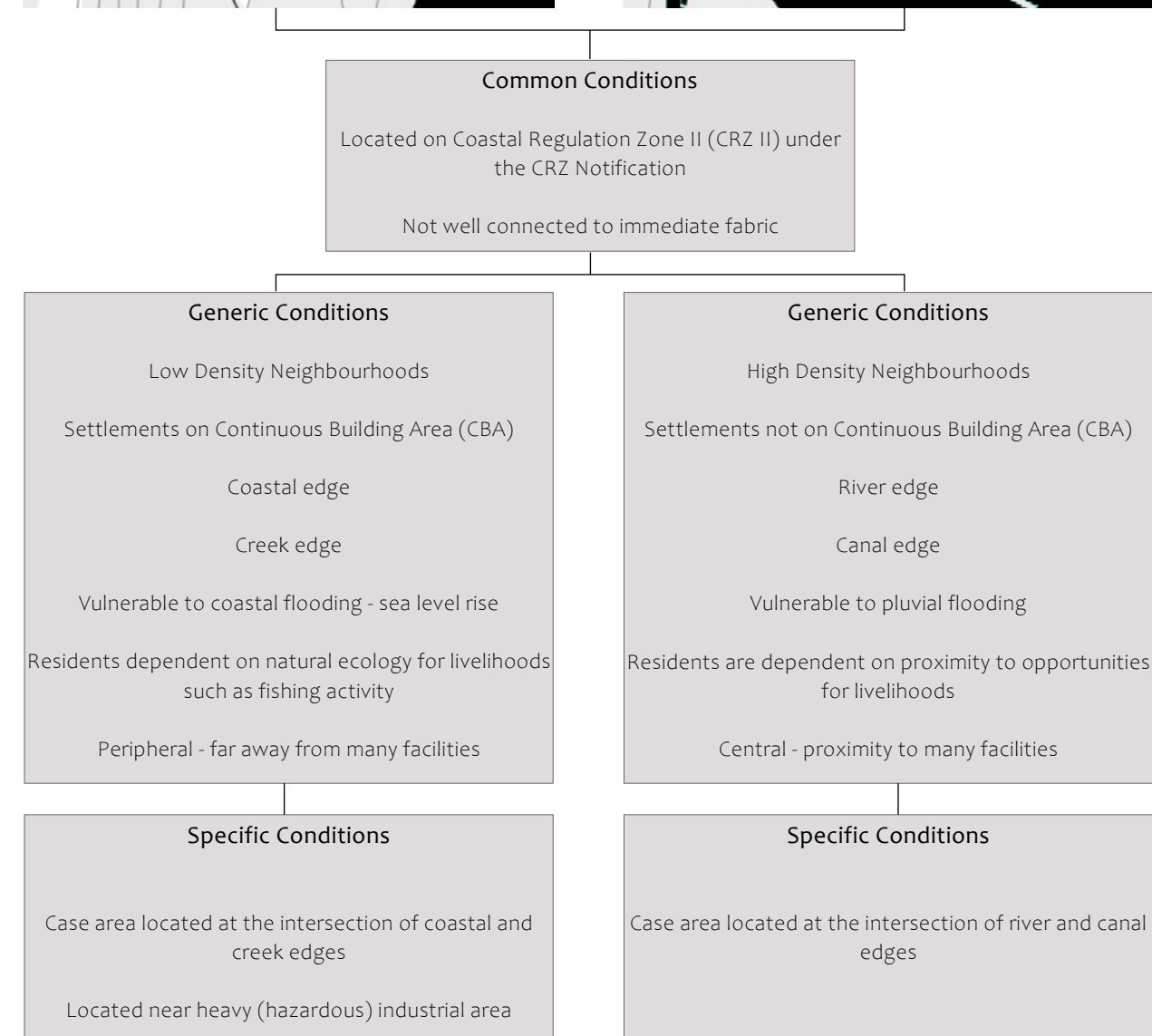
### Conditions for transferability

The two critical cases have some conditions in common and some general characteristics that enable the transferability of proposed measures. There are also some conditions that are very specific to the context.

### Ennore



### R A Puram





## Critical cases

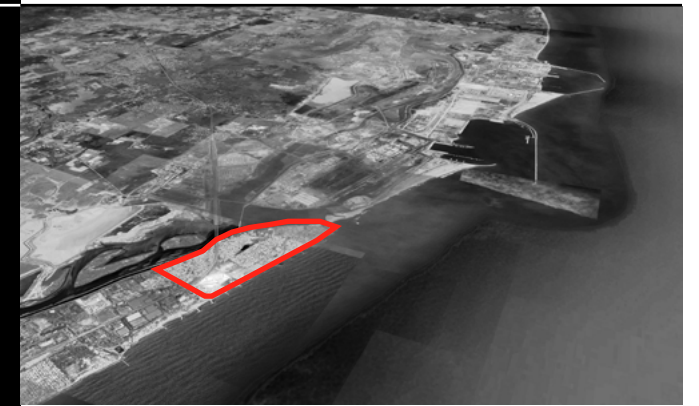
### ENNORE

#### Characteristics

Coastal - sea, creek

Peripheral area

Dependent on the natural resource



Aerial view of the slums between the Ennore creek and the sea

### R A PURAM

#### Characteristics

Inland - river, canal

Central area

Dependent on centrality/location within the city



Aerial view of the slums along the Adyar river and Buckingham canal

0 2.5 5 7.5 km



# 5 Critical Case Analysis

## Introduction to chapter

This chapter attempts to identify the processes and systems that affect the two study areas, both ecological and societal, and delineate the opportunities and challenges within these sites.

This analysis of the cases constitutes:

1. Systemic level - ecological structures
2. Contextual level - metropolitan structure, morphology and functions
3. Local (neighbourhood) level - cultural dimension - living space, economic space and community space

The chapter concludes with outlining the spatial challenges in aligning climate adaptation and local development.

## Contents

- Ennore
- R A Puram
- Conclusions and Challenges

Ennore. Source: Hari Sabanathan. Retrieved from: [www.facebook.com/mycitychennai](https://www.facebook.com/mycitychennai)





# Analysis

## Analysis

The analysis of the critical cases start with the ecological issues and challenges at a systemic level, followed by the understanding of the spatial structure, morphology, and functions in the area at the contextual level. Following this, the neighbourhood is explored in order to understand the spatial qualities and the socio-cultural aspects at a local level. This analysis is framed through the spatial manifestation of local culture.

At the end, the challenges in the ecological and societal domains are coupled in order to reveal the potentialities in linking climate adaptation and local development.

## Elements of Culture

The conceptualisation of local culture into spatial components, as revealed in the conceptual framework are broken down and analysed in the sites.

The components are broadly classified as:  
Living space (housing),  
Economic space, and  
Community space (social space, public space)

In addition, the characteristics of the edges are analysed in order to understand the conditions and constraints in the cases.



Source: Author





Ennore



Source: Author





## Ennore

### Context

Ennore is an area in North Chennai, historically famous for nurturing a healthy aquatic system and being rich in biodiversity, has emerged as a hub for large industries within the last two decades. A number of ports, thermal power plants, factories and coal yards have taken over the landscape.

This neighbourhood was recently incorporated within the Greater Chennai Corporation limits, becoming ward number 1 in the city. What was originally a rich coastal (lagoon) ecosystem holding great significance for the local fisher-folk, has now drastically transformed into a heavily encroached industrial area.

Owing to its environmental and social importance, this region has been classified as an ecologically sensitive area by the Tamil Nadu State Coastal Zone Management Authority (TNSCZMA) under the Coastal Regulation Zone (CRZ) notification of 2011, which restricts any kind of construction and alteration to the natural ecology. However, this region now suffers from various issues - both environmental and social.



View of Ennore creek. Source: Surya. Retrieved from: [www.facebook.com/mycitychennai](http://www.facebook.com/mycitychennai)

Ennore. Source: Aerial Holic. Retrieved from: [www.facebook.com/mycitychennai](http://www.facebook.com/mycitychennai)

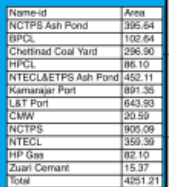
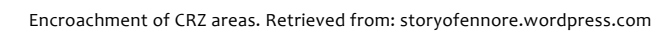




77

Over the last two decades, this area has seen major developments in the name of port infrastructure, thermal power station and industries occupying large chunks of land around Ennore.

The encroachments have reduced the depth and the spread of the Ennore Creek. It has further impoverished the fisherfolk living in these areas in the Mugatwarakuppam, Sivanpadai Kuppam and Kattukuppam, since the diversity of fish that once existed here has now drastically reduced.



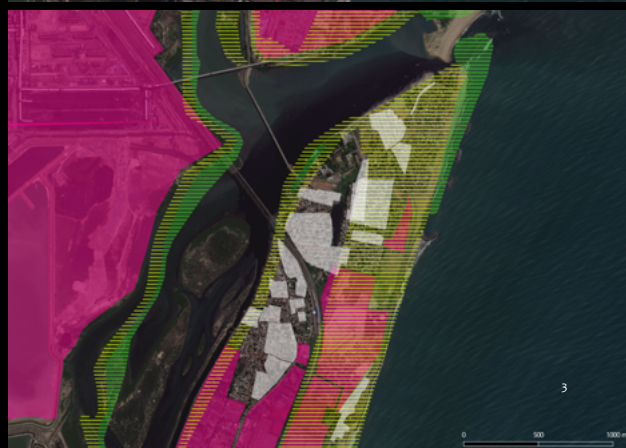


# Ennore



## MAPS

1. Road Network
2. Accessibility to public transport
3. Land use
4. Income level



## LEGEND

- Primary, trunk and corridor roads
- Secondary and tertiary roads
- Other roads
- Bus stops
- Suburban rail stops
- ..... Suburban rail
- 400m radius from bus stops
- 400m radius from suburban rail stops
- Income less than 250: 75-100%
- Income less than 250: 50-75%
- CRZ II
- CRZ I
- Industrial area
- Slums



Source: Google Earth, Geofabrik, ITDP

## Spatial Structure

Ennore is connected to the city by rail and a road network that connects various fishing villages in the area. The fishing villages are surrounded by large infrastructure encroaching upon the wetlands, affecting these communities in multiple ways, one of them being loss of livelihood.

There is a distinct overlap of areas zoned as CRZ and the actual condition - where these are industrial areas.

## Challenges

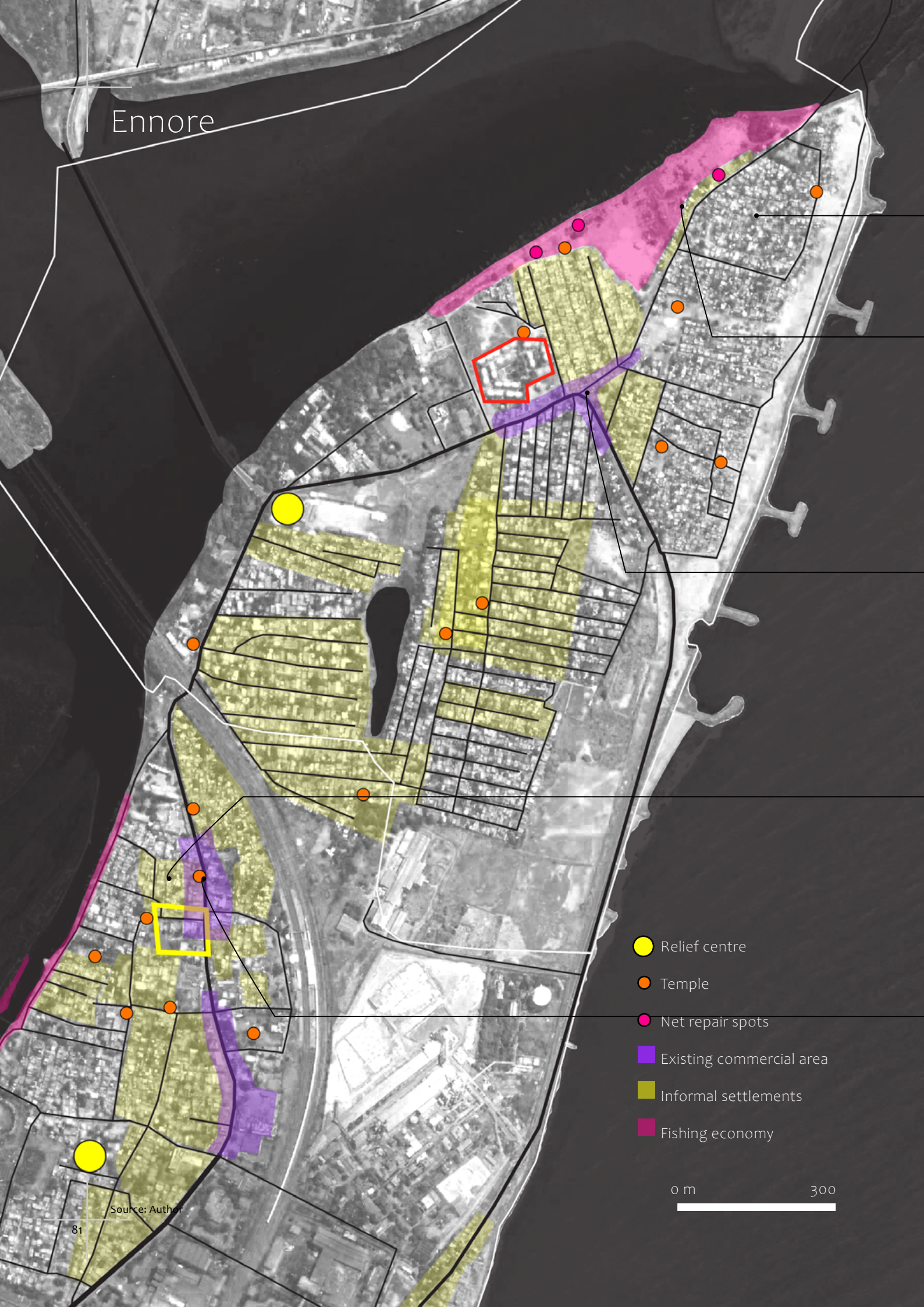
Apart from the pollution in the area caused by dumping of fly ash by TANGEDCO, this region is prone to saline intrusion and flooding as well. The image shows coastal erosion and accretion, changing its morphology over time. This has been addressed by building groynes to prevent erosion. However, there is a need to shift to nature-based solutions in order to address these externalities.



Change in coastal morphology due to erosion over the years, resulting in the addition of groynes

Source: Google Earth





Source: Google, Author

## Housing

There are many fishing villages, or *kuppams*, in Ennore, most of which are densely packed and close-knit communities. They comprise of a mix of permanent and temporary houses, depending on the social and economic status of the residents. In addition, the Tamil Nadu Slum Clearance Board (TNSCB) has constructed 3 tenements in Zone 1 (Thiruvottiyur) for families affected by the tsunami of 2004.

## Social spaces

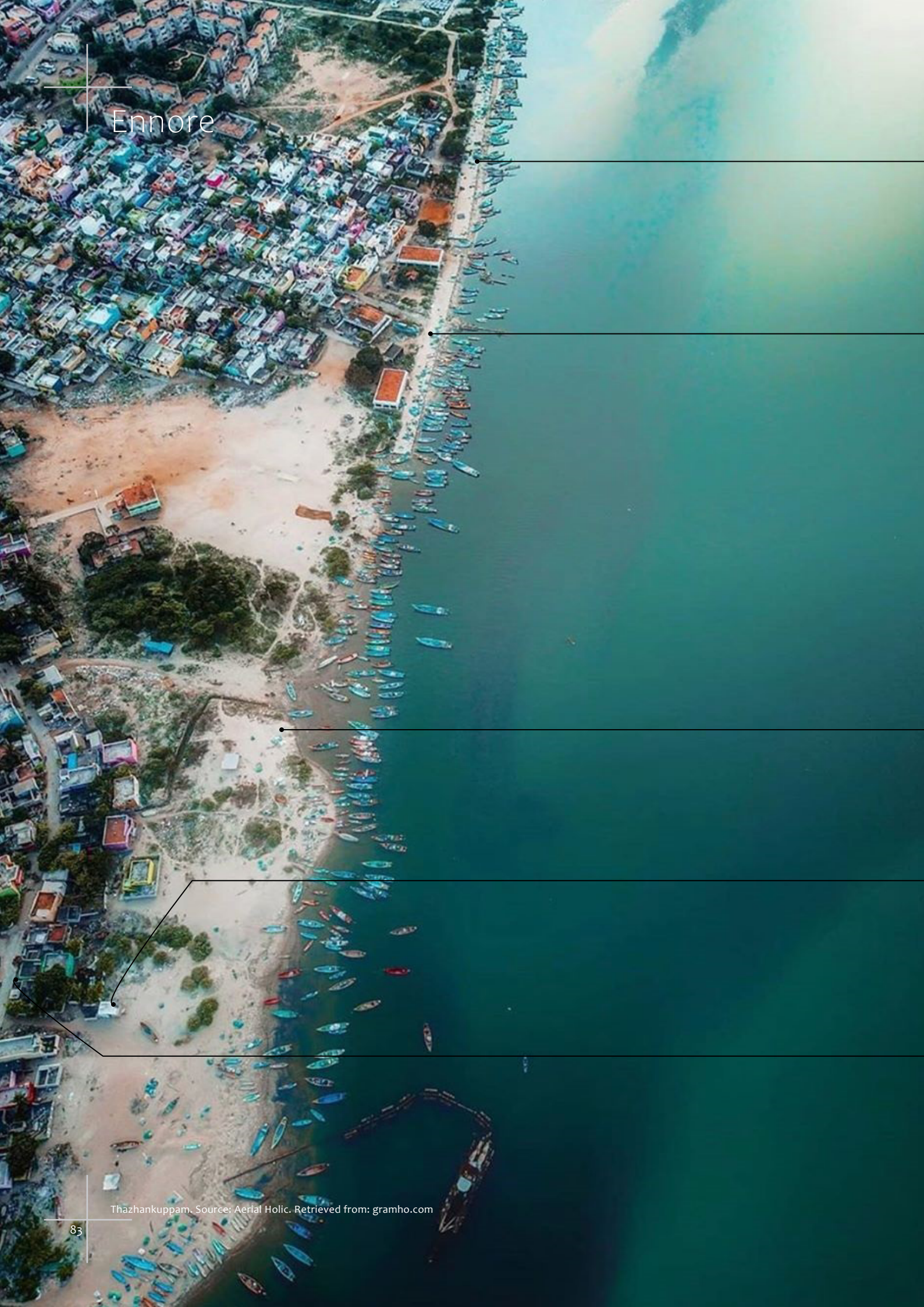
During the interviews conducted, most of the respondents maintained that the primary social space that brought the community together was the temple, especially during the *Thiruvizha*, which means festival in Tamil. Each settlement has a temple within or alongside it.

There is a lack of open green spaces such as parks or playgrounds in these areas and the children play on the streets or on the sand.

## Public facilities

Schools and marriage halls are the large public spaces that are present in this area. These double up as relief centres and evacuation areas, as designated by the City Disaster Management Plan (CDMP), during flooding and other disasters.





Ennore

Thazhankuppam. Source: Aerial Holic. Retrieved from: gramho.com



Source: Google, Author

## Economic space

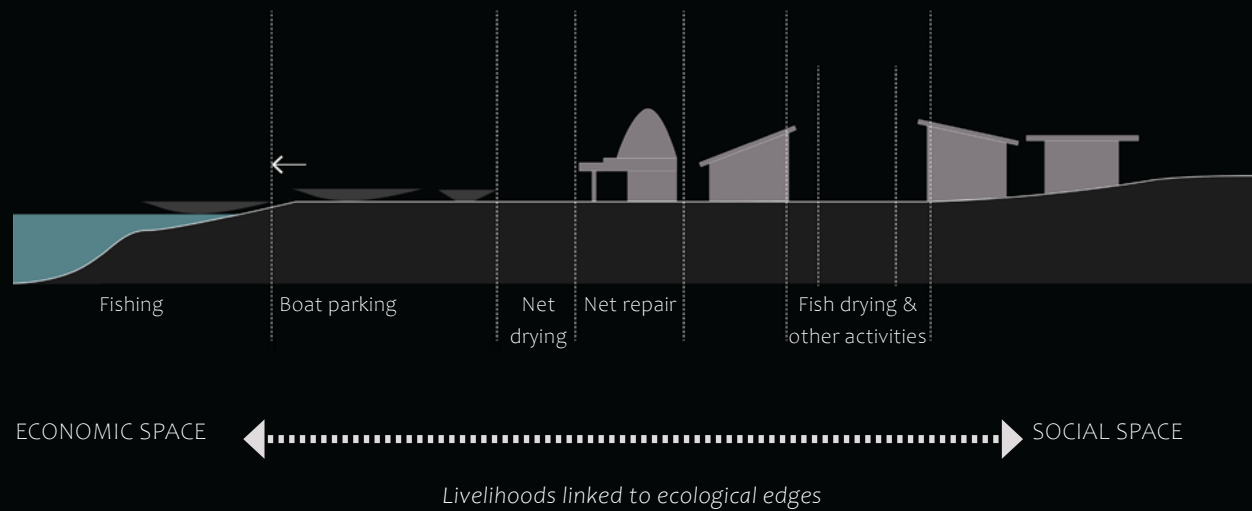
Most of the livelihoods in the area revolve around creek fishing. This is evident in the use of spaces by residents for various activities related to fishing. While the edges are used to house boats and dry nets, smaller semi-open spaces such as sheds and temples are used by the fishermen to repair nets as a group. Several of these spaces can be found closer to the edges of the settlements. Fish are kept for drying outdoors, wherever space is available.

The primary roads linking the different settlements together, is replete with small grocery stores, shops and temporary markets to sell seafood, fruits and vegetables.

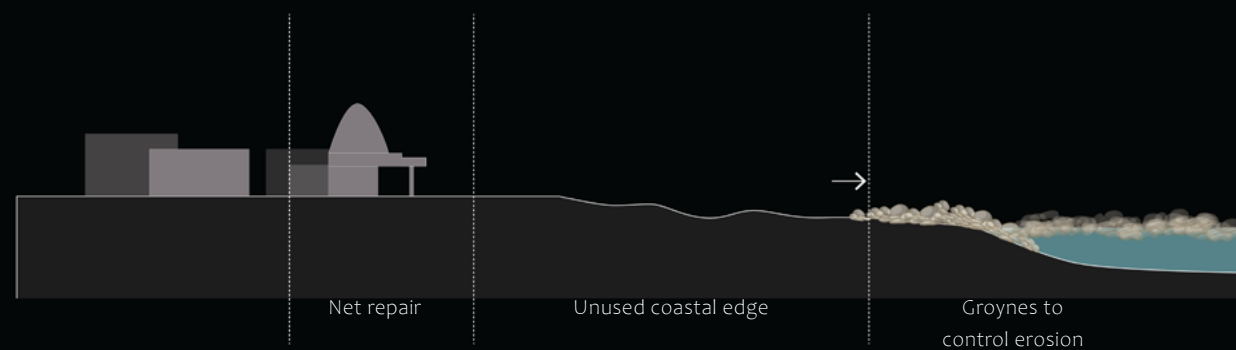
A major challenge for the fisher-folk living along the creek, caused by the reduction in fish species due to the pollution from the industries, is having to travel longer distances to catch fish everyday. While many still continue to engage in fishing as primary occupation, some residents have been employed in the industries and ports in Ennore and surrounding areas. This could also result in a disconnect between the communities and their immediate natural surroundings.



# Ennore



CREEK SIDE SECTION



SEA SIDE SECTION



Source: Author

## Edge Conditions

The Ennore peninsula is surrounded by the Kosasthalaiyar river, the Ennore creek and the Bay of Bengal. The edge conditions vary with each water body. The coastal edge is protected by groynes to control erosion, with a significant chunk of sandy area acting as a buffer between the settlements and the coastline.

Towards the creek, the edge transforms into a carrier of the primary economic activity in the area - creek fishing. The coast, being exposed to erosion and accretion, is used to store boats and dry fishing nets.

In the western edges of the peninsula abutting the river and the canal, the settlements are a lot closer to the water, creating smaller spaces for the fishing activity to take place.

In Ennore, the livelihoods of most of the people are linked to the natural system, making the edges important realms of economic activity, while the social spaces are found within the inner parts of the settlements.





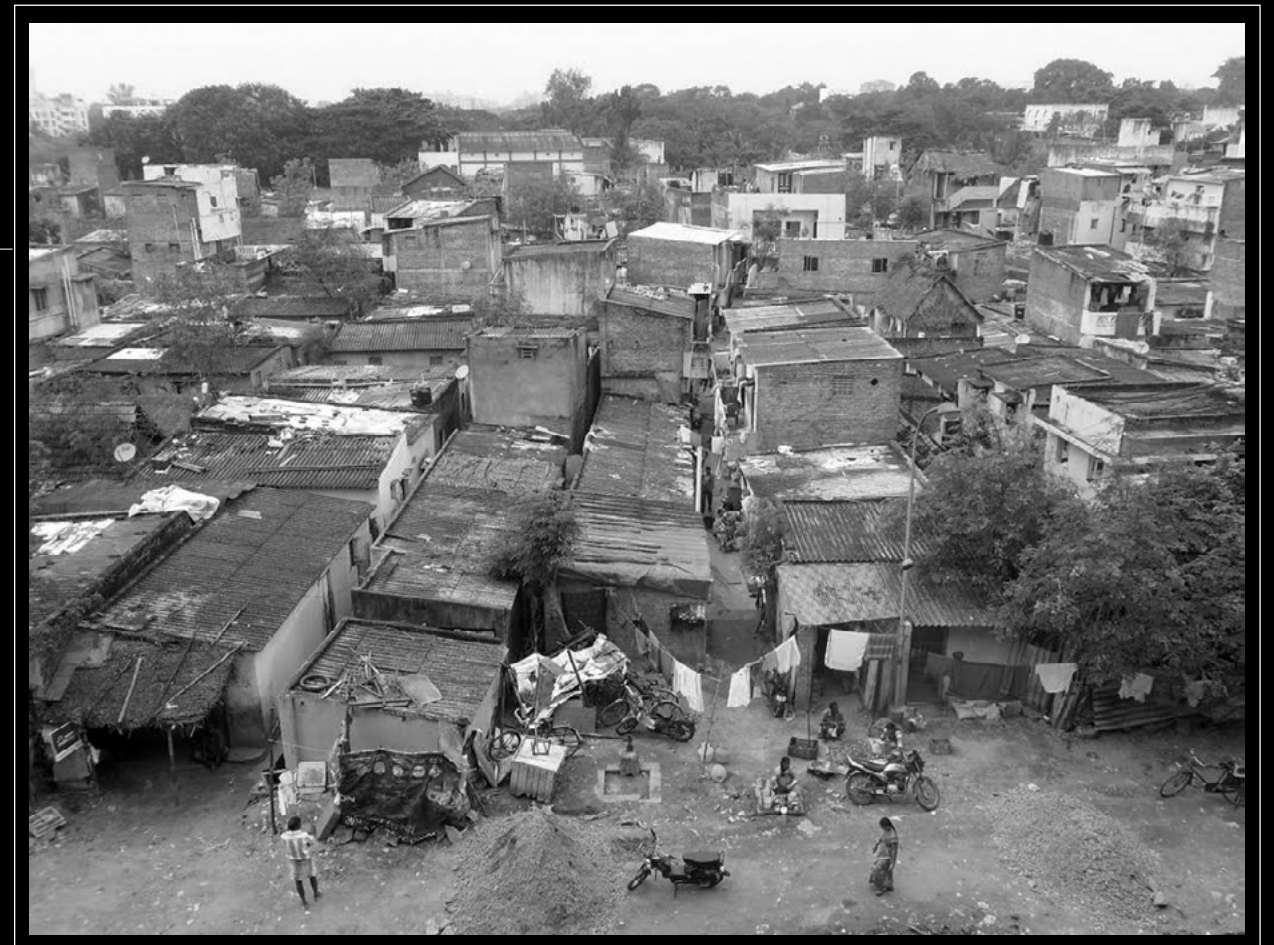
R A Puram



Source: Author

87

0 2.5 5 7.5 km







Aerial view of Adyar river. Source: Rajography. Retrieved from: [twitter.com/ChennaitesDotIn](https://twitter.com/ChennaitesDotIn)

## Context

Raja Annamalai Puram, or R A Puram, is an area in central Chennai, just North of the Adyar river, one of the three rivers flowing through the city. The Adyar river drains into the Bay of Bengal to the East.

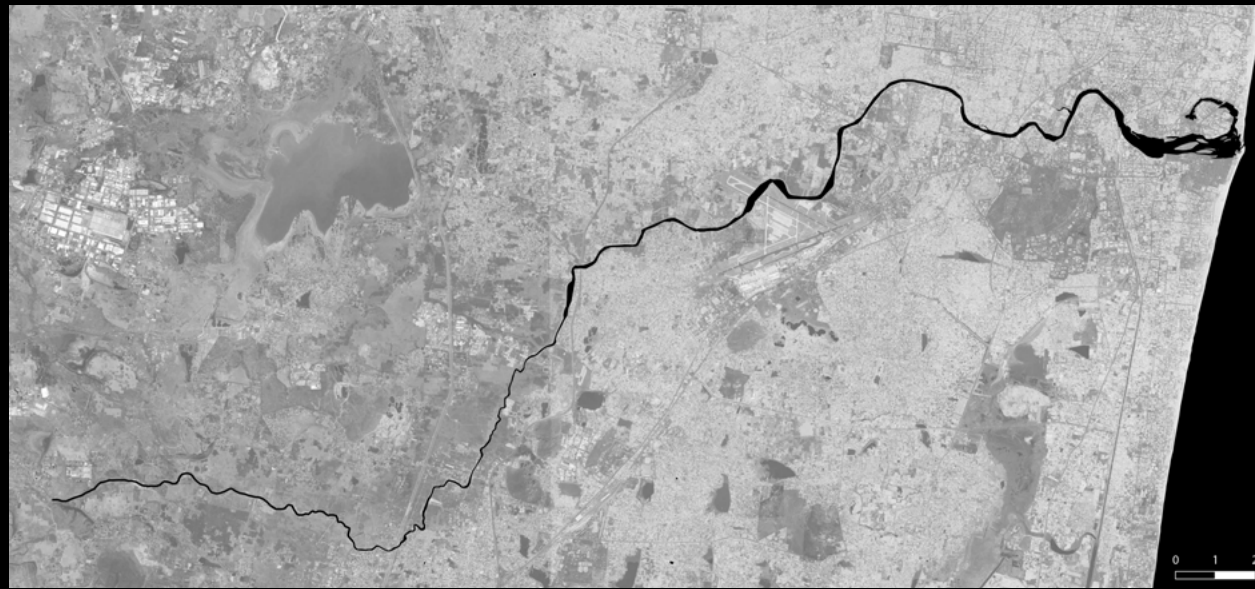
The Buckingham canal, constructed during the British rule, was a freshwater navigation canal running parallel to the coast connecting a district south of Chennai to Andhra Pradesh in the north. The canal is known to be a flood alleviator, playing a major role in acting as a buffer during the tsunami of 2004, reducing the impact on the city and other coastal districts to a large extent.

There are a number of informal settlements found along the edges of the Adyar river and the Buckingham canal. These are found in small patches of land, densely packed and often in unsanitary conditions. Recent initiatives by the government to restore the river and canal have posed eviction threats to several settlements along these bodies.

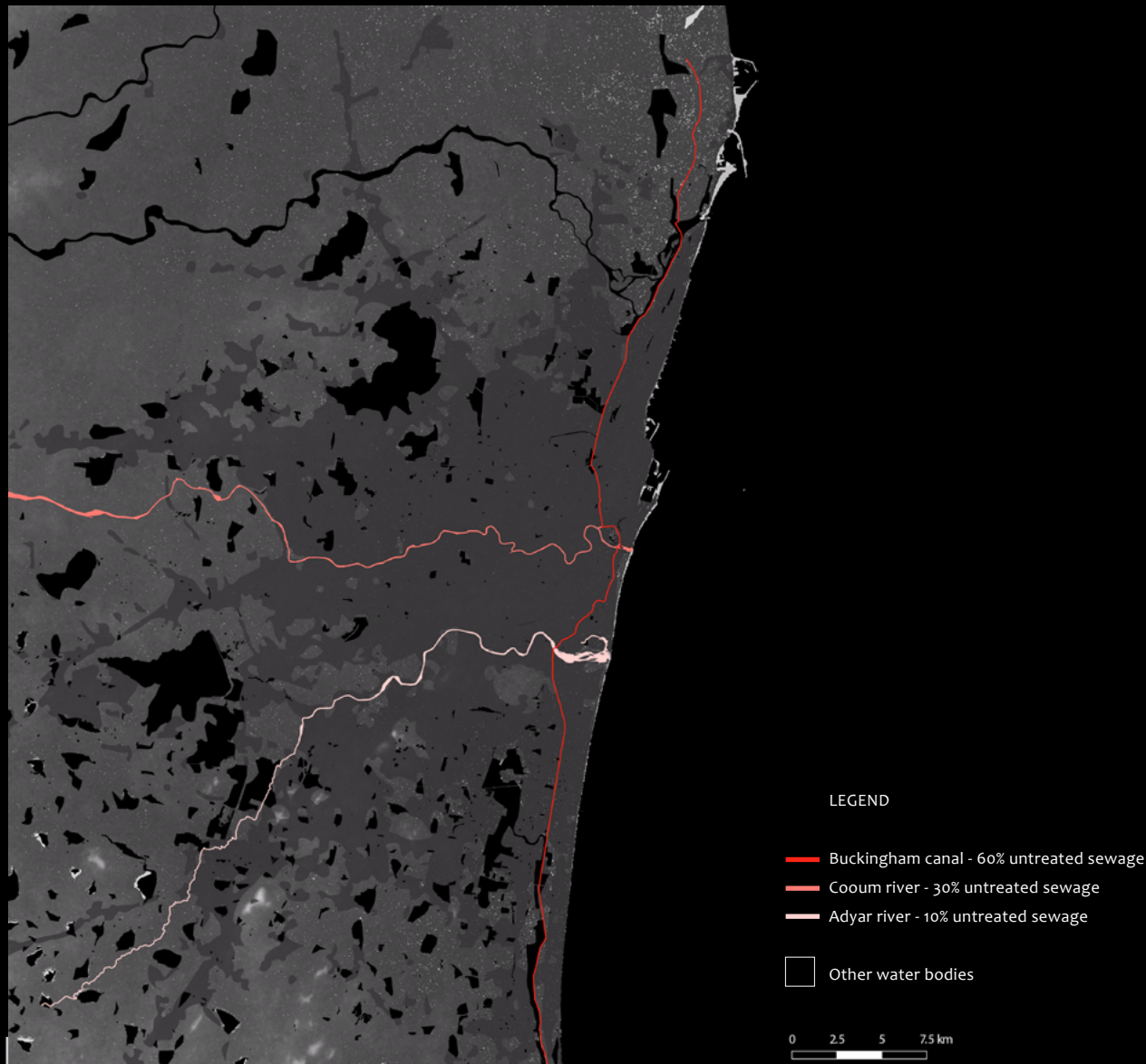


View of settlement from MRTS station. Source: Google Earth. Retrieved from: [mapio.net](https://mapio.net)





Source: Google Earth, Author



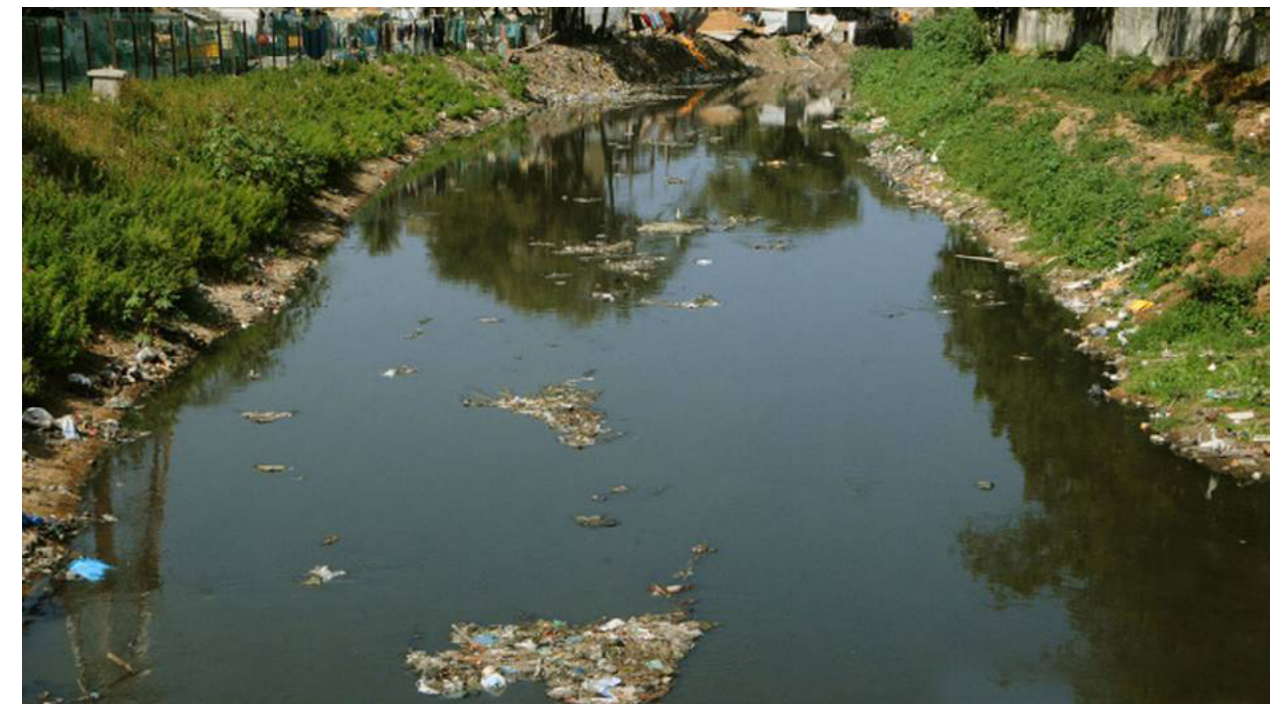
Source: Author

## Ecological Conditions

From the three main channels passing through the city, the Buckingham canal is the most polluted, carrying 60% of untreated sewage in the city followed by the Cooum river, which carries 30% and the rest by Adyar river.

This is contributed to by the Chennai Metropolitan Water Supply and Sewerage Board, as well as government agencies and residents who let out sewage through storm water drains into these channels. The choking of drains with garbage adds to the issue of not just contamination but also flooding.

Moreover, the Mass Rapid Transit System (MRTS) line has been constructed over the Buckingham canal, reducing its width and depth over time. The airport and other such industrial encroachments have contributed significantly to the reduced flood carrying capacity of the river.



Buckingham Canal. Source: R. Ragu. Retrieved from: [www.thehindu.com](http://www.thehindu.com)



# R A Puram



## MAPS

1. Road Network
2. Accessibility to public transport
3. Land use
4. Access to healthcare and leisure services

## LEGEND

- Primary, trunk and corridor roads
- Secondary and tertiary roads
- Other roads
- Metro stops
- Bus stops
- Suburban rail stops
- Metro line
- Suburban rail
- 400m radius from metro stop
- 400m radius from bus stops
- 400m radius from suburban rail stops
- Land Tenure - slums
- TNSCB
- TNHB
- Temple land
- Private land
- Natham
- Poromboke land
- Chennai Corporation land
- Government / PWD / Revenue Department land
- 400m from leisure points
- 400m from healthcare facilities
- Park
- Forest
- Recreation
- Commercial use
- OSR
- Industrial area
- Slums

Source: Geofabrik, ITDP

## Spatial Structure

These settlements lie on the banks of the Adyar river, and are located along the suburban rail station which has encroached upon the canal. The area is critical as it lies at the intersection of the canal and the river.

These slums fall on the OSR land - Open Space Reservation zoned by the CMDA. They are in proximity to commercial centres and public transport, although not well integrated with the immediate fabric.

## Challenges

The morphology of the river edges have changed over time with the river dynamics, and a part of the settlement had been cleared previously due to flooding from the Adyar river.

The area also falls within the Coastal Regulation Zone, which regulates the type of functions permissible at the edges. The river edges must be treated as buffers for flood protection.



2001



2010



2005



2019

Adyar river dynamics. Source: Google Earth





Source: Author

## Housing

Most informal settlements along the water bodies are densely packed and comprise of a mix of permanent and temporary houses, depending on the social and economic status of the residents. The area is characterised by narrow streets, well-shaded and active .

The immediate context comprises of recreational clubs, large independent affluent houses and institutions.

## Social spaces

Like in Ennore, the temples are the primary areas of congregation, mostly during festivals. Social spaces are limited to the streets, which house many activities and blend seamlessly the public and semi-private activities.

Owing to a lack of open space, the children are also seen playing in privately owned empty grounds and defunct spaces along the edges.

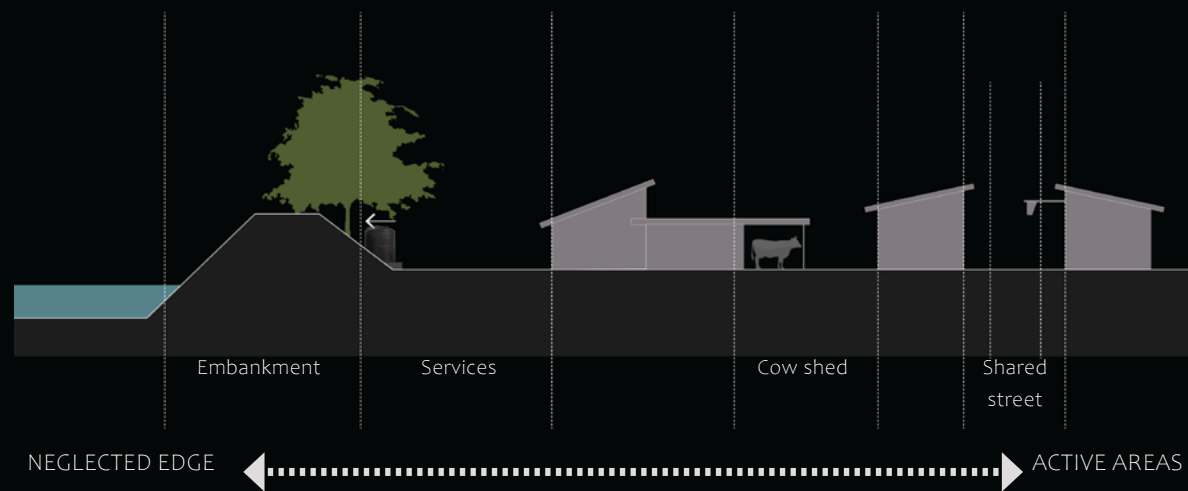
## Public facilities

Schools, marriage halls and railway stations are the large public spaces that are present in this area. These double up as relief centres and evacuation areas, as designated by the City Disaster Management Plan (CDMP), during flooding and other disasters.

## Local economy

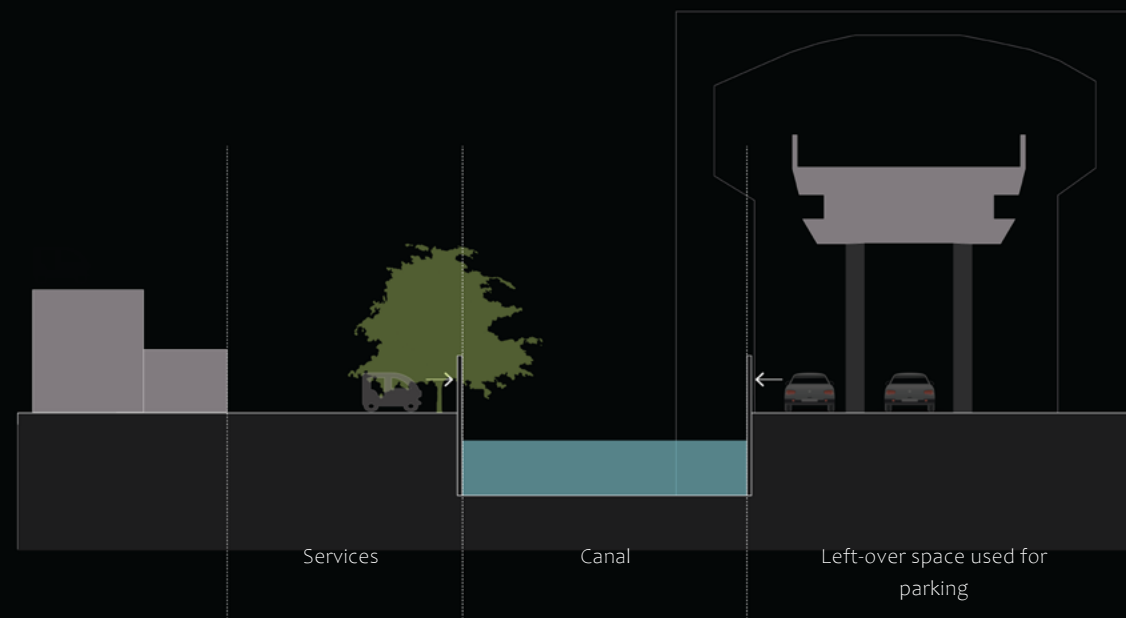
The residents in this area are engaged in different jobs such as construction labour, auto-rickshaw driving, household work and other daily wage jobs. The local economy does not relate to the natural ecology. Therefore, due to a lack of activity and ownership of the edges, the relationship between the community and the water bodies is strained.





Livelihoods linked to ecological edges

RIVER SIDE SECTION



CANAL SECTION



Source: CMDA

## Edge Conditions

The edge of the settlement that faces the Buckingham canal has little to no interaction with the canal itself; instead, the canal walls block any view to the canal and the MRTS station encroaches upon the canal. The space under the MRTS line is unused except for parking certain vehicles. The edge of the canal along the station is also used for parking vehicles and garbage disposal.

The river edges have been raised to form embankments to protect the communities living in this area. Therefore, the interaction with the river is also minimal. These edges have few residences facing the river, forming a backyard for the settlement.



# Conclusions & Challenges

## Linking Ecological & Social Challenges

### ENNORE

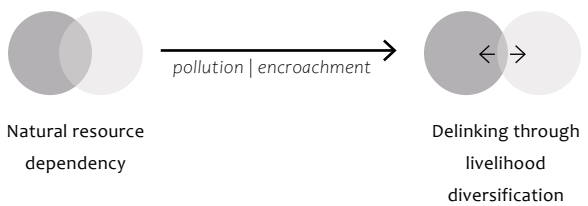
#### Ecological

- Ecology health**
- Wetland degradation with increasing industrial encroachment
  - Pollution of creek with fly ash
  - Saline intrusion
  - Loss of biodiversity
- Climate**
- Flooding by sea level rise
  - Reduction in creek width, alteration of hydrology pattern through encroachment

#### Social

- Living space**  
Densely packed and monofunctional
- Economic space**  
Reduction in fishing as a source of livelihood, and local economic identity
- Community space**  
Lack of sufficient public spaces that cater to different groups

### Society + Ecology relationship



### R A PURAM

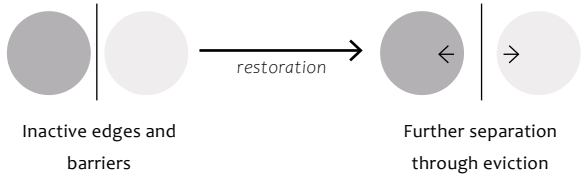
#### Ecological

- Ecology health**
- Pollution of the canal by different industries, and the releasing of untreated sewage disposal into the river by residential areas
- Climate**
- Flooding along the Adyar river with varying intensity of rainfall
  - Encroachments along Buckingham canal - reduced flow of water

#### Social

- Living space**  
Densely packed and separated from immediate fabric
- Economic space**  
Lack of facilities for local economic activity to thrive
- Community space**  
Lack of quality public spaces and accessibility of the edge

### Society + Ecology relationship

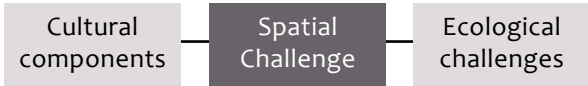


## Conclusions

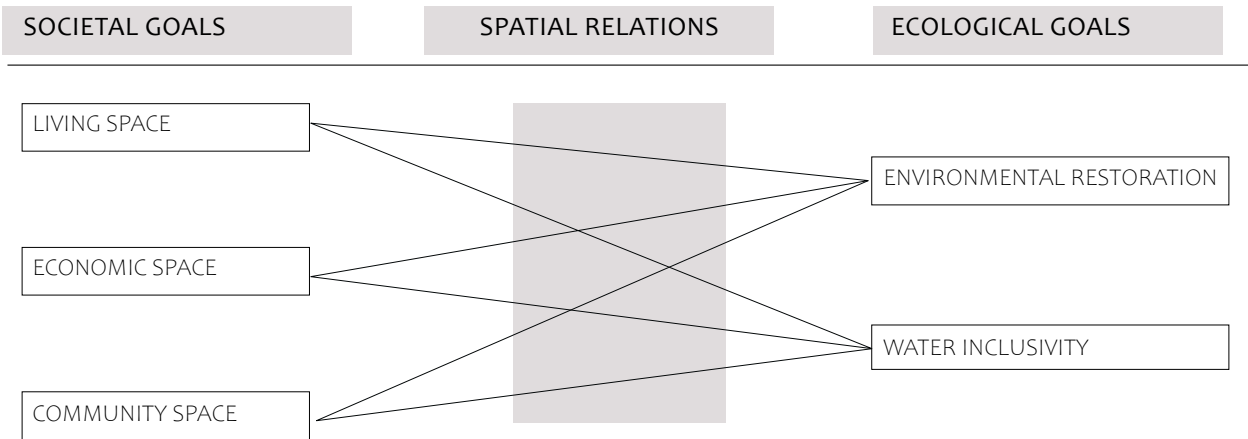
This chapter reveals the various challenges that the cases face, from the systemic level to the local level, and in both the ecological and societal domains. What is evident in both the cases, is the strained relationship between the society and ecology, due to different factors. This necessitates the linking of climate adaptation with local development, that considers the relationship between the cultural components and the ecological challenges. This coupling is encouraged in order to increase the reciprocity and relationship between the two systems, and to make the adaptation process more spatially just.

First, the main aim is postulated and the spatial challenges are outlined, connecting the two systems. Subsequently, the adaptive planning framework is framed with the definition of overall systemic goals and specific contextual goals, in order to facilitate a clear vision and direction.

The challenge lies in the spatial translation of the relationship between the cultural components and the ecological challenges through the linking of societal and ecological goals.



## Coupling the social and ecological systems





# 6 Systemic Operability

## Introduction to chapter

This chapter facilitates the sequential unveiling of the adaptive planning framework. It outlines the main aim of the framework, generic systemic goals at different scales and subsequently, reveals the strategic specific goals for the critical cases. In addition, it discusses the stakeholders that are currently involved in processes relating to the systemic change and those that need to be included in the shift to adaptive planning.

The main components of the adaptive planning framework are clearly set out goals, both systemic and societal, and the involvement of a diverse set of actors in carrying out adaptation measures.

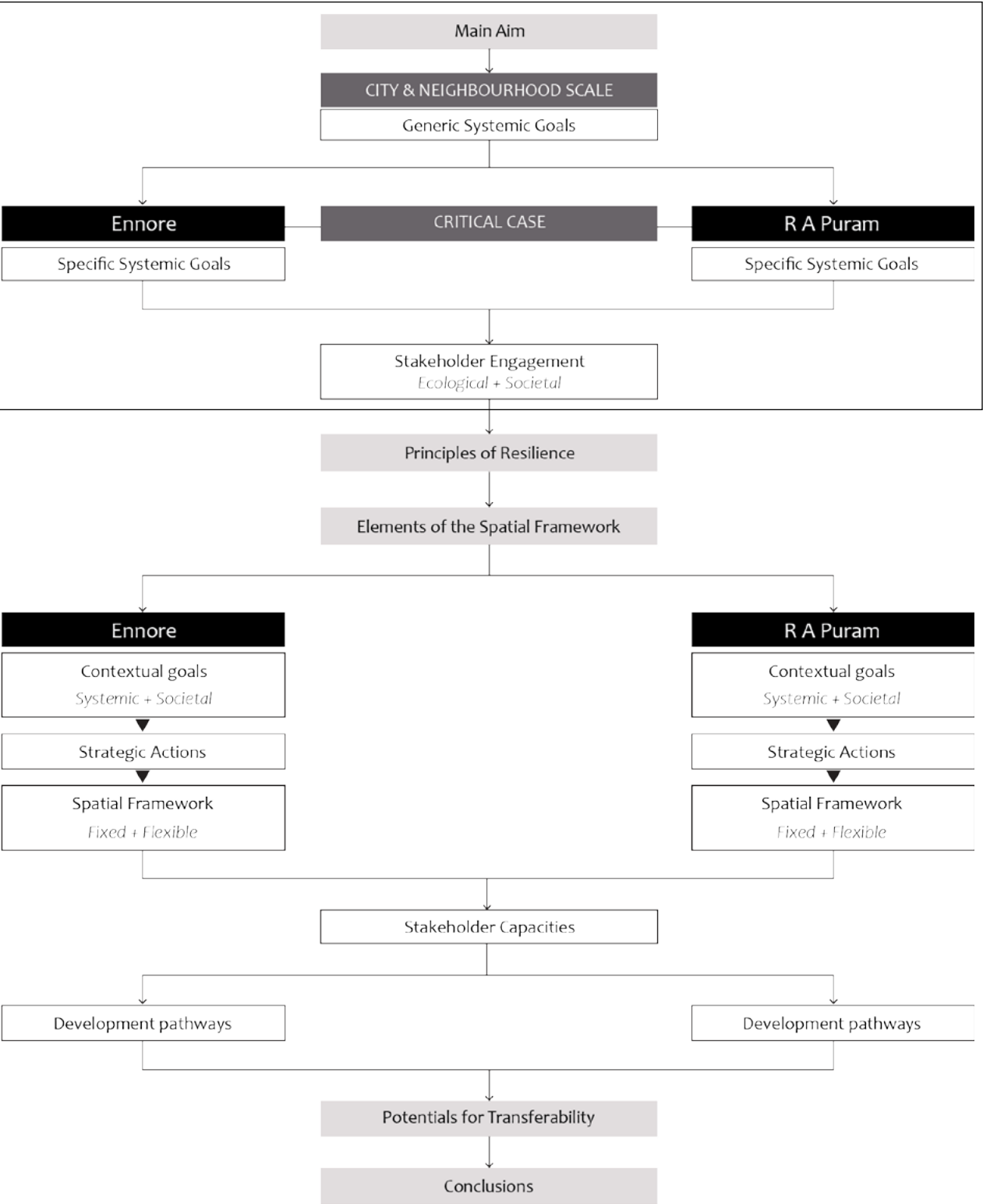
## Contents

- Planning Operability
- Systemic Goals
- Stakeholder Engagement

Aerial view of Chennai during 2015 floods. Source: Veethika. Retrieved from: [wikimedia.org/wikipedia/commons](https://commons.wikimedia.org/wiki/File:Chennai_floods_2015.jpg)



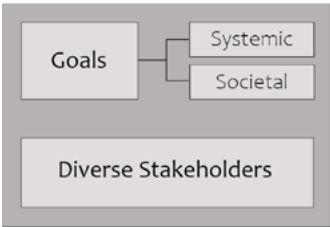
# Planning Operability



## Introduction

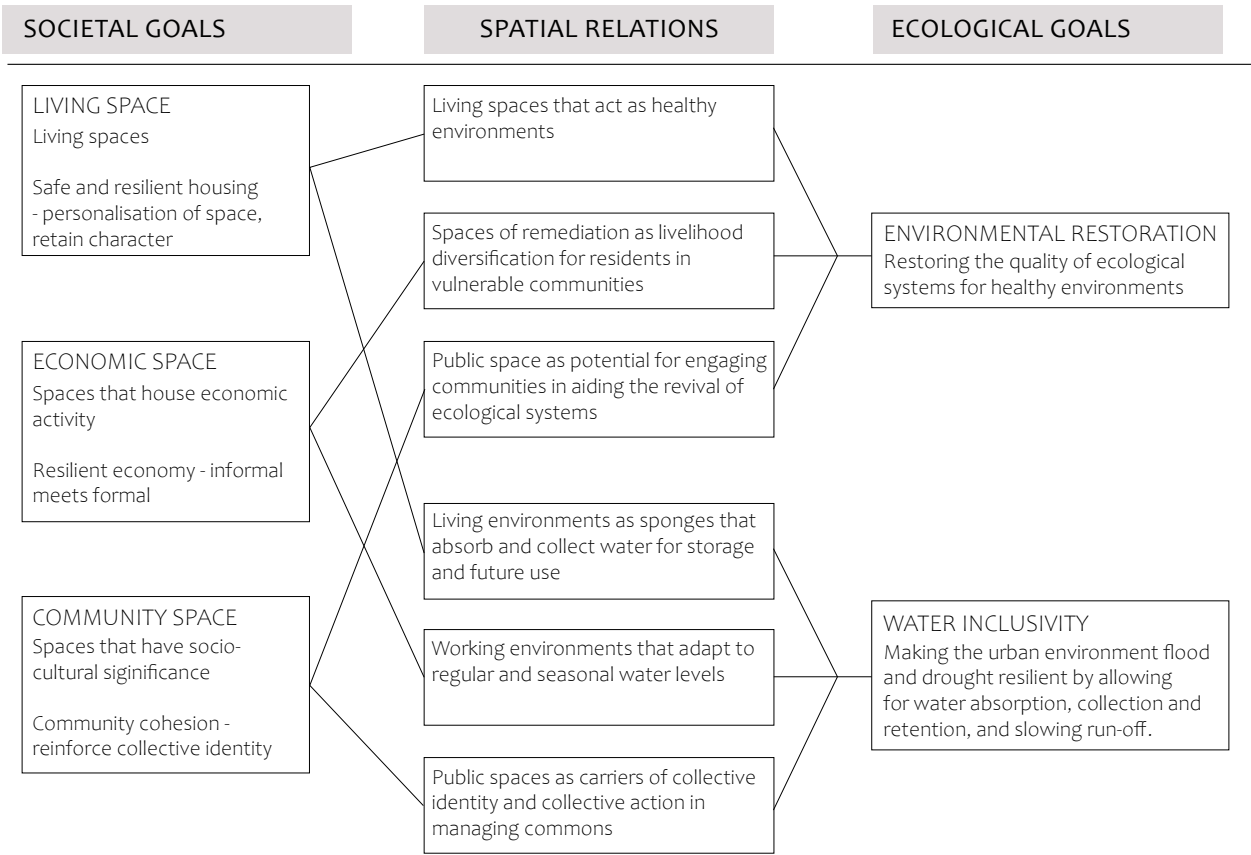
The methodology proposed in this thesis, as explained in the diagram, will be expanded in the following chapters. In continuation of the previously discussed challenge of coupling climate adaptation and local development, the main aim is postulated. Spatial relations between the cultural components and ecological challenges are defined.

Subsequently a systemic vision is developed, comprising of generic goals formulated at the city and neighbourhood scale. Following this, the specific systemic goals within the contexts of each critical case are delineated. The stakeholders involved in both levels are revealed, in an aim to highlight the interactions required to bring about change at different scales.

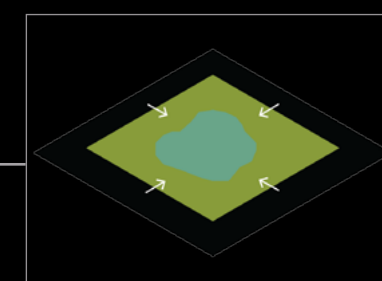
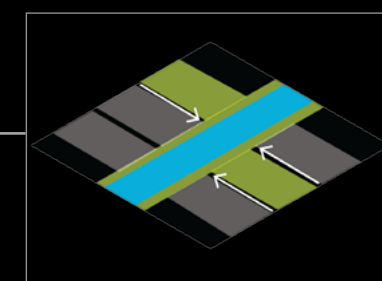
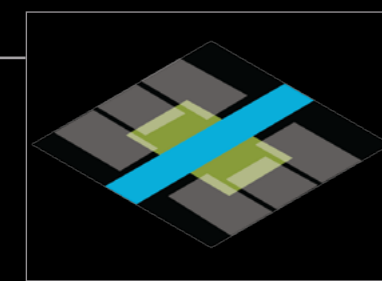
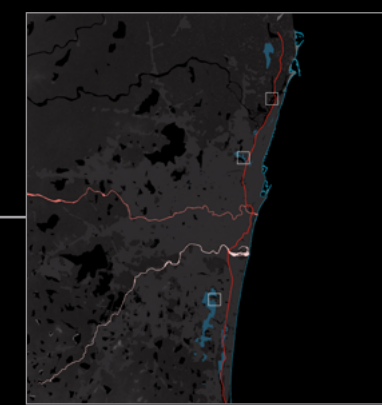
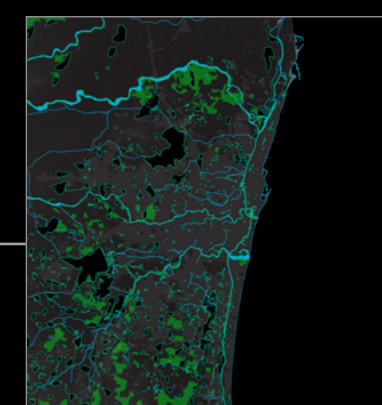
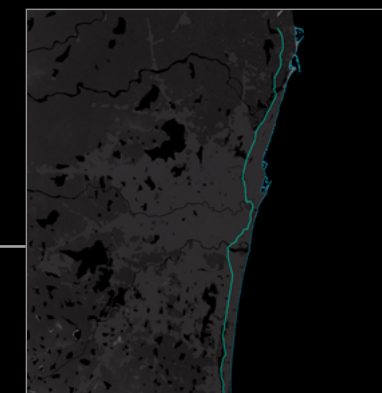
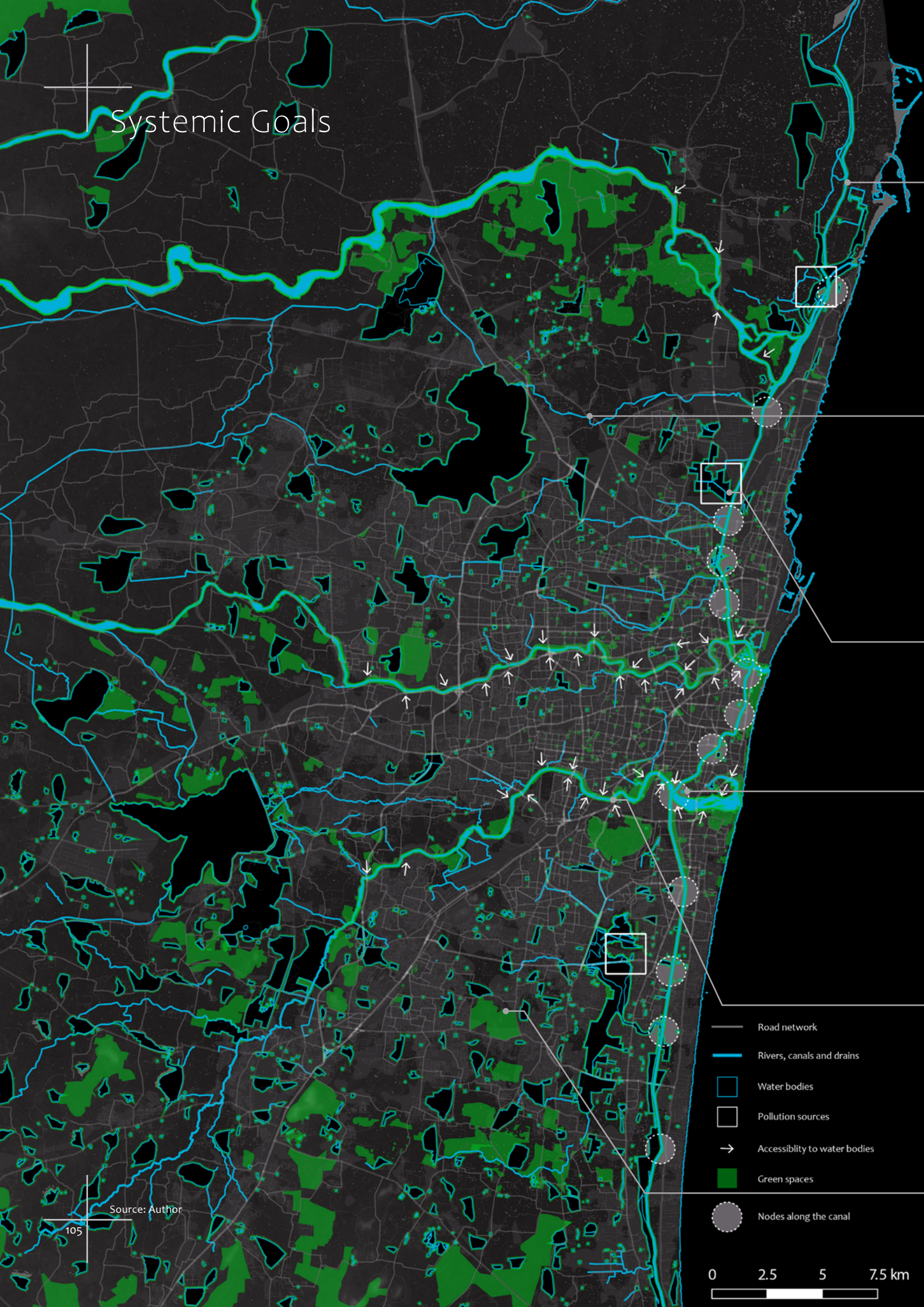


Components of the Adaptive Planning Framework

## Systemic Coupling







## City scale Vision

The goals outlined relate to both the ecological systems at the larger scale and the interaction of society with the ecology at a smaller scale.

The ecological concerns at a large scale are of respecting the geology and hydrology of the region and addressing the specific watershed as one delves into the local scale. At the micro scale, it relates to the edges of interaction between people and the water bodies.

## Generic Goals

### CITY SCALE

Canal revitalisation as a continuous channel, connecting the city locally, acting as flood alleviator

Network of green spaces connected to primary waterways in the city, absorbing and recharging ground water, while slowing run off

Environmental remediation of contaminated areas

### NEIGHBOURHOOD SCALE

Nodes along the canal that have different identities and economies within the informal settlements

Waterways in the city made more accessible to the residents by creating edges that house social, cultural and economic activities

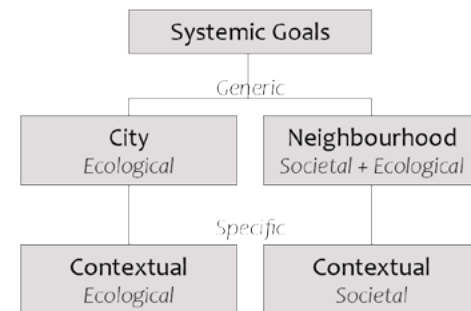
Smaller green/blue collection/absorption points activated through facilitating social and cultural links



# Systemic Goals

## Scaling down

The systemic goals outlined at the city scale, which focus on the ecological challenges, are translated into contextual ecological goals at the critical case areas.



## Ennore

Re-mediate surface and ground water resources to remove heavy metal contamination of water and soil

Revive aquatic ecosystem and biodiversity of Ennore creek

Increase perviousness of ground in order to recharge ground water and alleviate flooding

Facilitate ecological edges as flood buffer zones and promote development on higher ground



Source: Google Earth, Author

## R A Puram

Restore quality of water in the Buckingham canal

Revive health of ecosystem and biodiversity of Adyar river

Increase perviousness of ground in order to recharge ground water and alleviate flooding

Facilitate ecological edges as flood buffer zones to facilitate tidal flows and promote development on higher ground



Source: Google Earth, Author

## Contextual Goals

Some of the goals specified for each case are common. For example, increasing perviousness of ground in order to recharge water is a common goal between the cases and are transferable to other cases as well, at the contextual scale. Another commonality is the need to facilitate ecological edges as buffer zones. However, these vary in nature and width with the context. Therefore there are specificities in the operability of the goal. That being said, the goals here outline directions for different actions to follow suit.



# Stakeholder Engagement

## Introduction

Having outlined the aims and systemic goals, the next step focuses on the decision-making process involved in the system. The two main ecological goals - environmental restoration and water inclusivity have a number of stakeholders involved at different levels. They are broadly classified in five categories -

- public sector
- private sector
- non-governmental organisations
- research and academia
- community groups

A power-interest analysis for each goal reveals the existing stakeholders involved in the decision-making process at different levels.

## Stakeholders Involved

On analysing the stakeholders involved in the ecological goals relating environmental restoration and water inclusivity, it is understood that most of the control remains with the city and state governments with the exception of the Greater Chennai Corporation (GCC), which coordinates development within the corporation limits, even for rivers that go well beyond the limits of the corporation.

Private actors such as planners, architects and engineers, and even residents are a part of the consultation process, but do little in execution. In some areas, NGOs and NPOs such as the Environmentalist Foundation of India (EFI) and Care Earth Trust (CET), that are concerned with conservation of the environment, are getting more involved with the government bodies in different projects.

There is a need to further delegate planning, control and management at lower levels in order to establish a synergistic relationship with the environment.

Environmental restoration - existing



Water inclusivity - existing



## Levels of Governance

### State

- Government of Tamil Nadu (GoTN)
- Tamil Nadu Pollution Control Board (TNPCB)
- Tamil Nadu Coastal Zone Management Authority (TNCZMA)
- Tamil Nadu State Disaster Management Authority (TNSDMA)
- Tamil Nadu Public Works Department (TNPWD)

## Roles & Responsibilities

- State governing authority, finance
- Monitoring pollution
- Management and monitoring of CRZ
- Coordination of disaster response, risk reduction
- Execution, maintenance and monitoring of public buildings and services

### City

- Chennai Metropolitan Development Authority (CMDA)
- Chennai Rivers Restoration Trust (CRRT)
- Chennai Metro Water Supply and Sewerage Board (CMWSSB)

- Master planning, area development, regulating construction
- Development, maintenance and conservation of rivers
- Provision of water supply and sewage treatment

### Municipal

- Greater Chennai Corporation

- Civic governing body within corporation extent

### Local (Non-governmental)

- Private companies
- Planners
- Urban designers
- Architects
- Landscape architects
- Engineers
- Developers/Builders
- Research/academia
- NGOs
- Residents



# Stakeholder Engagement

## Proposal

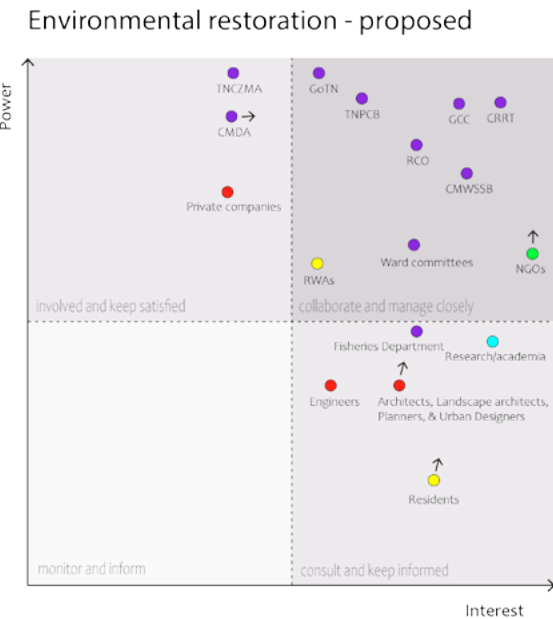
The proposed additions to the processes primarily include civil society representatives in not just consultation, but also in the implementation and management of projects. Additionally, more private players could be incentivised to take up responsibilities in execution and funding. There is also a need to decentralise government responsibilities and give more power to ward committees at a local level that are more in tune with the needs and concerns of the residents. This requires ward committees to be equipped with planners in order to coordinate the efforts at the local level.

The Resilient Chennai Office (RCO) could be the key agency to drive the coordinated development of water systems and vulnerable areas, along with disaster management efforts. The Fisheries Department could be involved in guiding restoration efforts of water systems in the city.

## Conclusion

This chapter has elucidated the need for clear goals and diverse stakeholders to act on them, on a systemic level focusing mainly on the ecological challenges. This needs to be aligned with the local development that takes into account the cultural components of the system. Therefore the next step is to define the societal goals and enable the translation of the goals to the specific cases.

- LEGEND
- public sector
  - private sector
  - non-governmental organisations
  - research and academia
  - community groups



## Goals

Canal revitalisation as a continuous channel, connecting the city locally, acting as flood alleviator

Network of green spaces connected to primary waterways in the city, absorbing and recharging ground water, while slowing run off

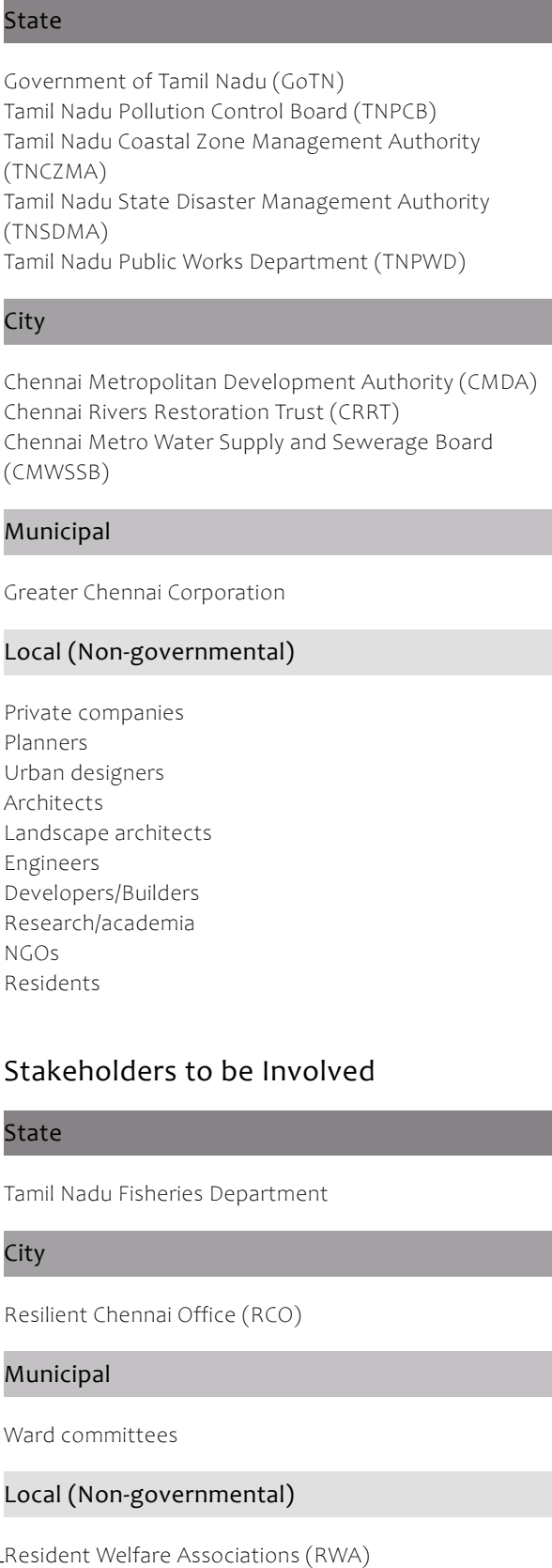
Environmental remediation of contaminated areas

Nodes along the canal that have different identities and economies within the informal settlements

Waterways in the city made more accessible to the residents by creating edges that house social, cultural and economic activities

Smaller green/blue collection/absorption points activated through facilitating social and cultural links

## Stakeholders Involved



Existing links  
Proposed links



# 7 Local Adaptation

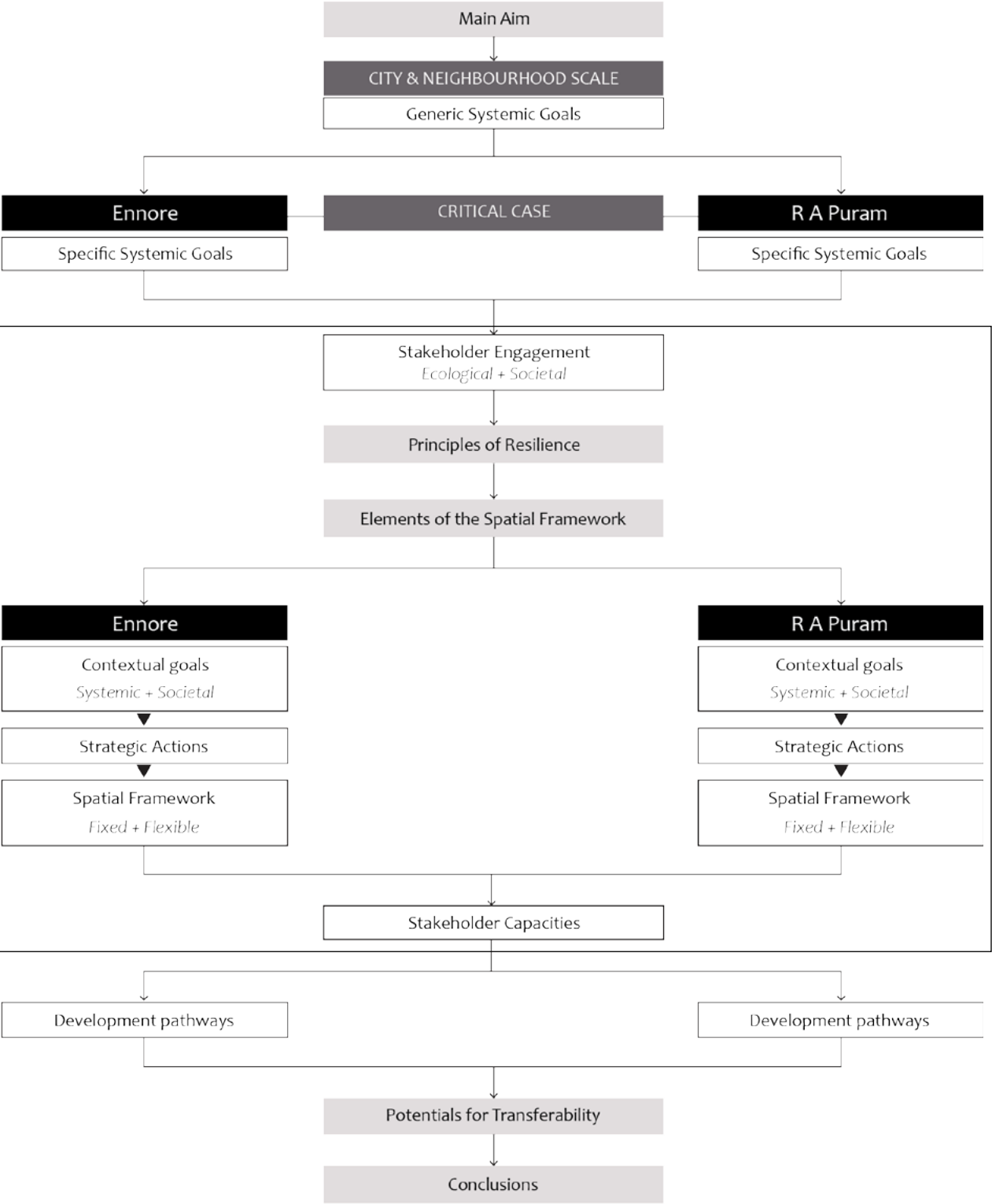
## Introduction to chapter

This chapter discusses the local adaptation strategy of the vulnerable communities to the systemic challenges through clearly defined systemic goals outlined in the previous chapter. Following the analysis of the stakeholders in the cultural domain, specific stakeholder relations are proposed. The spatial framework is revealed, which translates the goals into actions that follow spatial rules and principles of resilience. Through this spatial framework, the critical cases are explored. The chapter concludes with the desired changes in the capacities of the stakeholders aligned to the goals and measures.

## Contents

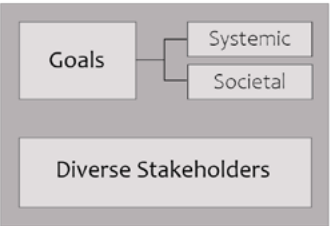
- Planning Operability
- Stakeholder Engagement
- Elements of the Spatial Framework
- Stakeholder Capacities
- Adaptation Measures
  - Ennore
  - R A Puram
- Key Stakeholders and Incentives





Introduction

The adaptive planning framework necessitates the inclusion of both systemic and societal goals and actors, in order to achieve spatial justice. This requires a scaling down of the project to the neighbourhood and ward level in order to reveal the stakeholders that need to be involved in carrying out local development.



Components of the Adaptive Planning Framework

The local adaptation of vulnerable communities to climate threats is achieved by the linking of the societal goals with the ecological goals through space. This chapter attempts to do the following:

- Reveal the stakeholders required in the cultural dimension - living space, economic space and community space
- Formulate the spatial framework rules and principles that guide the local development and thereby facilitate the building up of a resilient system
- Propose specific actions in each critical case that respond to the different goals and desired capacities of actors involved and reveal the incentives used to facilitate it



# Stakeholder Engagement

## Stakeholders Involved

Currently, the three components of living space, economic space and community space do not function as separate entities. Instead, when it comes to housing the urban poor, only the living environment is taken into account with attempts to address community development. This community development is proposed through NGOs. In this analysis the three components are taken separately in order to understand the separate function of each. The primary control remains with the government agencies - depending on the component. Residents are involved, to an extent, in consultation but public engagement is mostly carried out as a means to communicate plans and not involve them in the decision-making process. The private sector (architects and urban designers) are rarely engaged in providing affordable housing of good quality.

- LEGEND
- public sector
  - private sector
  - non-governmental organisations
  - research and academia
  - community groups



## Levels of Governance

| State                                   |
|-----------------------------------------|
| Revenue Department                      |
| Tamil Nadu Housing Board (TNHB)         |
| Tamil Nadu Slum Clearance Board (TNSCB) |
| Tamil Nadu Fisheries Department         |

| City                                                   |
|--------------------------------------------------------|
| Chennai Metropolitan Development Authority (CMDA)      |
| Chennai Metro Water Supply and Sewerage Board (CMWSSB) |

| Municipal                   |
|-----------------------------|
| Greater Chennai Corporation |

| Local (Non-governmental) |
|--------------------------|
| Urban designers          |
| Architects               |
| Engineers                |
| Developers/Builders      |
| NGOs                     |
| Community council        |
| Resident SHGs            |
| Residents                |

## Roles & Responsibilities

|                                                                       |
|-----------------------------------------------------------------------|
| Finance, land reforms                                                 |
| Execution and management of affordable housing                        |
| Rehabilitation of slums and provision of housing                      |
| Welfare, regulation, conservation, training, infrastructure provision |

|                                                            |
|------------------------------------------------------------|
| Master planning, area development, regulating construction |
| Provision of water supply and sewage treatment             |

|                                                |
|------------------------------------------------|
| Civic governing body within corporation extent |
|------------------------------------------------|



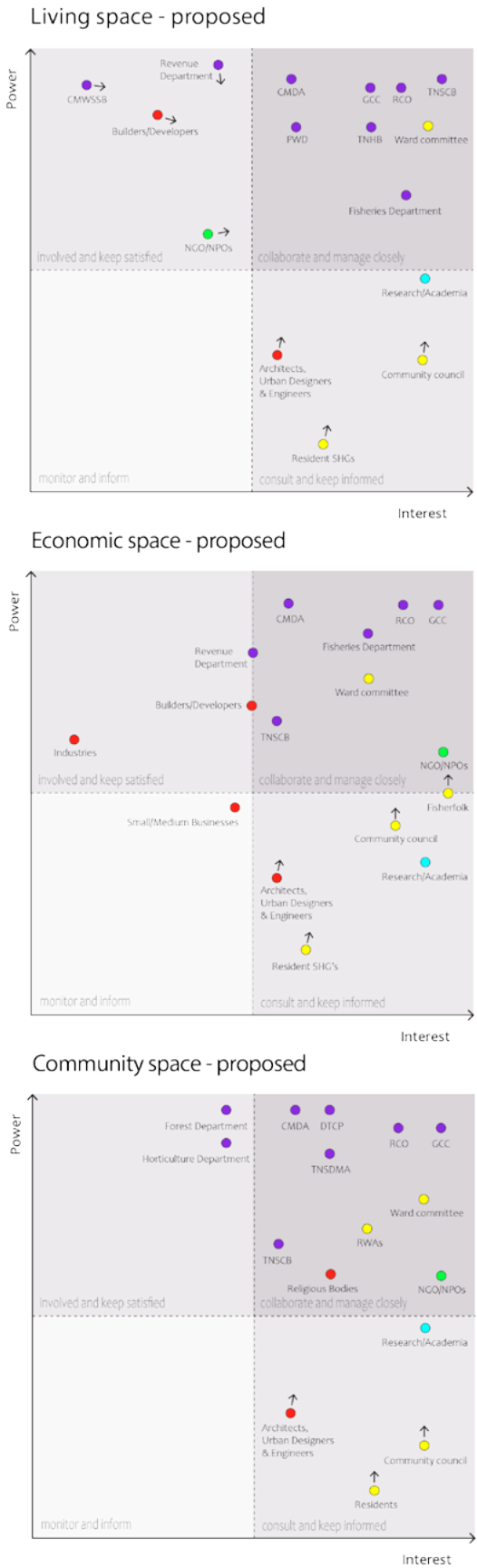
# Stakeholder Engagement

## Proposal

There is a need for more private actors to fund and execute projects for the urban poor. It also requires the active engagement of NGOs in collaborating within the settlements. More representation and power to the residents and community groups in the decision-making and implementation of actions in their own environments is required. Additionally, ward committees equipped with planner could aid the development process and facilitate closer networks of coordination with the vulnerable communities.

The newly introduced Tamil Nadu Shelter Fund (TNSF) funded by the World Bank could facilitate the funding of alternate affordable housing models, by incentivising the private sector through cross-subsidisation.

- LEGEND
- public sector
  - private sector
  - non-governmental organisations
  - research and academia
  - community groups



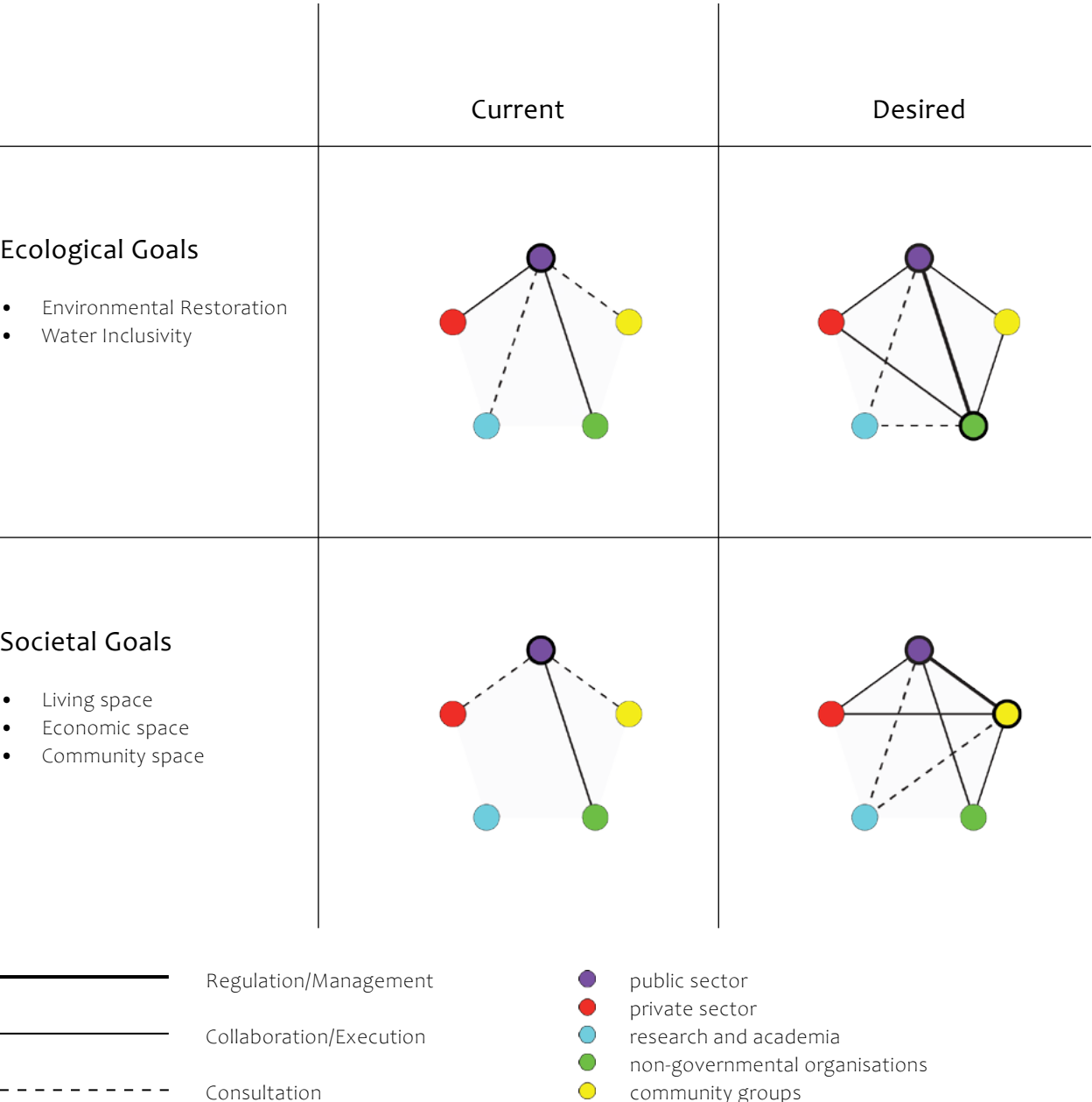
## Nature of interaction

The proposed models of engagement for the ecological and the societal goals describe the specific nature of interaction between the different categories of actors. The interactions are classified into the following:

- Regulation/Management: Agency coordinating different measures, with control over the regulations that shape the development
- Collaboration/Execution: Agencies involved in executing the projects and collaborating with other stakeholders to do so
- Consultation: Actors that are involved through consultation in the decision-making process

## Proposed model

The current models show maximum control over the decision-making and execution process with the public sector, which are the government agencies. This proposed model shows a shared control of the process of realising the societal goals between the public sector and community groups, with other actors collaborating to execute the projects. The process of realising the ecological goals show a shared control between the public sector and NGOs. In both cases, the private sector needs to be incentivised to help execute projects in order to relieve the pressure from the public sector.



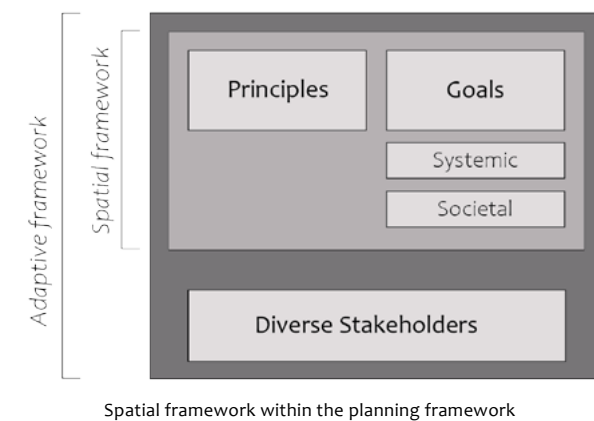


# Formulation of Spatial Framework

## Introduction

The adaptive planning framework facilitates actions, or adaptation measures by a diverse set of actors in order to achieve the goals. However, the translation of the goals into actions requires a spatial framework. The alignment of the local development with the systemic goals addressing the ecological challenges, is guided by the spatial framework.

The spatial framework proposed, comprises of spatial elements with assigned functions and rules. In order to build a resilient system, the local framework adopts certain principles of resilience.



## Principles

For the implementation of goals on space, a set of principles, or concepts, have been adopted that afford resilience of urban form to climate change - nature-inclusivity, indeterminacy, modularity and connectivity (Dhar & Khirfan, 2017). These principles play out in different dimensions - ecological, functional, physical and spatial (Dhar & Khirfan, 2017). The translation of the principals is done through the spatial framework that defines the spatial rules. These principles are manifested in space through the spatial elements defined in the framework.

## Spatial applications

### Ecological

Relationship between built space and nature

### Functional

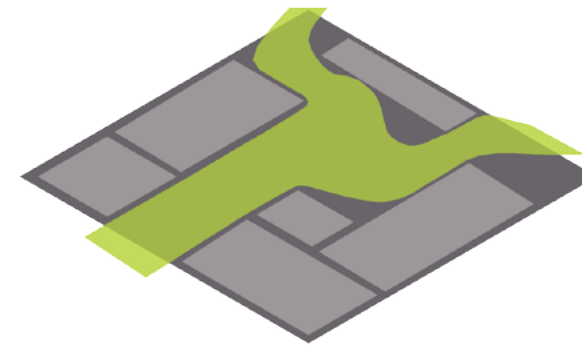
Land use  
Planned activities  
Incidental/unplanned activities

### Physical

Street characteristics  
Block characteristics  
Building characteristics

### Spatial

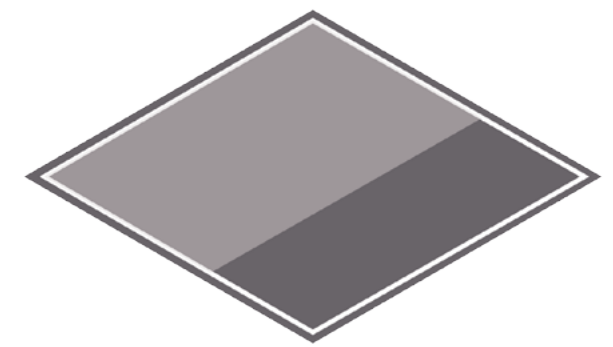
Pattern of layout  
Diversity of urban form



### Nature-Inclusivity

Space that is in harmony with nature, inclusive spaces

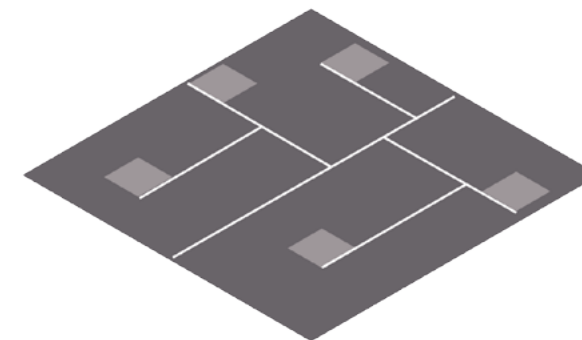
Aligned with the need to link societal and ecological challenges, this principle is crucial in establishing a symbiotic relationship between the two



### Indeterminacy

The unexplored space or components that are not-determined so as to afford unforeseen functions and flexibility

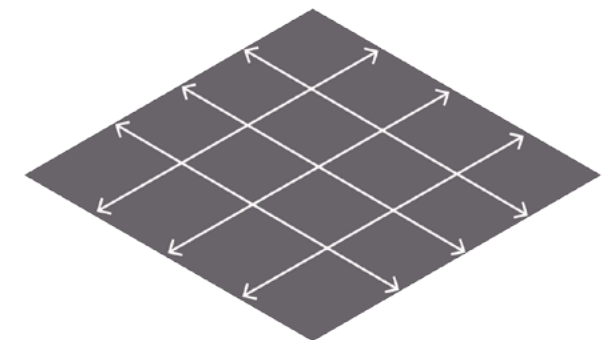
Flexibility, being a key component of adaptive systems, requires indeterminacy of spaces in order to allow room for various possibilities of the usage of space



### Modularity

Decentralised spaces - fail-safe  
Clustering Hierarchical components

This principle is key in order to offer different spaces and components the flexibility of acting independently or as a part of the network.

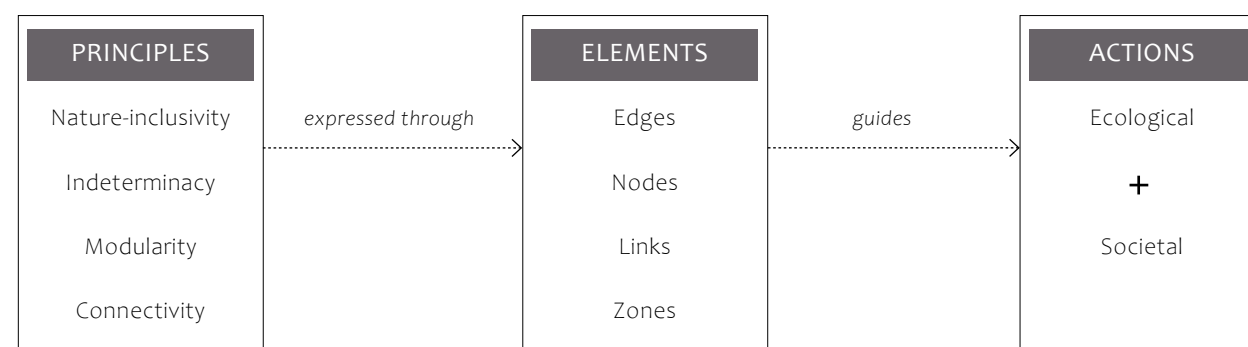


### Connectivity

Networks between streets and blocks

Connectivity, especially through streets and pedestrian access is essential to the project as it emphasises the integration with the surrounding context.

## Translation of Principles in the Spatial Framework and Actions





Spatial Framework

Elements of Spatial Framework

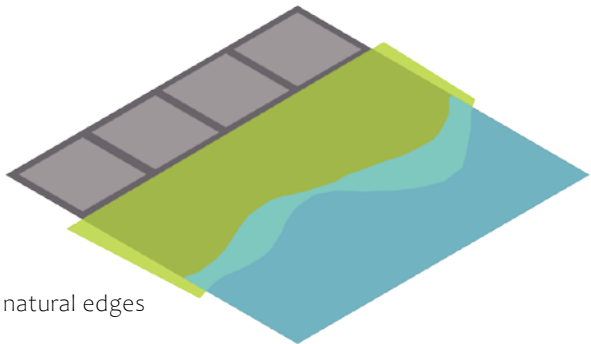
EDGES



Functions

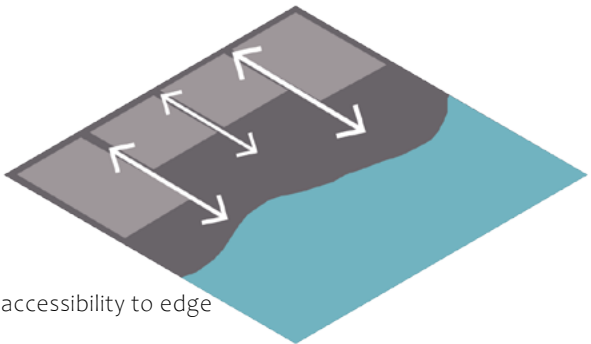
Buffer areas along ecological boundaries, respecting natural processes and conditions

Principles translated through spatial elements



natural edges

Nature-Inclusivity



accessibility to edge

Connectivity

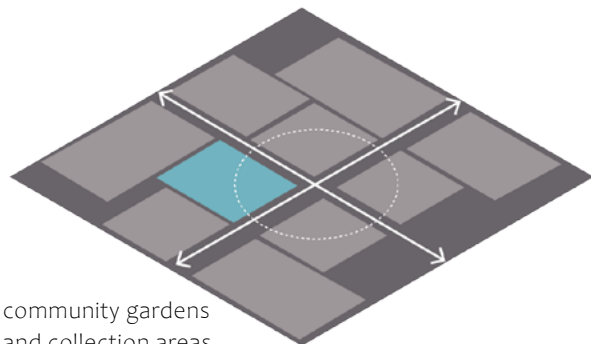
NODES



Nodes of integration with ecology

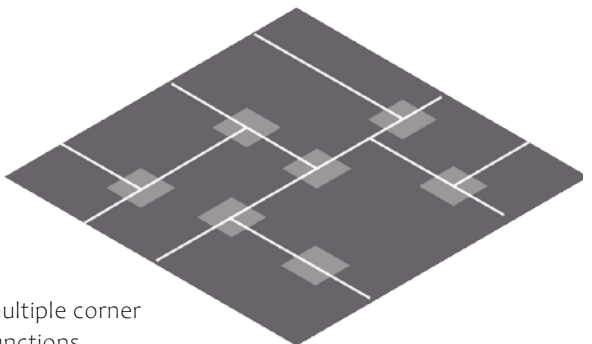


Nodes of integration with the surrounding context



community gardens and collection areas

Nature-Inclusivity



multiple corner functions

Modularity / Connectivity

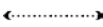
LINKS



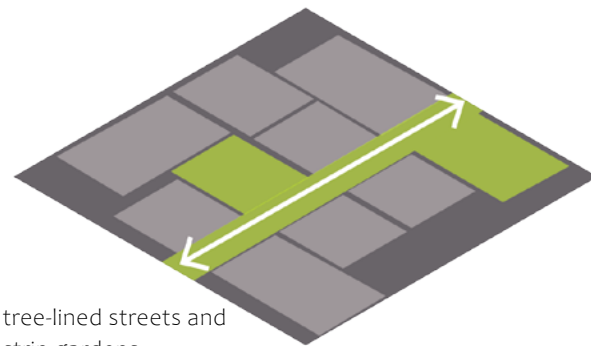
Primary corridors with existing commercial activity



Strengthen existing roads - link interactive spaces connecting nodes within and between settlements

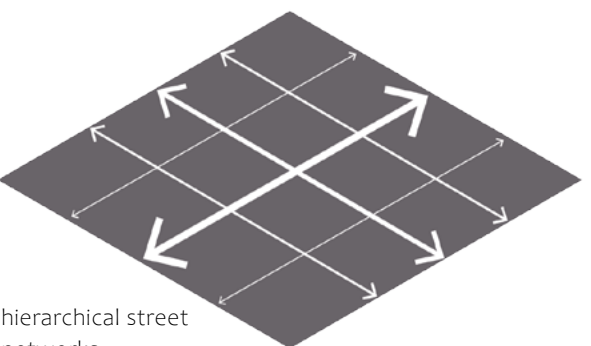


Proposed links within and between settlements



tree-lined streets and strip gardens

Nature-Inclusivity



hierarchical street networks

Modularity

ZONES



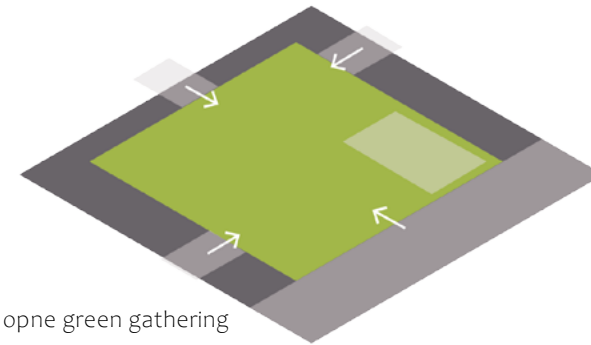
Areas that can house different functions - not predefined



Existing zones of informal settlements

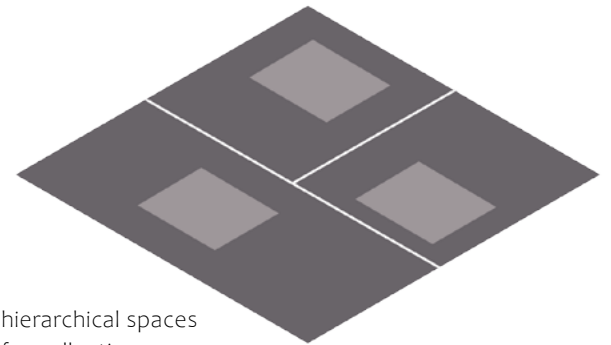


Existing zones of commercial areas



open green gathering spaces

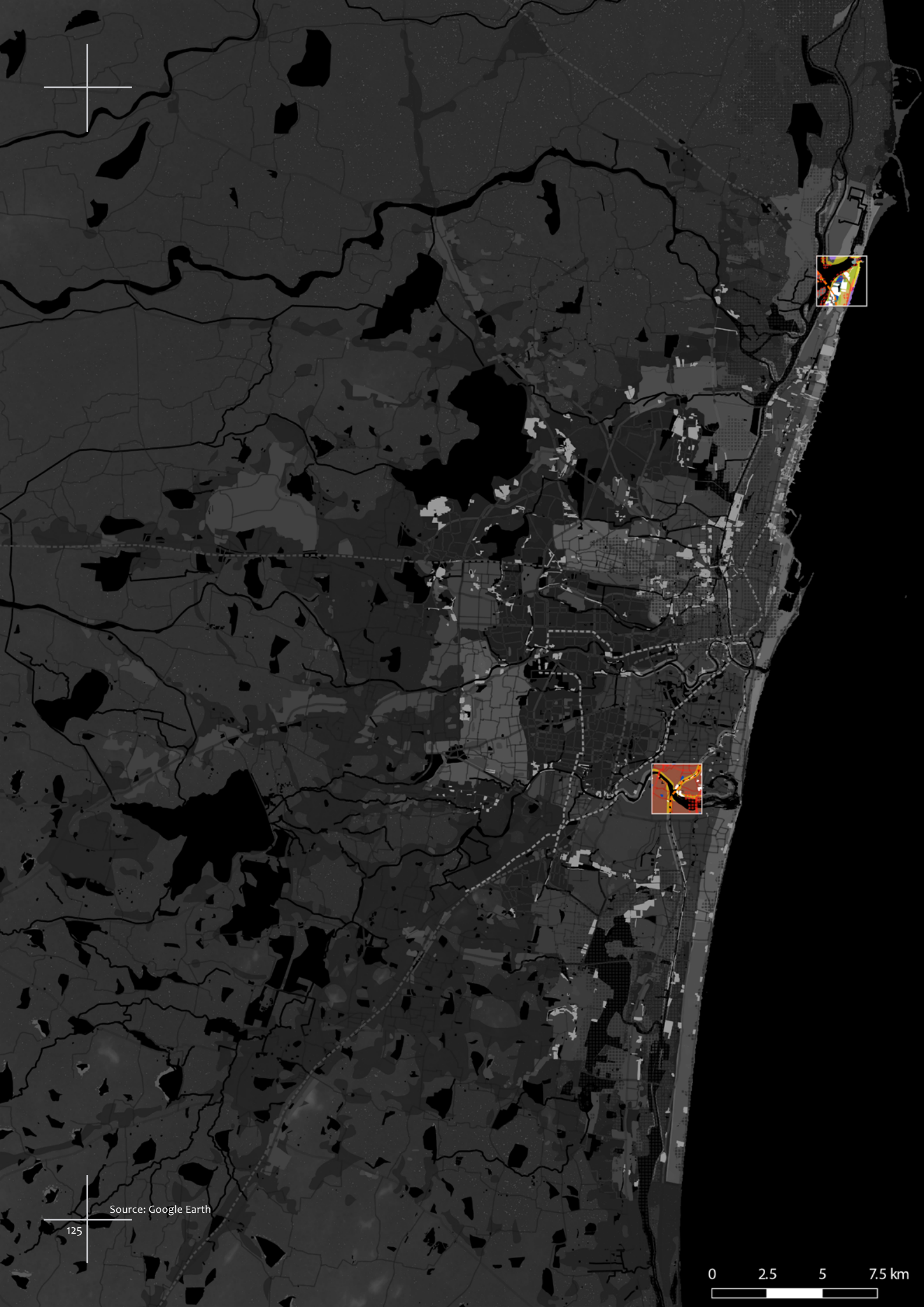
Nature-Inclusivity / Indeterminacy



hierarchical spaces for collective use

Modularity

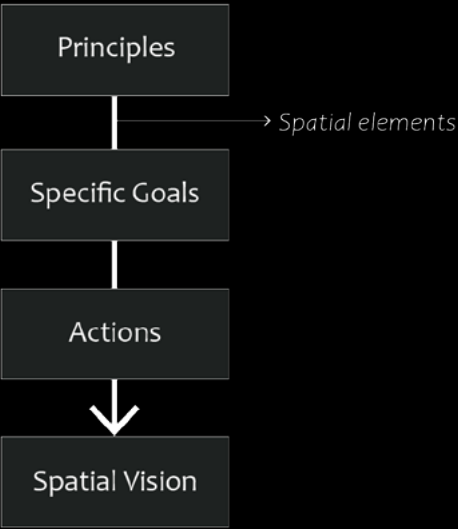




# Testing the Adaptive Framework

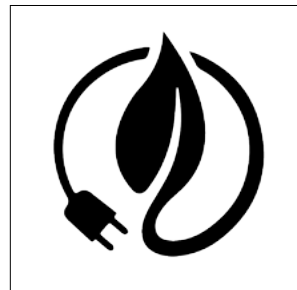
## Process

The adaptive planning framework that has been defined, is tested in the critical cases. The process of testing is as follows:

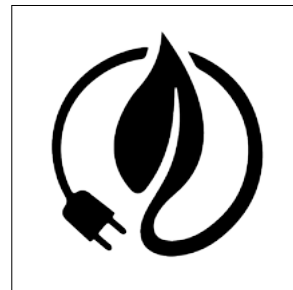


From the principles, specific ecological and societal goals are defined for each case, based on which a set of actions are proposed. Some of the actions address either a societal or an ecological goal, and some address both a societal and an ecological goal. These actions are attached to one or more spatial elements in the framework, following the specific goals outlined for the case. The building up of the spatial framework through the actions, according to the spatial elements and rules, leads to the spatial vision.

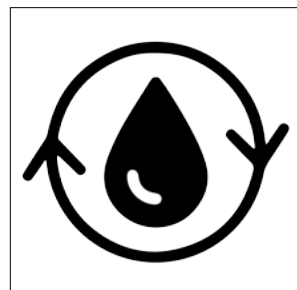




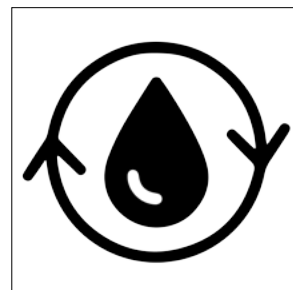
Re-mediate surface and ground water resources to remove heavy metal contamination of water and soil



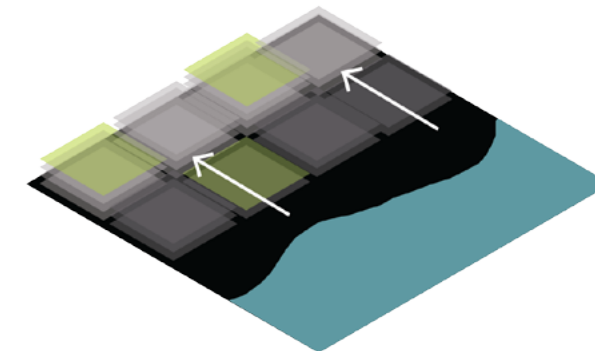
Revive aquatic ecosystem and biodiversity of Ennore creek



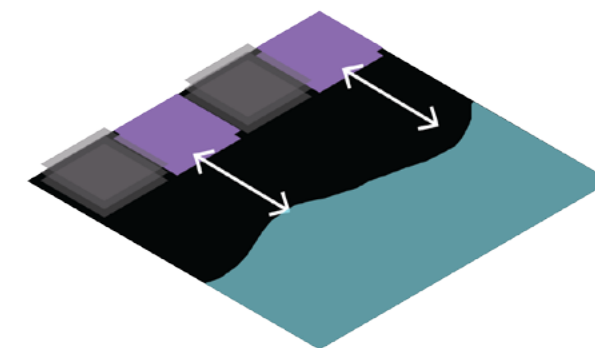
Increase perviousness of ground in order to recharge ground water and alleviate flooding



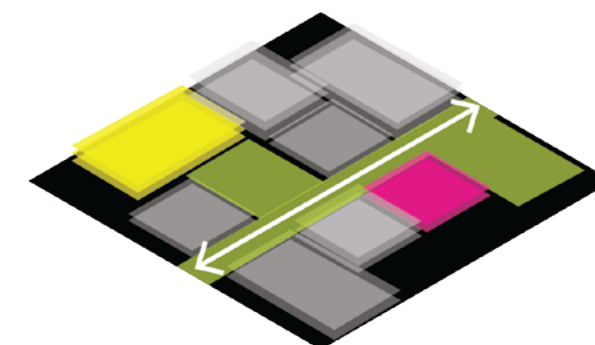
Facilitate ecological edges as flood buffer zones and promote development on higher ground



**LIVING SPACE**  
Create resilient but flexible housing spaces, to retain relationship with ecology within living environments



**ECONOMIC SPACE**  
Enhance relationship with the edge through strengthening local economy



**COMMUNITY SPACE**  
Enhance relationship within the community and with the context through networks of public spaces

## Contextual goals - Specific

The problems in Ennore are centred around the deterioration of the health of environmental systems in addition to the threat of erosion, flooding and sea level rise over time. This puts the fishing villages in this area at risk for many reasons - reducing fishing activity and consequently income, and the state of existing conditions of the built environment. This puts them at the risk of resettlement. Therefore, the goals addressed here attempt to integrate strategies for ecological restoration, flooding alleviation and societal challenges such as housing and livelihood spaces that will be compromised in resettlement. The case analysis helped to identify the livelihood spaces of a few settlements in Ennore in order to guide adaptation strategies.

The three strategic goals at the local scale in the living space, economic space and community space, respond to the principles of nature-inclusivity, connectivity, modularity and indeterminacy.

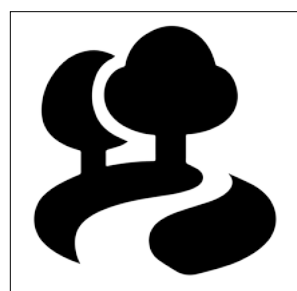
## Societal



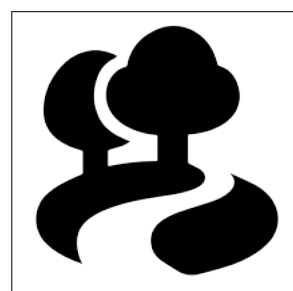
**LIVING SPACE**  
Create safer and more resilient living spaces, with possibilities for future transformation and personalisation of space



**ECONOMIC SPACE**  
Delineate edges for fishing economy to flourish, adapt and transform and provide opportunities for diversification by enhancing the interaction between formal and informal market

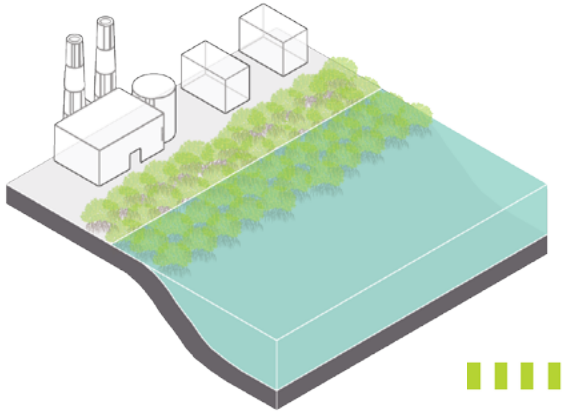


**COMMUNITY SPACE**  
Activate networks of public spaces building on existing cultural infrastructure to reinforce community cohesion and interaction



**COMMUNITY SPACE**  
Facilitate new expressions of collective identity through public functions for the community and its immediate context



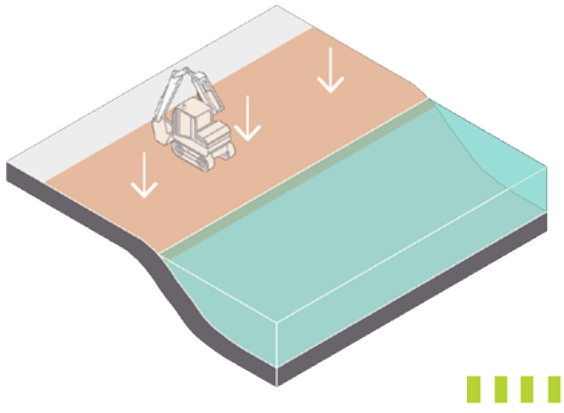


Bioremediation

Phytoremediation using mangroves and other plants that capture heavy metals from the water and soil in edges surrounding the industries and restoring the natural ecology.

Stakeholders

| Regulation                                                                                          | Collaboration                                                                                                                | Consultation                                                                          |
|-----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>TNCZMA</li> <li>TNPCB</li> <li>ULBs</li> <li>NGOs</li> </ul> | <ul style="list-style-type: none"> <li>NGOs</li> <li>Residents</li> <li>Govt. Industries</li> <li>Pvt. Industries</li> </ul> | <ul style="list-style-type: none"> <li>NGOs</li> <li>Research Institutions</li> </ul> |

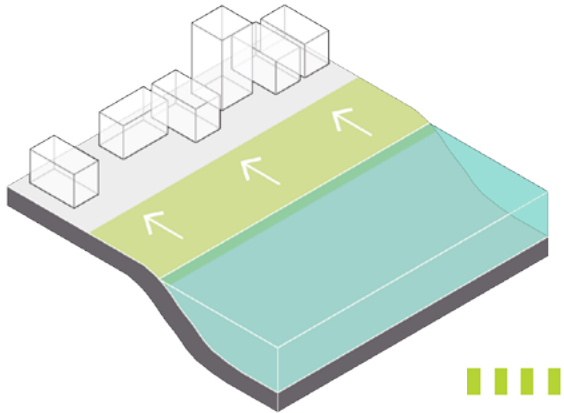


In-situ soil stabilisation

Stabilising the heavy metals present within the soil, preventing them from spreading.

Stakeholders

| Regulation                                                              | Collaboration                                                       | Consultation                                                                                                   |
|-------------------------------------------------------------------------|---------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>TNCZMA</li> <li>TNPCB</li> </ul> | <ul style="list-style-type: none"> <li>Private companies</li> </ul> | <ul style="list-style-type: none"> <li>NGOs</li> <li>Research Institutions</li> <li>Local residents</li> </ul> |

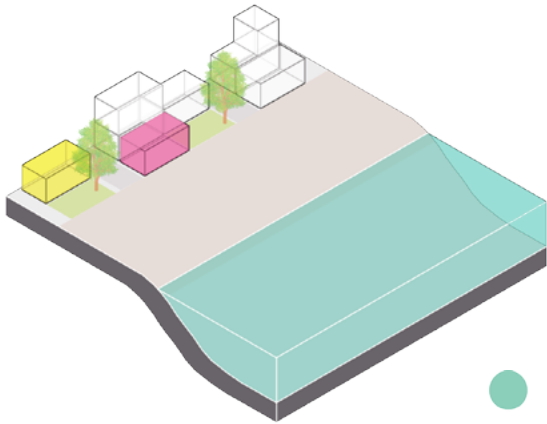


Delineate buffer area

Accommodating water level fluctuations with floodable areas and natural edges, and building on higher ground

Stakeholders

| Regulation                                                             | Collaboration                                                                                                             | Consultation                                                                          |
|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>TNSDMA</li> <li>CMDA</li> </ul> | <ul style="list-style-type: none"> <li>Private companies</li> <li>TNSCB</li> <li>ULBs</li> <li>Local residents</li> </ul> | <ul style="list-style-type: none"> <li>NGOs</li> <li>Research institutions</li> </ul> |

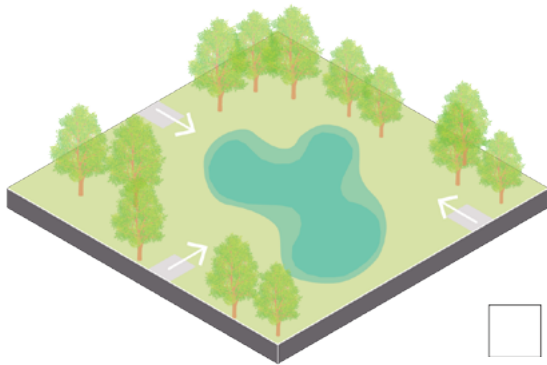


Activate Edges

Activating nodes at ecological edges with economic and socio-cultural functions - built and open, to foster a sense of ownership of the community with the edges.

Stakeholders

| Regulation                                                                                         | Collaboration                                                                                                                            | Consultation                                                                      |
|----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Ward committee</li> <li>TNSCB</li> <li>Residents</li> </ul> | <ul style="list-style-type: none"> <li>NGOs</li> <li>Local residents</li> <li>Architects &amp; urban designers</li> <li>TNSCB</li> </ul> | <ul style="list-style-type: none"> <li>SHGs</li> <li>Community Council</li> </ul> |

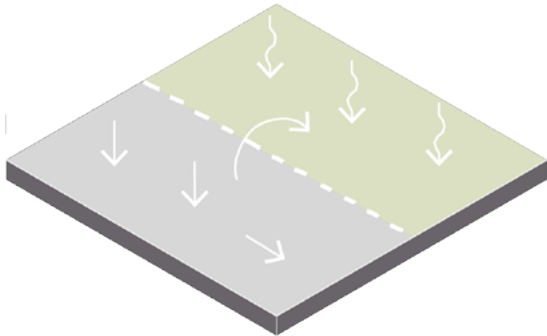


Create retention spaces with buffer areas

Retention areas as large open spaces accessible to the neighbouring settlements, acting as recreational areas that foster healthy relationships with the ecology.

Stakeholders

| Regulation                                                                                   | Collaboration                                                                                                              | Consultation                                                                                                                                    |
|----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>CMDA</li> <li>Ward committee</li> <li>NGOs</li> </ul> | <ul style="list-style-type: none"> <li>NGOs</li> <li>Local residents</li> <li>PWD</li> <li>Landscape architects</li> </ul> | <ul style="list-style-type: none"> <li>NGOs</li> <li>Research Institutions</li> <li>Local residents</li> <li>Horticulture department</li> </ul> |



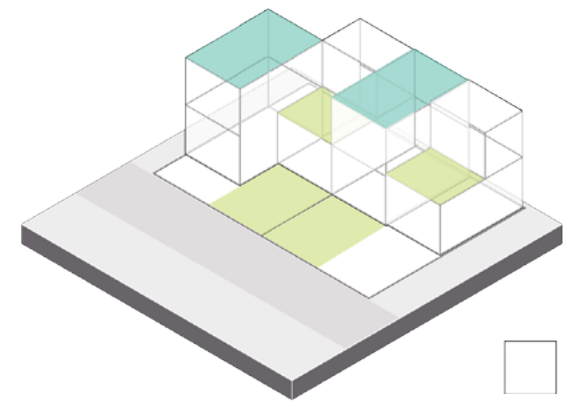
Increase permeable ground cover

Material palette to include porous/permeable material to increase ground water recharge and reduce run-off.

Stakeholders

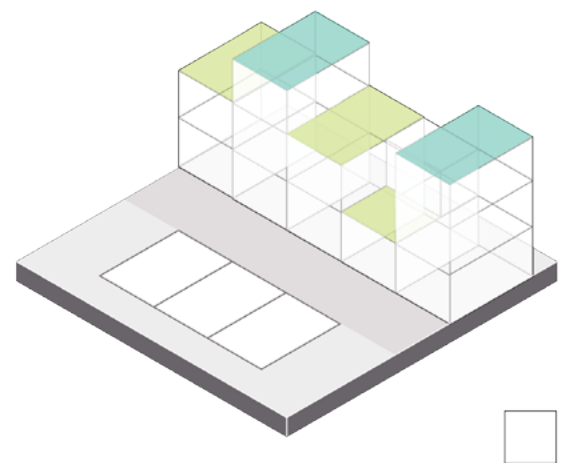
| Regulation                                             | Collaboration                                                                                            | Consultation                                                                          |
|--------------------------------------------------------|----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>CMDA</li> </ul> | <ul style="list-style-type: none"> <li>Architects, urban designers &amp; landscape architects</li> </ul> | <ul style="list-style-type: none"> <li>NGOs</li> <li>Research institutions</li> </ul> |





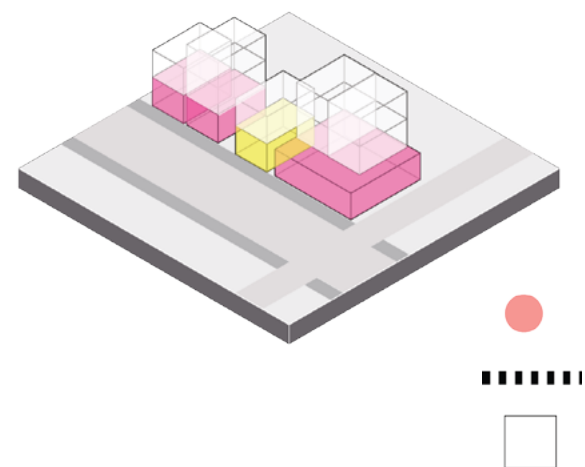
**Create separate plots with services**  
Offering individual plots with fixed open space - built ratio, with individual gardens acting as retention spaces, offering the possibility of urban farming.

| Regulation                                                                                   | Collaboration                                                                                                        | Consultation                                                                                      |
|----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>TNSCB</li> <li>CMWSSB</li> <li>Communities</li> </ul> | <ul style="list-style-type: none"> <li>Residents</li> <li>Architects &amp; urban designers</li> <li>TNSCB</li> </ul> | <ul style="list-style-type: none"> <li>Fisheries department</li> <li>Community Council</li> </ul> |



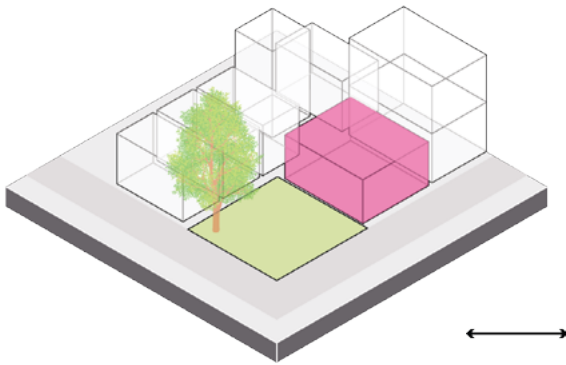
**Build modular units - CBA**  
Modular housing that can facilitate personalisation and transformation over time or sharing with other families, with rooftop RWH and terrace gardens that encourage active participation in adaptation.

| Regulation                                                                                   | Collaboration                                                                                                        | Consultation                                                                                      |
|----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>TNSCB</li> <li>CMWSSB</li> <li>Communities</li> </ul> | <ul style="list-style-type: none"> <li>Residents</li> <li>Architects &amp; urban designers</li> <li>TNSCB</li> </ul> | <ul style="list-style-type: none"> <li>Fisheries department</li> <li>Community Council</li> </ul> |



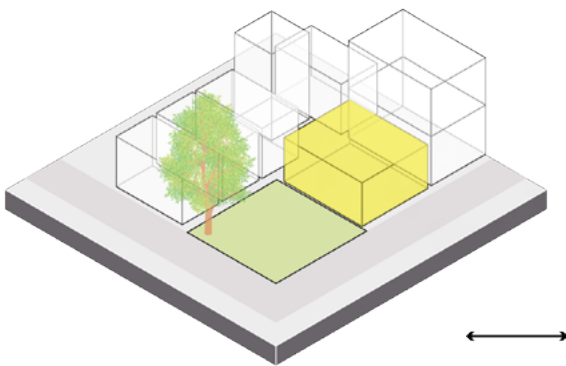
**Facilitate mixed-use buildings**  
Mixed-use functions along primary linkages, especially around market areas to activate public realm and accommodate apartment housing

| Regulation                                                                                                           | Collaboration                                                                                | Consultation                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Ward committees</li> <li>Fisheries Department</li> <li>Communities</li> </ul> | <ul style="list-style-type: none"> <li>Architects</li> <li>Construction companies</li> </ul> | <ul style="list-style-type: none"> <li>Community Council</li> <li>Commercial establishments</li> <li>Private companies</li> </ul> |



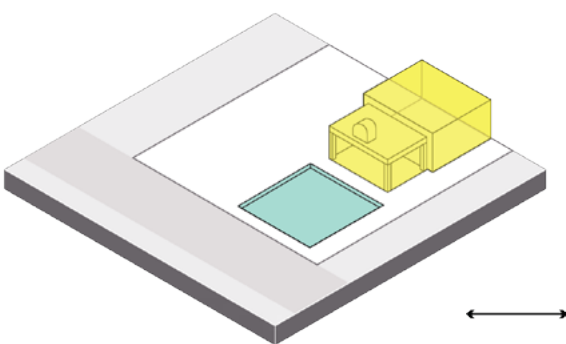
**Create spaces for local economy**  
Semi-open spaces for local economy to flourish that can be used by the fishermen to carry out net repair and fish drying on open space that could be used for public gathering.

| Regulation                                                                                         | Collaboration                                                                                                  | Consultation                                                                                      |
|----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>TNSCB</li> <li>CMWSSB</li> <li>Local communities</li> </ul> | <ul style="list-style-type: none"> <li>Architects</li> <li>Residents</li> <li>TNSCB</li> <li>CMWSSB</li> </ul> | <ul style="list-style-type: none"> <li>Fisheries Department</li> <li>Community Council</li> </ul> |



**Create community spaces**  
Community halls and canteens that can engage the collective and absorption grounds that can be used as parks and playgrounds.

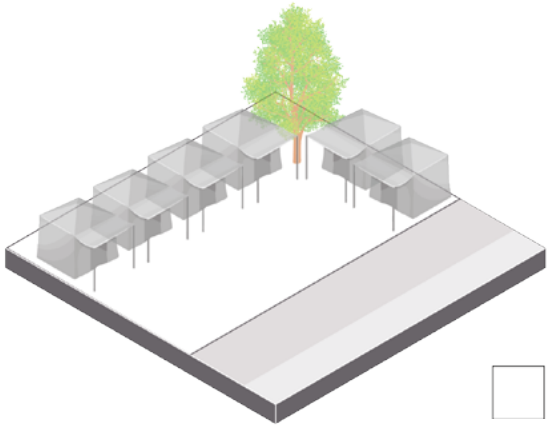
| Regulation                                                                                         | Collaboration                                                                                                  | Consultation                                                                      |
|----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>TNSCB</li> <li>CMWSSB</li> <li>Local communities</li> </ul> | <ul style="list-style-type: none"> <li>Architects</li> <li>Residents</li> <li>TNSCB</li> <li>CMWSSB</li> </ul> | <ul style="list-style-type: none"> <li>NGOs</li> <li>Community Council</li> </ul> |



**Activate cultural centres**  
Temples and other cultural centres activated with retention ponds and space for festivals and larger public gatherings.

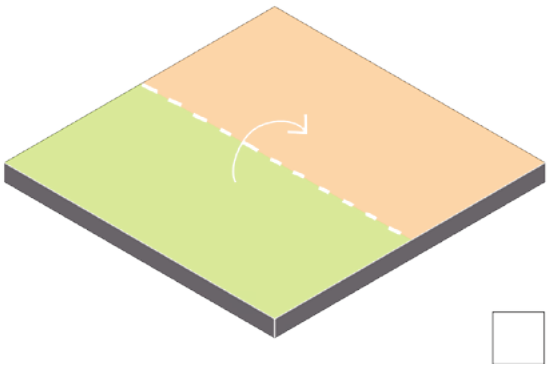
| Regulation                                                                           | Collaboration                                                                | Consultation                                                        |
|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------|---------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Residents</li> <li>Ward committees</li> </ul> | <ul style="list-style-type: none"> <li>Architects</li> <li>CMWSSB</li> </ul> | <ul style="list-style-type: none"> <li>Community Council</li> </ul> |





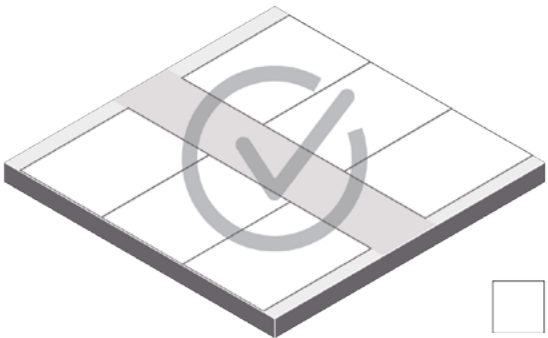
**Facilitate temporary markets and fairs**  
Spaces for markets and fairs for the surrounding communities along commercial spines, also doubling up as temporary night shelters for the homeless to encourage economic integration.

| Regulation                                                                  | Collaboration                                                                                                                     | Consultation                                                              |
|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>Ward committee</li><li>CMDA</li></ul> | <ul style="list-style-type: none"><li>Residents</li><li>Architects &amp; urban designers</li><li>Construction companies</li></ul> | <ul style="list-style-type: none"><li>Community councils (Ward)</li></ul> |



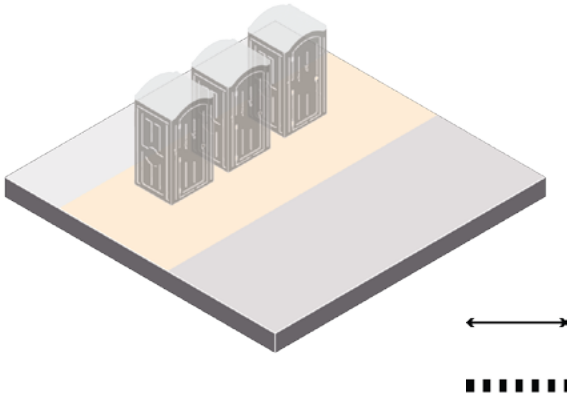
**Reclassification of zone functions**  
Reclassification of CRZ areas, or change in to curb industrial expansion on ecologically sensitive areas

| Regulation                                                           | Collaboration                                                                                       | Consultation                                                          |
|----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>TNSCZMA</li><li>CMDA</li></ul> | <ul style="list-style-type: none"><li>Architects</li><li>Planners</li><li>Urban designers</li></ul> | <ul style="list-style-type: none"><li>Research Institutions</li></ul> |



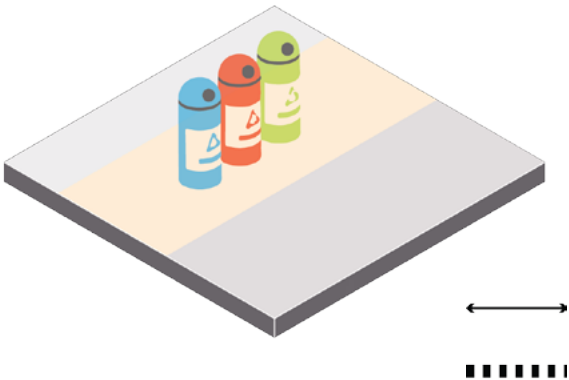
**Facilitate tenure security for residents**  
Tenure security measures and subdivision of plots to facilitate modularity and flexibility in housing should be encouraged.

| Regulation                                                                       | Collaboration                                                           | Consultation                                                           |
|----------------------------------------------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>TNSCB</li><li>Revenue Department</li></ul> | <ul style="list-style-type: none"><li>GoTN Finance Department</li></ul> | <ul style="list-style-type: none"><li>NGOs</li><li>Residents</li></ul> |



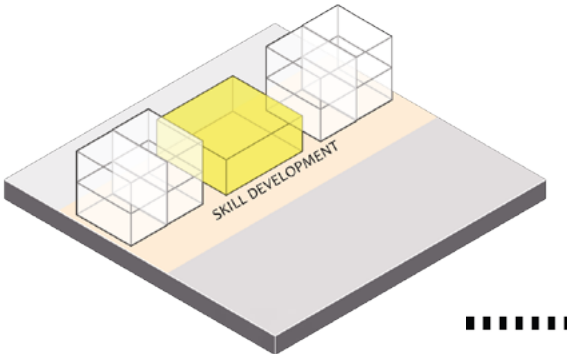
**Provide public toilets**  
Open defecation due to the lack of adequate toilet facilities contributes to deterioration of public health. Public toilets need to be installed along primary links and within communities.

| Regulation                                                         | Collaboration                                                                                              | Consultation                                                          |
|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>GCC</li><li>CMWSSB</li></ul> | <ul style="list-style-type: none"><li>Residents</li><li>Ward committee</li><li>Private companies</li></ul> | <ul style="list-style-type: none"><li>Research institutions</li></ul> |



**Enable waste segregation**  
In order to avoid dumping of garbage along water bodies, waste segregation bins need to be installed in multiple points and the residents must be educated on using them.

| Regulation                                                                 | Collaboration                                             | Consultation                                         |
|----------------------------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------|
| <ul style="list-style-type: none"><li>GCC</li><li>Ward committee</li></ul> | <ul style="list-style-type: none"><li>Residents</li></ul> | <ul style="list-style-type: none"><li>NGOs</li></ul> |



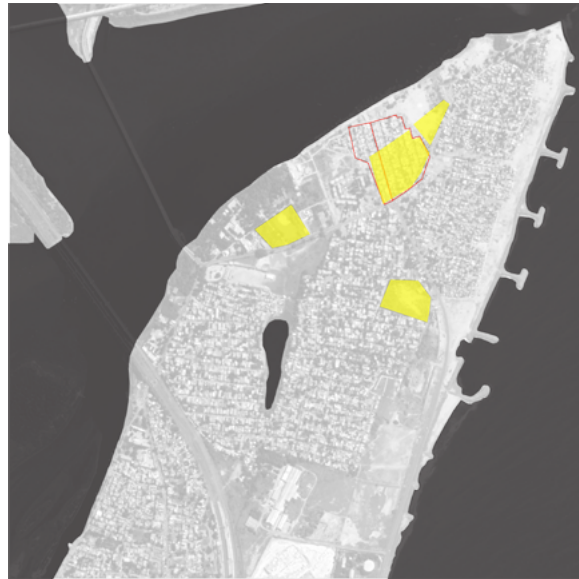
**Create skill development centres**  
Each ward should have a skill development centre to equip residents, especially women, with skills that will aid economic growth and opportunities.

| Regulation                                                                                             | Collaboration                                                                                                      | Consultation                                                                 |
|--------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>TNSCB</li><li>Fisheries Department</li><li>Communities</li></ul> | <ul style="list-style-type: none"><li>NGOs</li><li>Architects</li><li>TNSCB - Community Development Wing</li></ul> | <ul style="list-style-type: none"><li>Community Council, residents</li></ul> |



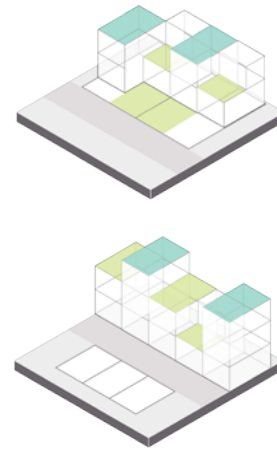
# Ennore

## Relation between the spatial framework and actions



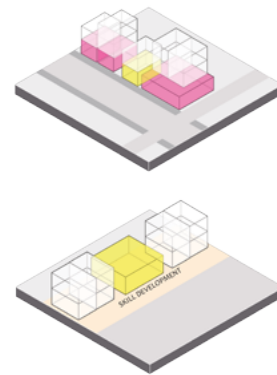
### Housing

Areas that could accommodate housing for the settlement to be rehabilitated - preferred spaces along the coast for easy access to creek for fishing.



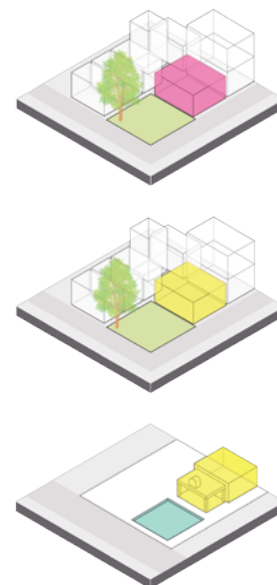
### Mixed use

Areas that could accommodate mixed use development with a combination of housing, and social and economic activities - around primary corridor, connecting existing commercial area.



### Public function

Areas that could create a network of small social and cultural spaces (built and open) along access routes within the housing areas that connect the central corridor and ecological edges.



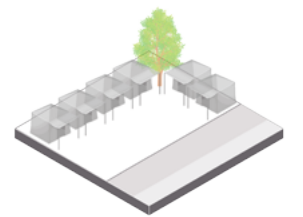
### Open green spaces

Areas that could be transformed into larger community greens (retention areas) - along primary (large) and secondary links (small-medium).



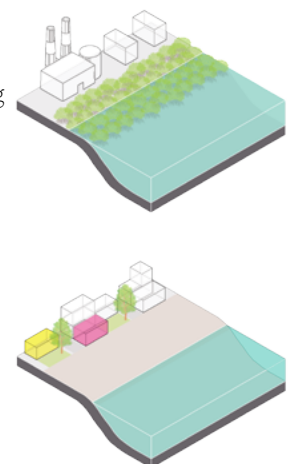
### Market areas

Areas that are flexible to host markets, fairs and other temporary functions and events, along the primary link.



### Buffer areas

Areas that are located along the edges - nodes that house social and economic functions that interact with the edge. These could be built or open activities that engage the community in a healthy relationship with the ecology.







#### Indeterminacy

Spaces whose function is not fixed or discovered

#### Connectivity

Networks and links between streets and blocks and green-blue networks

#### Nature-inclusivity

Buffer spaces, retention areas and built environment in harmony with nature

#### Modularity

Clustering of communities - each with their own social, cultural and economic functions and retention areas  
Activated nodes with functional connections

### Spatial Vision

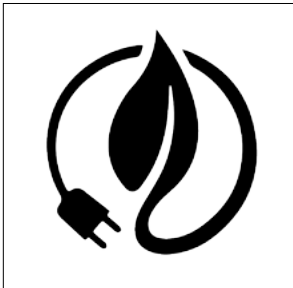
The spatial vision is the combination of the different actions, spatial elements and goals. The actions respond to the goals, and the actions are in turn guided by the spatial framework - the elements.

The robustness of the spatial vision helps in building up a system that is resilient, through the principles.

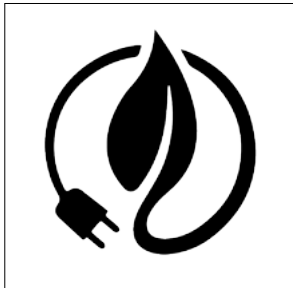
#### LEGEND

-  Buffer areas along ecological boundaries, respecting natural processes and conditions
-  Nodes of integration with ecology
-  Nodes of integration with the context
-  Primary corridors with existing commercial activity
-  Strengthen existing roads - link interactive spaces connecting nodes within and between settlements
-  Proposed links within and between settlements
-  Areas that can house different functions - not predefined
-  Existing zones of informal settlements
-  Commercial / mixed-use zones
-  Rehabilitation areas
-  Public functions
-  Green network
-  Temporary market area

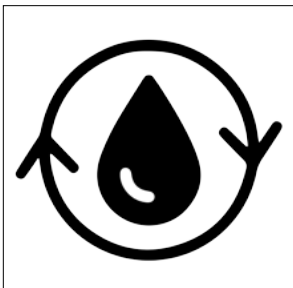




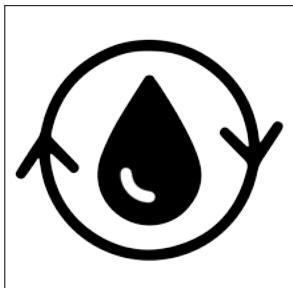
Restore quality of water in the Buckingham canal



Revive health of ecosystem and biodiversity of Adyar river



Increase perviousness of ground in order to recharge ground water and alleviate flooding



Facilitate ecological edges as flood buffer zones to facilitate tidal flows and promote development on higher ground

Societal



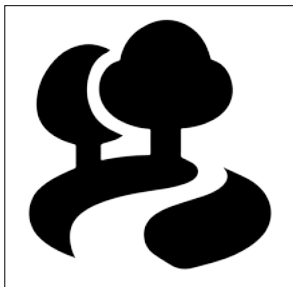
LIVING SPACE  
Facilitate higher densities in living spaces that are on safer ground within the area, retaining character and flexibility



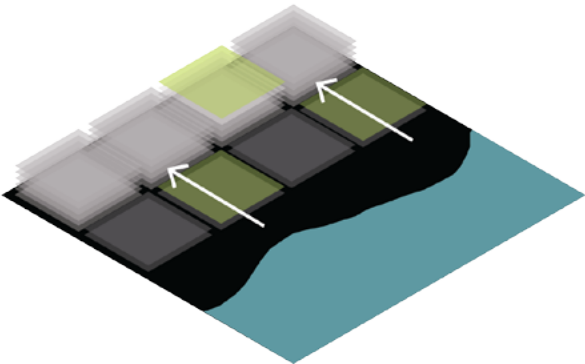
ECONOMIC SPACE  
Facilitate space for local economy to flourish, adapt and transform, and enhance interaction with the formal city (immediate context)



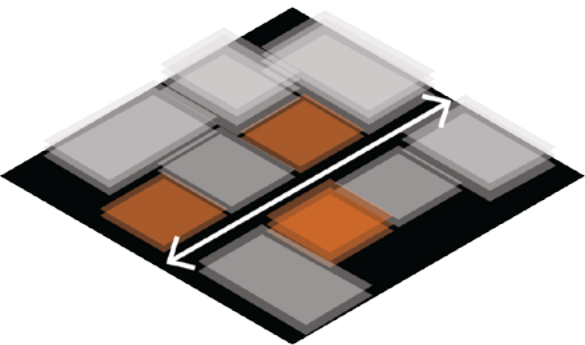
COMMUNITY SPACE  
Activate networks of public spaces to reinforce community cohesion and interaction



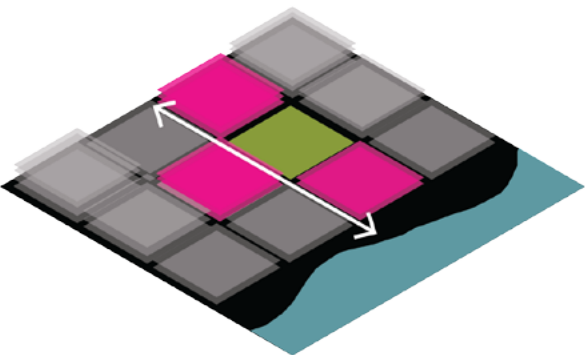
COMMUNITY SPACE  
Enhance the accessibility to the river and canal through public function, offering the potential for new collective identities



LIVING SPACE  
Create resilient high density housing spaces, on higher ground while retaining ground relationship.



ECONOMIC SPACE  
Enhance relationship with the immediate coontext through providing mixed functions and creating opportunities for interaction.



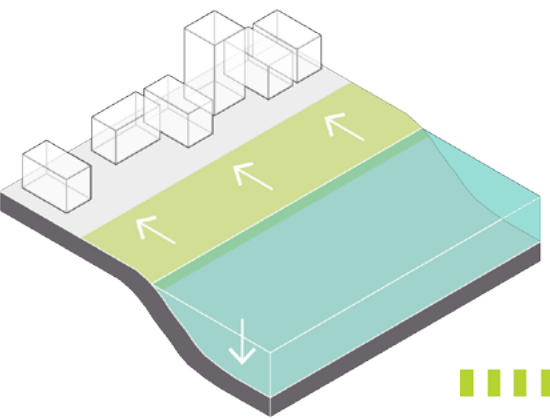
COMMUNITY SPACE  
Build relationship with the river and canal edges through accessible routes with public functions creating a network of public spaces

Contextual goals - specific

In this area, the goals attempt to integrate strategies for ecological restoration, flooding alleviation and societal challenges such as housing and livelihood spaces, in order to reconnect the two elements. This area is defined by a common neglect of the ecological edges from everyday life, thereby affecting society’s relationship with it. The health of the water systems are also a contributing reason to the neglect. Proposals to restore the waterways of Chennai are considered in combination with livelihood factors of the settlements at risk of eviction.

The three strategic goals at the local scale in the living space, economic space and community space, respond to the principles of nature-inclusivity, connectivity, modularity and indeterminacy.



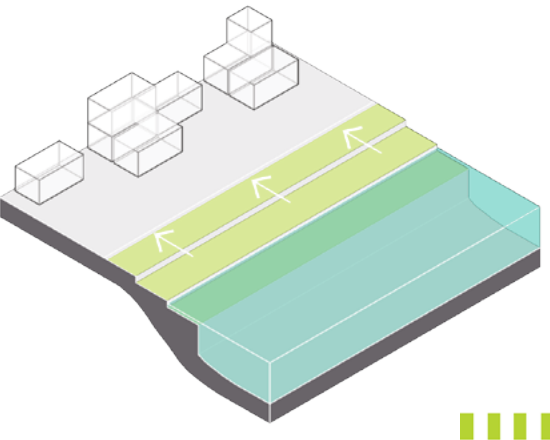


River cleaning and widening

Desilting and cleaning the river of debris and demarcation of buffer area with natural edge that accounts for fluctuations, building on higher ground.

Stakeholders

| Regulation                                                                         | Collaboration                                                                                                   | Consultation                                                                                             |
|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>CRRT</li> <li>CMDA</li> <li>NGOs</li> </ul> | <ul style="list-style-type: none"> <li>WRD</li> <li>CMWSSB</li> <li>CRRT</li> <li>PWD</li> <li>TNSCB</li> </ul> | <ul style="list-style-type: none"> <li>NGOs</li> <li>Research Institutions</li> <li>Residents</li> </ul> |

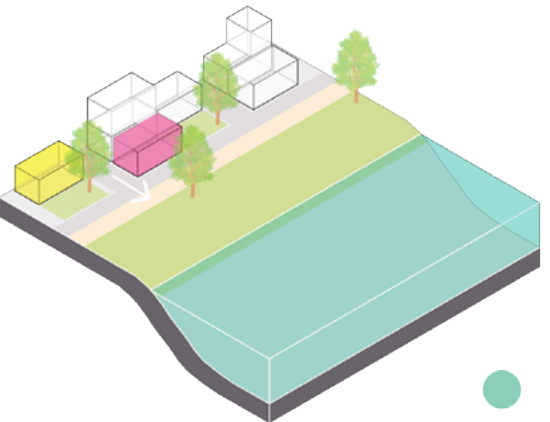


Opening canal edge and buffer area

Removing canal wall obstruction and widening it to accommodate horizontal flow.

Stakeholders

| Regulation                                                          | Collaboration                                                                                                   | Consultation                                                                                             |
|---------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>CRRT</li> <li>GCC</li> </ul> | <ul style="list-style-type: none"> <li>WRD</li> <li>CMWSSB</li> <li>CRRT</li> <li>PWD</li> <li>TNSCB</li> </ul> | <ul style="list-style-type: none"> <li>NGOs</li> <li>Research Institutions</li> <li>Residents</li> </ul> |

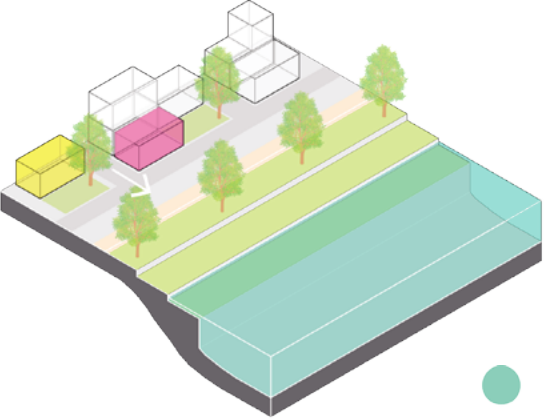


Activating river edges

Increasing accessibility to river edge and facilitating economic, social and cultural activities - built or open.

Stakeholders

| Regulation                                                                                          | Collaboration                                                                                                                            | Consultation                                                                      |
|-----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Ward committee</li> <li>CRRT</li> <li>Communities</li> </ul> | <ul style="list-style-type: none"> <li>NGOs</li> <li>Local residents</li> <li>Architects &amp; urban designers</li> <li>TNSCB</li> </ul> | <ul style="list-style-type: none"> <li>SHGs</li> <li>Community Council</li> </ul> |

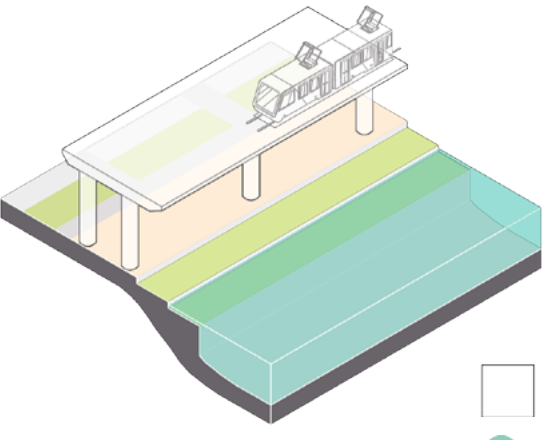


Activating canal edges

Increasing accessibility to canal edge and facilitating social and recreational functions - built and open, at multiple points along the canal.

Stakeholders

| Regulation                                                                                          | Collaboration                                                                                                                            | Consultation                                                                      |
|-----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Ward committee</li> <li>CRRT</li> <li>Communities</li> </ul> | <ul style="list-style-type: none"> <li>NGOs</li> <li>Local residents</li> <li>Architects &amp; urban designers</li> <li>TNSCB</li> </ul> | <ul style="list-style-type: none"> <li>SHGs</li> <li>Community Council</li> </ul> |

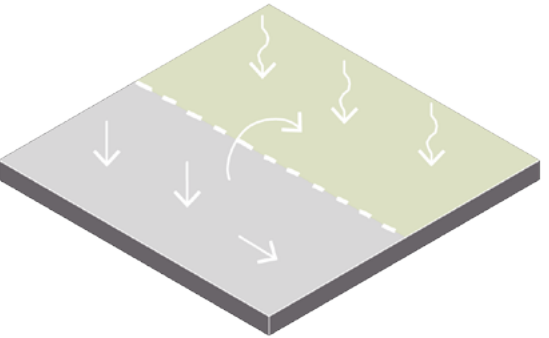


Repurposing spaces below the MRTS line

Facilitating temporary functions such as markets, pop up stalls and games below the Metro bridge to provide opportunities for economic activity.

Stakeholders

| Regulation                                                                                          | Collaboration                                                                                                          | Consultation                                                                                    |
|-----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Ward committee</li> <li>CRRT</li> <li>Communities</li> </ul> | <ul style="list-style-type: none"> <li>NGOs</li> <li>Local residents</li> <li>Urban designers</li> <li>CMRL</li> </ul> | <ul style="list-style-type: none"> <li>Research Institutions</li> <li>Ward residents</li> </ul> |



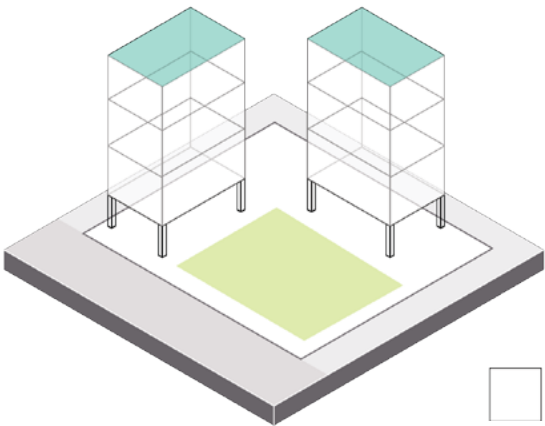
Increasing permeable ground cover

Material palette to include porous/permeable material to increase ground water recharge and reduce run-off

Stakeholders

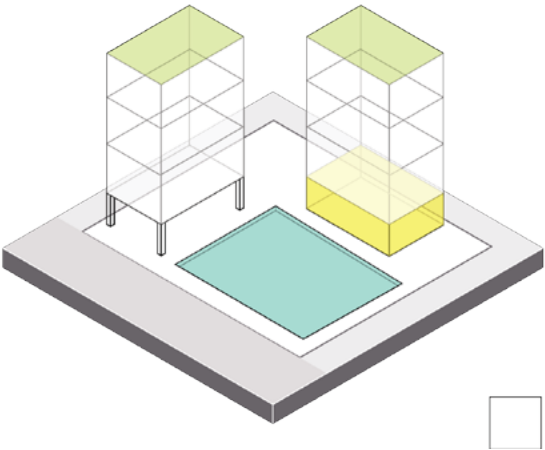
| Regulation                                             | Collaboration                                                                                            | Consultation                                                                          |
|--------------------------------------------------------|----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>CMDA</li> </ul> | <ul style="list-style-type: none"> <li>Architects, urban designers &amp; landscape architects</li> </ul> | <ul style="list-style-type: none"> <li>NGOs</li> <li>Research institutions</li> </ul> |





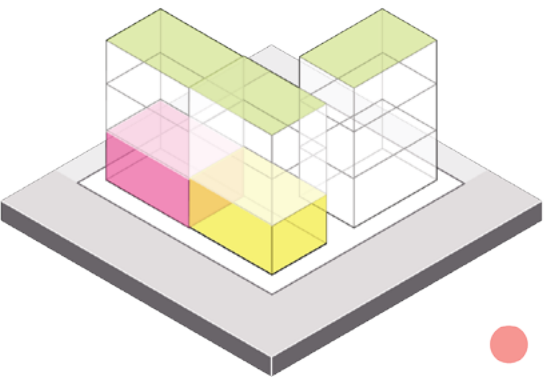
**Build tenements / apartments**  
 Apartment buildings with rooftop RWH facility and open play areas or community gardens.

| Regulation                                                                                   | Collaboration                                                                                                        | Consultation                                                                                      |
|----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>TNSCB</li> <li>CMWSSB</li> <li>Communities</li> </ul> | <ul style="list-style-type: none"> <li>Residents</li> <li>Architects &amp; urban designers</li> <li>TNSCB</li> </ul> | <ul style="list-style-type: none"> <li>Fisheries department</li> <li>Community Council</li> </ul> |



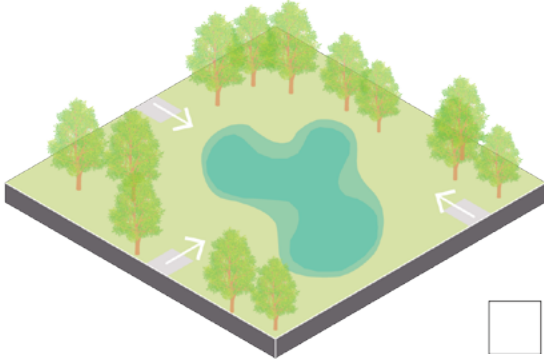
**Build apartments with social spaces**  
 Apartment buildings with community hall and gathering space and terrace gardens.

| Regulation                                                                                   | Collaboration                                                                                                        | Consultation                                                                                      |
|----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>TNSCB</li> <li>CMWSSB</li> <li>Communities</li> </ul> | <ul style="list-style-type: none"> <li>Residents</li> <li>Architects &amp; urban designers</li> <li>TNSCB</li> </ul> | <ul style="list-style-type: none"> <li>Fisheries department</li> <li>Community Council</li> </ul> |



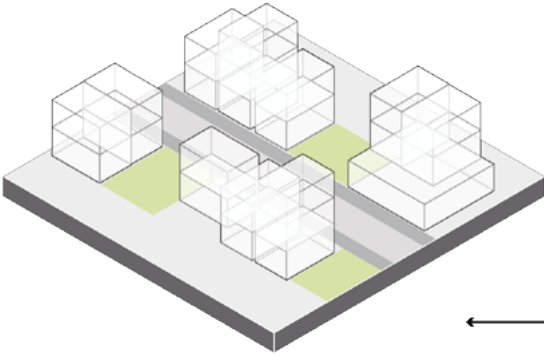
**Facilitate mixed-use buildings**  
 Mixed-use functions along primary linkages, especially around market areas to activate public realm

| Regulation                                                                             | Collaboration                                                                                               | Consultation                                                                                                                      |
|----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Ward committees</li> <li>Communities</li> </ul> | <ul style="list-style-type: none"> <li>Architects</li> <li>Construction companies</li> <li>TNSCB</li> </ul> | <ul style="list-style-type: none"> <li>Community Council</li> <li>Commercial establishments</li> <li>Private companies</li> </ul> |



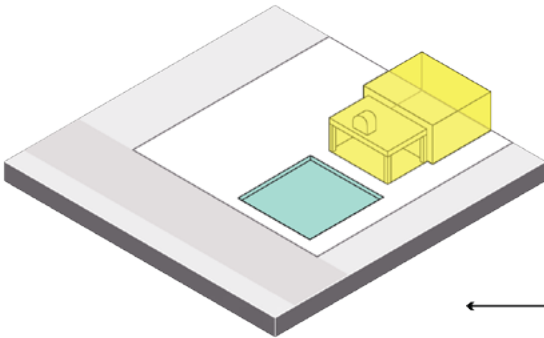
**Create retention spaces with buffer areas**  
 Retention areas as medium open spaces accessible to the neighbouring settlements, acting as recreational areas that foster healthy relationships with the ecology.

| Regulation                                                                                   | Collaboration                                                                                                              | Consultation                                                                                                                                    |
|----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>CMDA</li> <li>Ward committee</li> <li>NGOs</li> </ul> | <ul style="list-style-type: none"> <li>NGOs</li> <li>Local residents</li> <li>PWD</li> <li>Landscape architects</li> </ul> | <ul style="list-style-type: none"> <li>NGOs</li> <li>Research Institutions</li> <li>Local residents</li> <li>Horticulture department</li> </ul> |



**Create a network of open spaces**  
 Network of open spaces managed locally by resident communities to promote urban horticulture and interaction

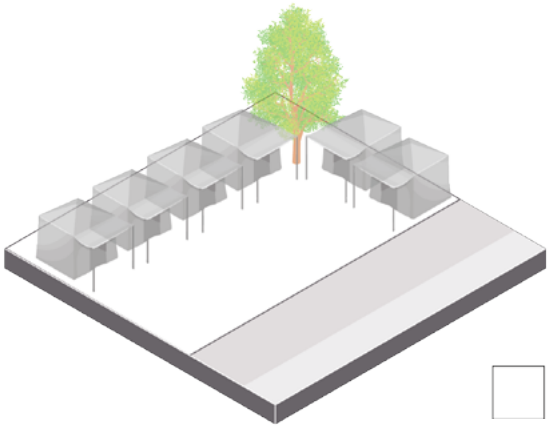
| Regulation                                                                                                    | Collaboration                                                                                                | Consultation                                                                                                                                    |
|---------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>CMDA</li> <li>Ward committee</li> <li>Local resident groups</li> </ul> | <ul style="list-style-type: none"> <li>Local residents</li> <li>PWD</li> <li>Landscape architects</li> </ul> | <ul style="list-style-type: none"> <li>NGOs</li> <li>Research Institutions</li> <li>Local residents</li> <li>Horticulture department</li> </ul> |



**Activate cultural centres**  
 Temples and other cultural centres activated with retention ponds and space for festivals and larger public gathering

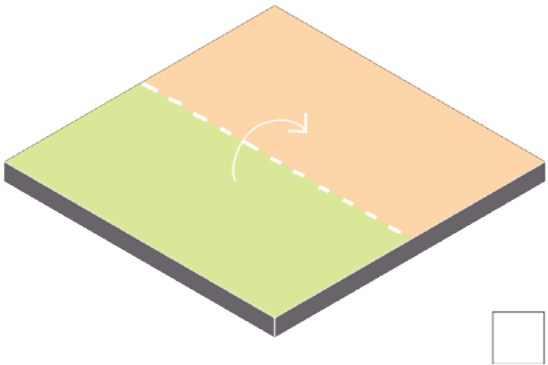
| Regulation                                                                           | Collaboration                                                                                            | Consultation                                                        |
|--------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Residents</li> <li>Ward committees</li> </ul> | <ul style="list-style-type: none"> <li>Architects</li> <li>CMWSSB</li> <li>Temple authorities</li> </ul> | <ul style="list-style-type: none"> <li>Community Council</li> </ul> |





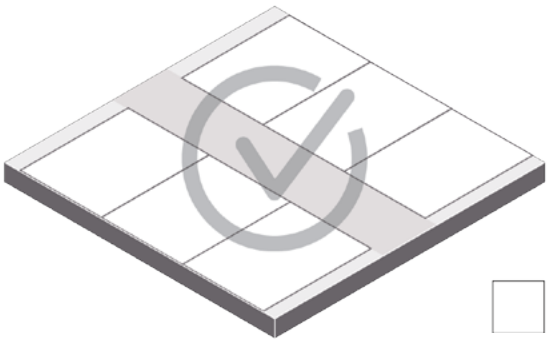
**Facilitate temporary markets and fairs**  
 Spaces for markets and fairs for the surrounding communities along commercial spines, also doubling up as temporary night shelters for the homeless to encourage economic integration.

| Regulation                                                                     | Collaboration                                                                                                                         | Consultation                                                                |
|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Ward committee</li> <li>CMDA</li> </ul> | <ul style="list-style-type: none"> <li>Residents</li> <li>Architects &amp; urban designers</li> <li>Construction companies</li> </ul> | <ul style="list-style-type: none"> <li>Community councils (Ward)</li> </ul> |



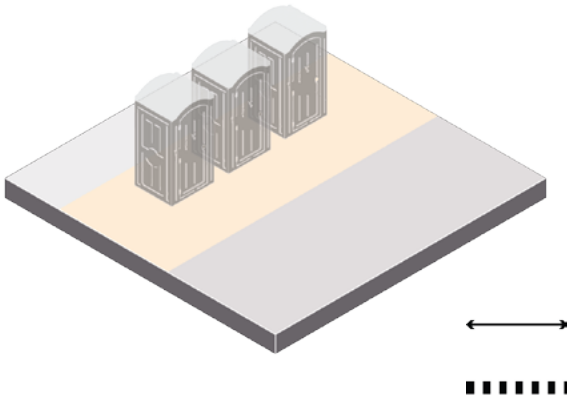
**Reclassification of zone functions**  
 Reclassification of OSR areas to allow for residential functions in certain cases, in order to offer safe public edges along waterways.

| Regulation                                                              | Collaboration                                                                                           | Consultation                                                            |
|-------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>TNSCZMA</li> <li>MoEF</li> </ul> | <ul style="list-style-type: none"> <li>Architects</li> <li>Planners</li> <li>Urban designers</li> </ul> | <ul style="list-style-type: none"> <li>Research Institutions</li> </ul> |



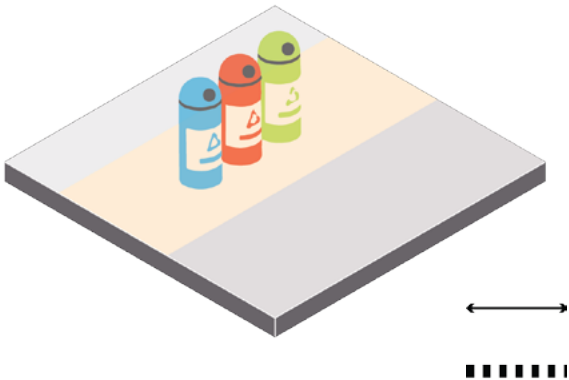
**Facilitate tenure security for residents**  
 Tenure security measures and subdivision of plots to facilitate modularity and flexibility in housing should be encouraged.

| Regulation                                                                          | Collaboration                                                             | Consultation                                                              |
|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>TNSCB</li> <li>Revenue Department</li> </ul> | <ul style="list-style-type: none"> <li>GoTN Finance Department</li> </ul> | <ul style="list-style-type: none"> <li>NGOs</li> <li>Residents</li> </ul> |



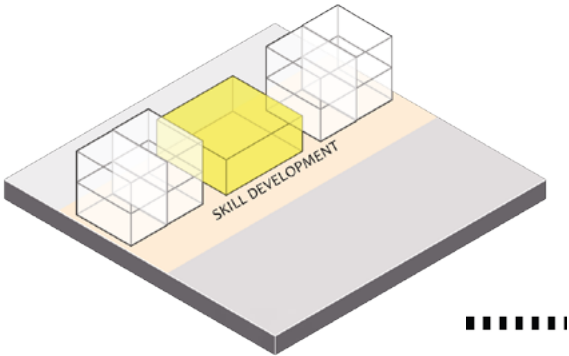
**Provide public toilets**  
 Open defecation due to the lack of adequate toilet facilities contributes to deterioration of public health. Public toilets need to be installed along primary links and within communities.

| Regulation                                                            | Collaboration                                                                                                  | Consultation                                                            |
|-----------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>GCC</li> <li>CMWSSB</li> </ul> | <ul style="list-style-type: none"> <li>Residents</li> <li>Ward committee</li> <li>Private companies</li> </ul> | <ul style="list-style-type: none"> <li>Research institutions</li> </ul> |



**Enable waste segregation**  
 In order to avoid dumping of garbage along water bodies, waste segregation bins need to be installed in multiple points and the residents must be educated on using them.

| Regulation                                                                    | Collaboration                                               | Consultation                                           |
|-------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------------------|
| <ul style="list-style-type: none"> <li>GCC</li> <li>Ward committee</li> </ul> | <ul style="list-style-type: none"> <li>Residents</li> </ul> | <ul style="list-style-type: none"> <li>NGOs</li> </ul> |



**Create skill development centres**  
 Each ward should have a skill development centre to equip residents, especially women, with skills that will aid economic growth and opportunities.

| Regulation                                                                                                 | Collaboration                                                                                                          | Consultation                                                                   |
|------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>TNSCB</li> <li>Fisheries Department</li> <li>Communities</li> </ul> | <ul style="list-style-type: none"> <li>NGOs</li> <li>Architects</li> <li>TNSCB - Community Development Wing</li> </ul> | <ul style="list-style-type: none"> <li>Community Council, residents</li> </ul> |

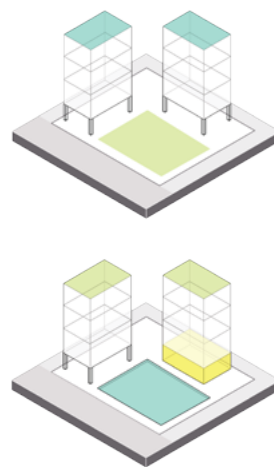


## Relation between the spatial framework and actions



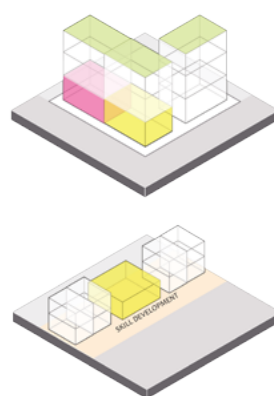
### Housing

Areas that could accommodate housing for the settlement to be rehabilitated - in parts of the settlement area and around primary link.



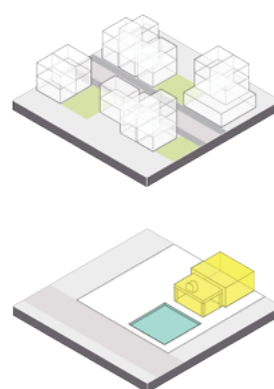
### Mixed use

Areas that could accommodate mixed use development with a combination of housing, and social and economic activities - around primary corridor, connecting existing commercial area.



### Public function

Areas that could create a network of small social and cultural spaces (built and open) along access routes within the housing areas that connect the central corridor and ecological edges.



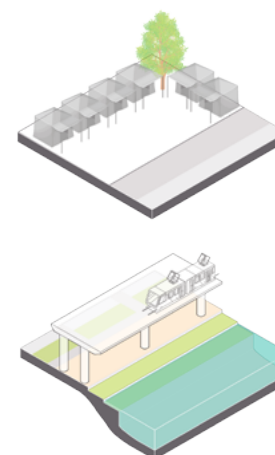
### Open green spaces

Areas that could be transformed into community greens (retention areas) - along primary and secondary links.



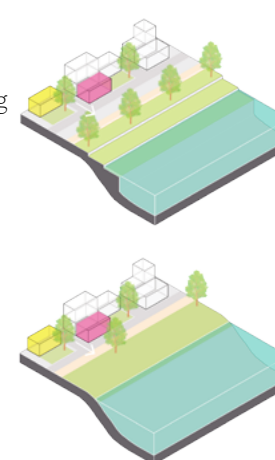
### Market areas

Areas that are flexible to host markets, fairs and other temporary functions and recreational events. This can also be accommodated under the MRTS bridge.

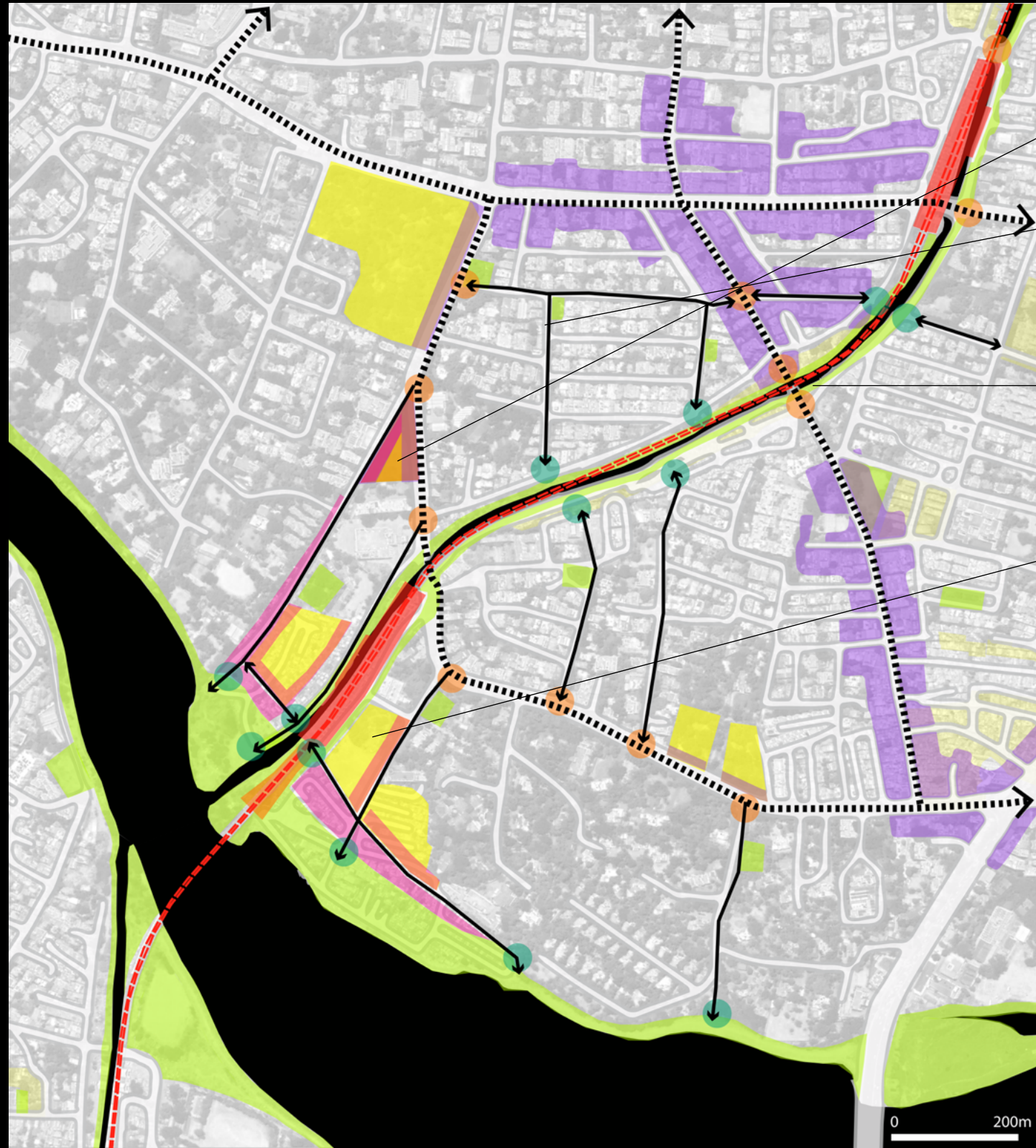


### Buffer areas

Areas that are located along the edges - nodes that house social and economic functions that interact with the edge. These could be built or open activities that engage the community in a healthy relationship with the ecology.







**Indeterminacy**  
Spaces who function is not fixed or discovered

**Connectivity**  
Networks and links between streets and blocks and green-blue networks

**Nature-inclusivity**  
Buffer spaces, retention areas and built environment in harmony with nature

**Modularity**  
Clustering of communities - each with their own social, cultural and economic functions and retention areas  
Activated nodes with functions

## Spatial Vision

The spatial vision is the combination of the different actions, spatial elements and goals. The actions respond to the goals, and the actions are in turn guided by the spatial framework - the elements.

The robustness of the spatial vision helps in building up a system that is resilient, through the principles.

### LEGEND

-  Buffer areas along ecological boundaries, respecting natural processes and conditions
-  Nodes of integration with ecology
-  Nodes of integration with the context
-  Primary corridors with existing commercial activity
-  Strengthen existing roads - link interactive spaces connecting nodes within and between settlements
-  Proposed links within and between settlements
-  Areas that can house different functions - not predefined
-  Existing zones of informal settlements
-  Existing zones of commercial areas



# Key Stakeholders & Incentives

## Key Stakeholders

There are a number of stakeholders that are essential to this project. These stakeholders have different capacities and the project aims to expand the capacities in order to create the conditions for successful adaptation.

## Incentives

The detailed list of actors and their responsibilities are elucidated here, following which they are grouped according to the type of actors and their capacities in order to identify incentives for their involvement in the process.

| Key Stakeholders                  | Level            | Current Capacities                                                                                                                                                                                              | Desired Capacities                                                                                                                                                                                                                                                     |
|-----------------------------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MoEFCC      CRZ                   | India            | CRZ zones classification and permissible activities                                                                                                                                                             | Revise permissible activities to curb industrial encroachment into ecologically sensitive areas, strict enforcement                                                                                                                                                    |
| GCC      CDMP                     | City             | Zone-wise plan for disaster response measures                                                                                                                                                                   | Involvement of civic society in adaptation                                                                                                                                                                                                                             |
| CRRT                              | City             | Eco-restoration plans for waterways within city                                                                                                                                                                 | Incorporate society in carrying out restoration at different points along the waterway, encourage local management of commons                                                                                                                                          |
| TNSCB                             | State            | Rehabilitation and resettlement to peripheral areas<br>In-house architects<br>Fixed tenement typologies with a focus on only housing                                                                            | Resettlement to parcels of land within a 2 km radius of current location<br>Alternate affordable housing delegated to private developers and architects<br>Involving communities in developing typologies based on requirements for housing, social and economic needs |
| CMDA                              | City             | Land use/ zoning and building regulations                                                                                                                                                                       | Revision of land use norms for Open Space and Recreational (OSR) areas to include residential functions and incorporate permeability rules in zoning norms<br>Definition of minimum buffer areas along waterways and coasts for tidal protection                       |
| Ward committees                   | Local            | No planning power, civic representation                                                                                                                                                                         | Enable planning power within committee with in-house planners to address issues within ward boundary<br>Civic representation in ward committee                                                                                                                         |
| Resilient Chennai Office          | City             | Resilience Strategy; access to solutions, service providers and partners from across public, private and non-profit sectors; and membership to a global network of member cities to learn from and collaborate. |                                                                                                                                                                                                                                                                        |
| World Bank      TNSF              | International    | Tamil Nadu Shelter Fund (TNSF) invests in affordable housing and/or in situ livelihood infrastructure for vulnerable people and economically weaker sections.                                                   | 1                                                                                                                                                                                                                                                                      |
| NGOs - IRCDUC, CRC, EFI, CET, CAG | City             | Carrying out restoration activities and social studies, and creating awareness among civil society about social and environmental issues                                                                        | Reaching out to the vulnerable communities and engaging them in restoration efforts                                                                                                                                                                                    |
| Resident and Community groups     | Local            | Insufficiently involved                                                                                                                                                                                         | Key stakeholders in decision-making represented in councils and ward committees                                                                                                                                                                                        |
| Private developers                | City             | Insufficiently involved                                                                                                                                                                                         | Funding and execution for projects, and incentivise transfer of ownership of land through TDR                                                                                                                                                                          |
| Architects and Engineers          | City             | Insufficiently involved                                                                                                                                                                                         | Affordable housing design and execution                                                                                                                                                                                                                                |
| Urban planners and designers      | City             | Insufficiently involved                                                                                                                                                                                         | Design of community spaces with the community residents                                                                                                                                                                                                                |
| Research institutions             | City/State/Natio | Technical assistance, scientific study and formulation of strategies                                                                                                                                            |                                                                                                                                                                                                                                                                        |
| Religious Bodies                  | Local            | Insufficiently involved                                                                                                                                                                                         | Collaborating with communities to preserve cultural values relating to environment                                                                                                                                                                                     |



# Key Stakeholders & Incentives

| Key Stakeholders                                                                                                                                                       | Current Capacities                                                                                                        | Desired Capacities                                                                                                                                                                                        | Incentives/ Key Interests                                                                                                                                                        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div><div></div> CMDA</div> <div>TNSCB</div> <div>GoTN - TNSDMA</div> <div>MoEFCC</div> <div>GCC</div> <div>Ward Committees</div> <div>CRRT</div> <div>RCO</div>       | <div>Current Norms and regulations</div> <div>Centralised control of development</div> <div>Subsidiary organisation</div> | <div>Revised Norms and regulations to incorporate systemic and societal goals</div> <div>Decentralised control of development and planners at local level</div> <div>Primary Operating organisation</div> | <div>Quicker results and assessment of sustainable development measures</div> <div>Easy management and coordination of different projects with vision-oriented development</div> |
| <div><div></div> Planners</div> <div>Architects</div> <div>Landscape architects</div> <div>Urban designers</div> <div>Builders / Developers</div> <div>Companies</div> | <div>Limited involvement in execution</div> <div>Limited role in funding</div>                                            | <div>Increased involvement in execution</div> <div>Increased role in funding</div>                                                                                                                        | <div>Financial incentives - tax exemption</div> <div>Subsidies on building materials</div> <div>Transferable Development Rights (TDR)</div> <div>Cross-subsidisation</div>       |
| <div><div></div> Research Institutions</div> <div>Universities</div>                                                                                                   | <div>Limited role in consultation</div>                                                                                   | <div>Increased role in consultation</div>                                                                                                                                                                 | <div>Funding/grants for research</div>                                                                                                                                           |
| <div><div></div> NGO</div> <div>NPO</div> <div>IGO</div>                                                                                                               | <div>Act independently of government agenda</div>                                                                         | <div>Increased alignment and coordination with government plans and goals</div>                                                                                                                           | <div>Funding</div>                                                                                                                                                               |
| <div><div></div> Community councils/organisations</div> <div>Religious groups</div> <div>Resident Welfare Associations</div> <div>Support groups</div>                 | <div>Involved to a limited extent in decision-making and execution</div>                                                  | <div>Increased agency in decision-making process and management of built environment</div>                                                                                                                | <div>Build accountability</div> <div>Quality of life</div> <div>Sense of ownership and empowerment</div>                                                                         |



An aerial photograph of a city, likely Chennai, India, showing a dense urban area with a river and green spaces. The river is a dark, winding shape in the center, surrounded by lush green trees and vegetation. The city buildings are visible in the foreground and background, with some areas showing more dense, colorful structures. The overall scene is a mix of urban development and natural greenery.

# 8 Development & Conclusions

## Introduction to chapter

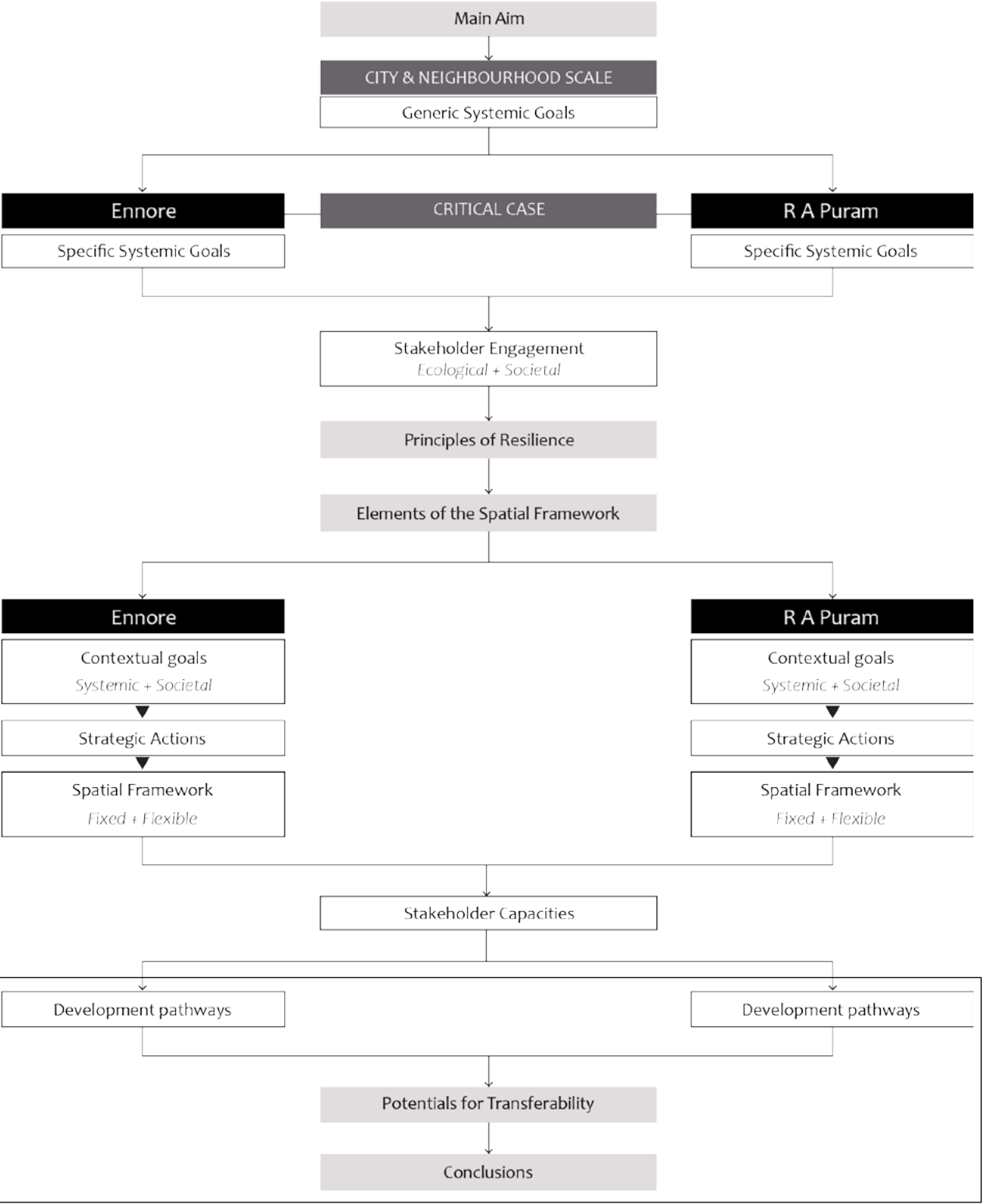
This chapter builds on the spatial framework and vision from the previous chapter and sets out to reveal the development process, taking into consideration the engagement of different stakeholders through the process. In order to do so, the phasing of the actions are first developed, and the key stakeholders, policies and platforms required at the different phases are identified. Subsequently, two extreme scenarios of stakeholder interaction are considered, based on which the development pathways are revealed. In addition, this chapter highlights some of the spatial qualities of the proposed pathways.

The chapter culminates with the conditions for transferability of the adaptation measures in order to reveal the generic and specific elements in transferability, and the final conclusions of the thesis in relation to the research questions.

## Contents

- Timeline & Phasing
- Development Pathways
- Transferability
- Conclusions





Introduction

The previous chapters have highlighted the spatial conditions of climate vulnerability, the local cultural values, and consequently, the adaptive planning framework and the adaptation measures that contribute towards mitigation of climate effects while also contributing to spatial justice. In this chapter, the unfolding of the adaptation process will be highlighted, under specific governance scenarios.

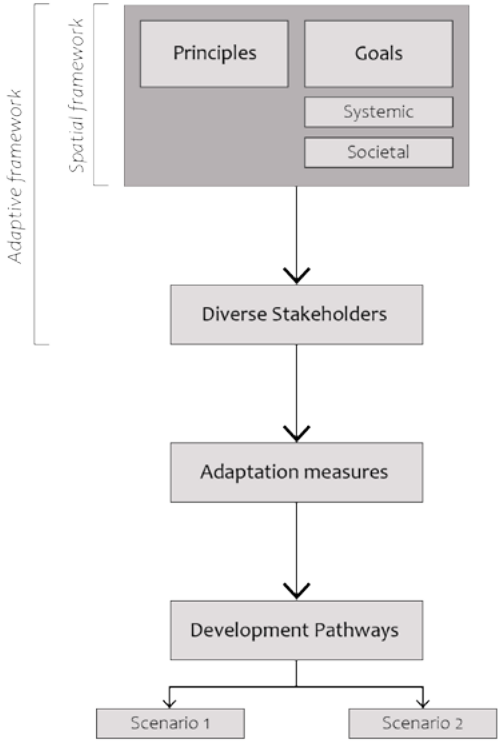
The aim is to reveal different possibilities of development based on the capacities of the stakeholders, policies and platforms that control development.

Process

The chapter first proposes a phasing strategy for the development process, following which it outlines the evolutionary goals in the two systems - the societal and ecological which reveal desirable functional characteristics or qualities of these systems. A detailed action-wise phasing is then carried out for each of the cases.

After this, the chapter discusses the scenarios based on which the development pathways are represented in each case, revealing the key conditions and variables in each. The development pathways follow specific actions by diverse stakeholders. The future transformation in the ideal scenario is represented in detail, showing the spatial qualities of the proposed transformations.

Lastly, the transferability of the adaptation measures are discussed, exposing the generic and specific aspects that need to be considered in doing so. The final conclusions of the thesis present the research questions and a summary of how they have been addressed, offering a comprehensive picture of the project.





# Timeline & Phasing

## Phasing

The development is divided into four phases - the initiation phase, the execution phase, the activation phase and the performance phase. The phases are divided according to the priorities (sequence) of actions. Each phase is defined by certain types of actions that are required to be completed in order to provide the base conditions for other actions to take place. The phasing does leave room for experimentation and flexibility with respect to actions that need to be tested in order to implement them.

The phasing strategy also takes into consideration the time required to encourage multiple actors, especially local communities, to actively carry out actions.

| INITIATION PHASE                  | EXECUTION PHASE  | ACTIVATION PHASE              | PERFORMANCE PHASE  |
|--------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| Setting up the initial conditions and policies for executing projects to achieve the societal and ecological goals | Implementation of key projects in the living environments, following the societal goals           | Activating the local area through various functions that elevate them from dormant to performative environments | Evaluation of the performance of the environment in alignment with the goals                          |
| Project experimentation phase which informs policy changes in later stages                                         | Continuation and monitoring of strategic projects for evaluation                                  | Facilitating the formation of networks for collective action                                                    | Periodic revision of policies to initiate actions based on current performance/ conditions            |

| Evolutionary Goals |                           | 5 years                                                               | 10 years                                                                           | 15 years                                                                                |
|--------------------|---------------------------|-----------------------------------------------------------------------|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Ecological Goals   | Environmental Restoration | Improved quality of water, reduction in pollution                     | Restored activities on water bodies, like fishing                                  | Water provides opportunity for new economic and recreational activities                 |
|                    | Water Inclusivity         | Reduction in flooding impact, improvement in ground water table       | Reduction in flooding impact, adapting to SLR, stabilisation of ground water table | No flooding impact - the urban environment is able to adapt to extreme rainfall and SLR |
| Societal Goals     | Living Space              | Rehabilitation of existing settlements                                | Improved quality of life in rehabilitated settlements                              | Residents have more power and are able to transform their living environments           |
|                    | Economic Space            | Reduction in poverty levels and increase in number of employed people | Stabilisation of local economy                                                     | New economic activities within the settlements responding to external changes           |
|                    | Community Space           | Increased social/public activity within the community                 | Increased participation in planning and design process                             | Agency over public realm to cope with unforeseen events and external pressures          |

## Evolutionary Goals

The evolutionary goals are a part of the final phase - the performance phase. Towards the end of the activation phase the assessment begins, with the evolutionary goals guiding the adaptation pathways every 5 years. These are called evolutionary because they are incremental in nature, using the preceding goal as a starting point.

The goals are outlined according to the societal and ecological channels discussed earlier. These goal give rise to new possibilities in linking the societal and ecological systems over time.

## Stakeholder Involvement

The key stakeholders and platforms in the development process are revealed. These stakeholders are classified according to the phase in which they are involved or need to be involved. Based on the policy changes involved in the initial steps, the scenarios are derived, leading to different pathways.

Involvement Phases:

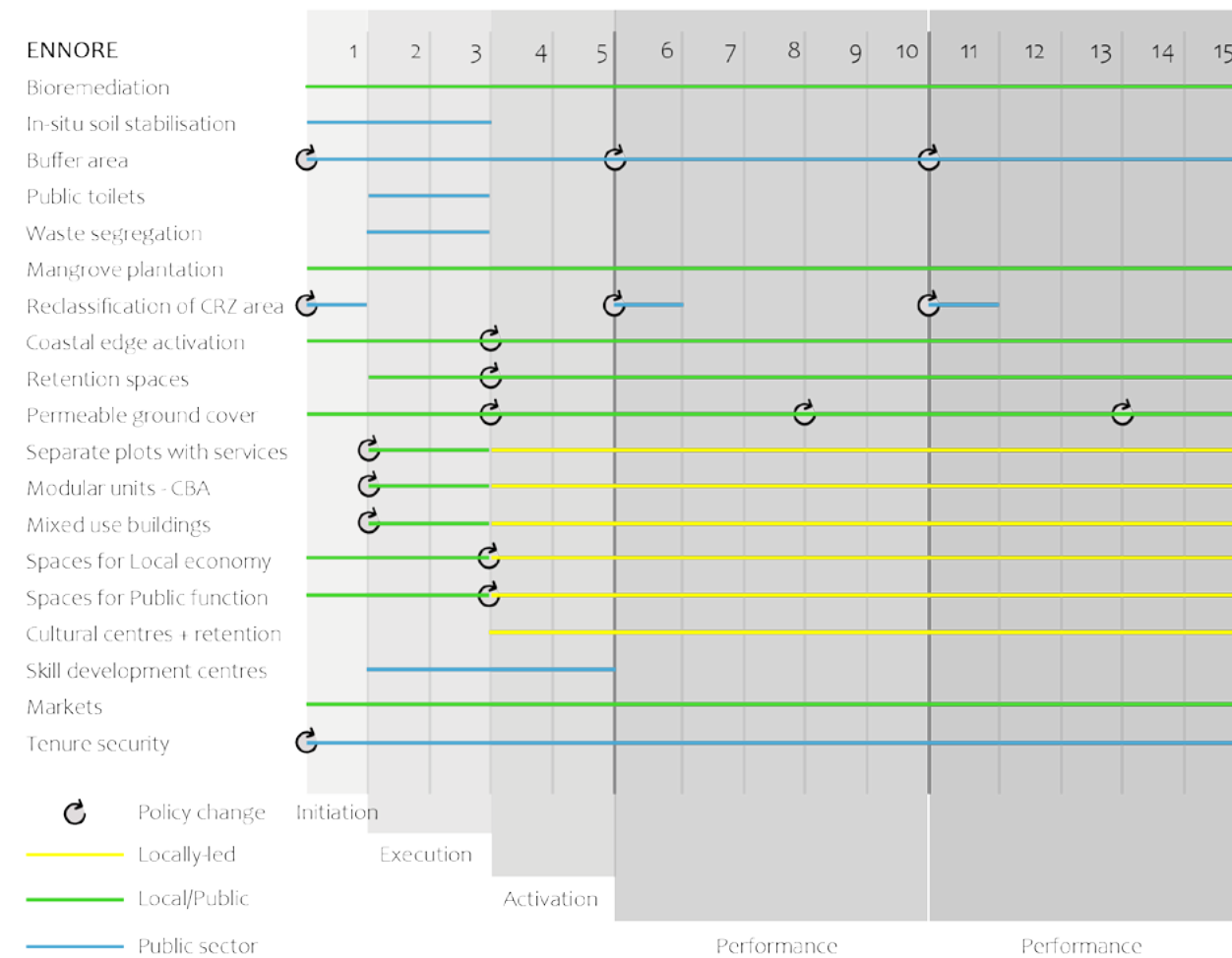
- 1 - Initiation phase
- 2 - Execution phase
- 3 - Activation phase
- 4 - Performance phase

| Stakeholder                       | Platform | Level               | Involvement Phase |   |   |   |
|-----------------------------------|----------|---------------------|-------------------|---|---|---|
|                                   |          |                     | 1                 | 2 | 3 | 4 |
| MoEFCC                            | CRZ      | India               |                   |   |   |   |
| GCC                               | CDMP     | City                |                   |   |   |   |
| CRRT                              |          | City                |                   |   |   |   |
| TNSCB                             |          | State               |                   |   |   |   |
| CMDA                              |          | City                |                   |   |   |   |
| Ward committees                   |          | Local               |                   |   |   |   |
| Resilient Chennai Office          |          | City                |                   |   |   |   |
| World Bank                        | TNSF     | International       |                   |   |   |   |
| NGOs - IRCDUC, CRC, EFI, CET, CAG |          | City                |                   |   |   |   |
| Resident and Community groups     |          | Local               |                   |   |   |   |
| Private developers                |          | City                |                   |   |   |   |
| Architects and Engineers          |          | City                |                   |   |   |   |
| Urban planners and designers      |          | City                |                   |   |   |   |
| Research institutions             |          | City/State/National |                   |   |   |   |
| Religious Bodies                  |          | Local               |                   |   |   |   |



# Timeline & Phasing

## CRITICAL CASES



### Introduction

The timeline for the actions in the critical cases follow the phasing strategy discussed ahead. Each action is indicated with a line of a certain colour representing the key stakeholder involved in it. These are classified into:

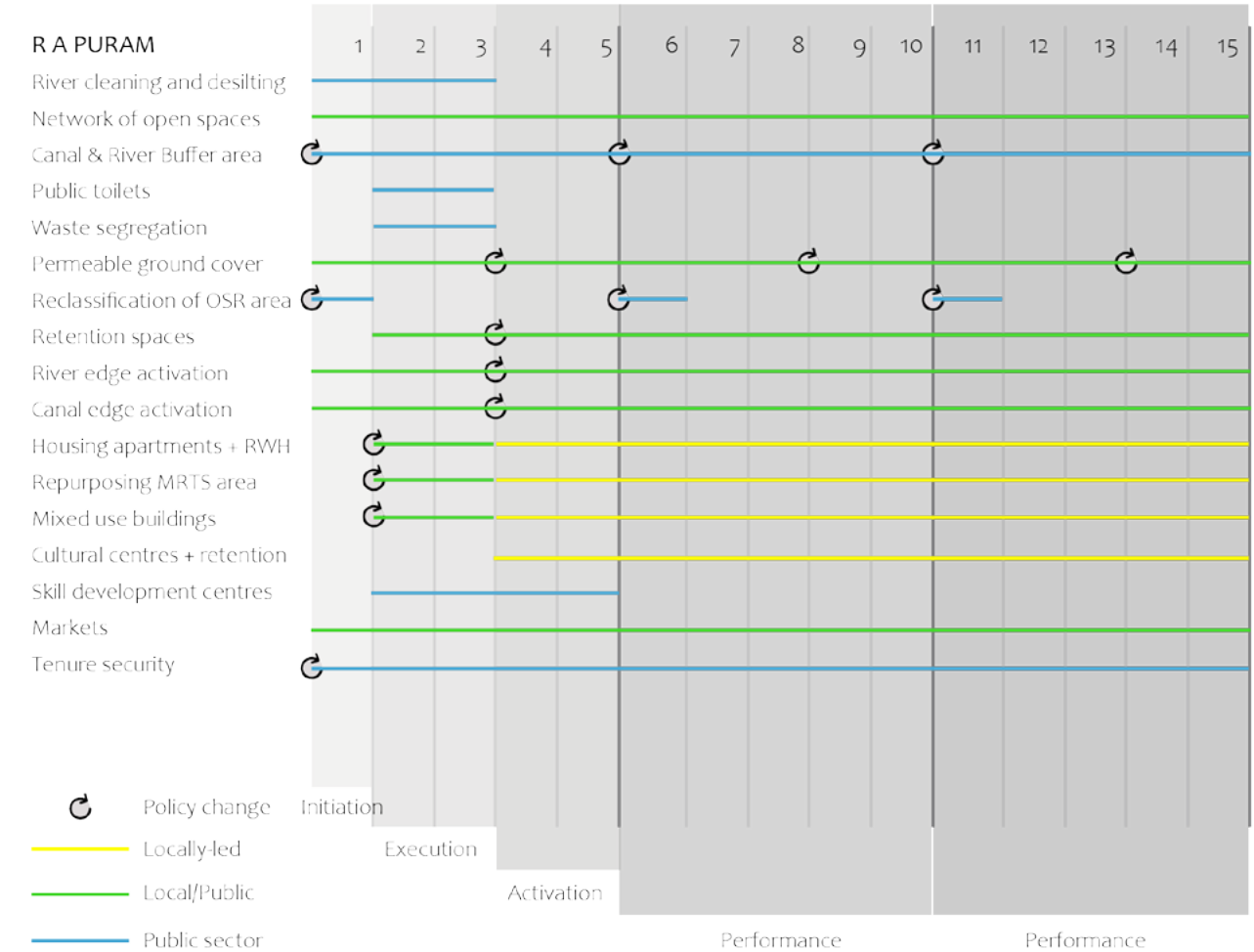
- Locally-led: Actions led by non governmental organisations, community groups or private sector companies
- Local/Public: Actions that could be led by either the government, local community, NGOs or private sector
- Public sector: Actions led by the government agencies

The timeline also marks the policy changes that are required during different phases for certain actions to be executed or for other actors to be activated.

### Ennore

In this case, in order to initiate the process of development, tenure arrangements must be made and buffer areas must be delineated. The reclassification of the CRZ area to curb industrial expansion is a crucial step, although external to the local development strategy, since it affects the contamination level of water bodies. The rehabilitation process depends on the change in policy and capacity of TNSCB.

The activation of community spaces through public functions, temporary and permanent, are tested in the first few years, resulting in its incorporation into planning frameworks, and regularisation based on the success of the experiments. Some actions are tested and incorporated into policy cyclically, based on the conditions at the time. These are revised every 5 years during the performance phase.

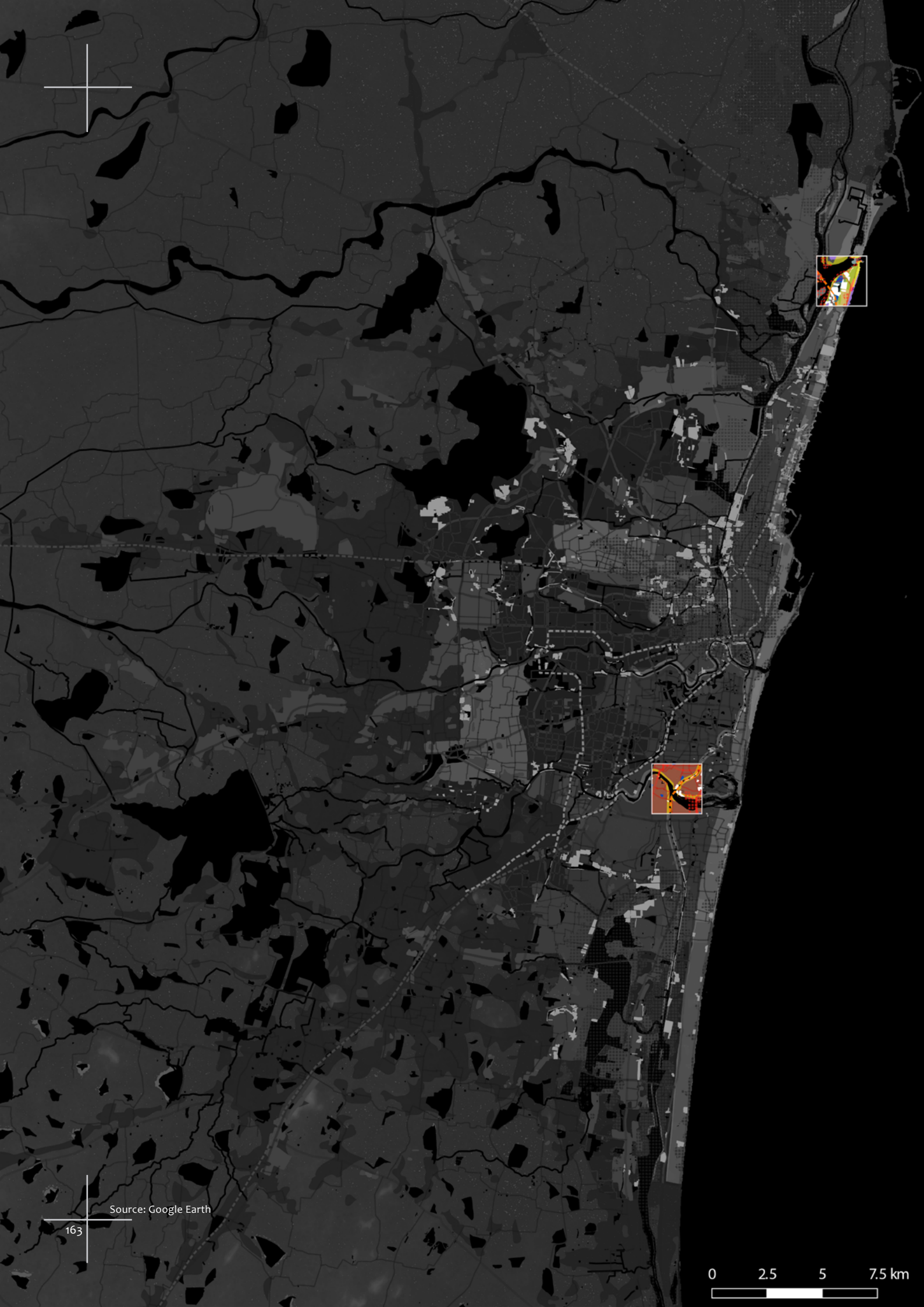


### R A Puram

This case follows a similar timeline as Ennore. However, in this case, the reclassification of the OSR area to allow housing function determines the location of the rehabilitation.

Similar to the case in Ennore, some actions are tested out by multiple actors in the initial years, but during the activation phase, the community starts to take over. While some actions, like skill development centre and housing are limited in time frame, some actions, such as edge activation and markets do not have a limited time frame and could happen any time.

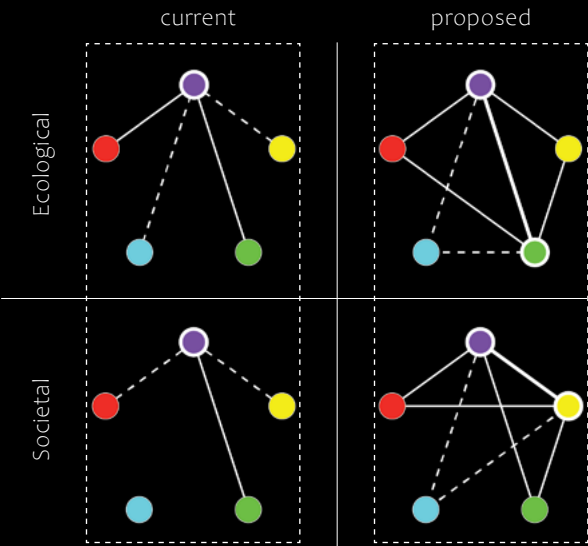




# Development Pathways

## Process

The development pathways in each site depend on the timeline discussed before, and the capacities of the actors involved. Leading from there, the scenarios are defined according to th stakeholder interaction models proposed:



The least preferred and the most ideal scenario are considered to guide the development pathways.

- LEGEND
- public sector
  - non-governmental organisations
  - research/academia
  - private sector
  - community groups

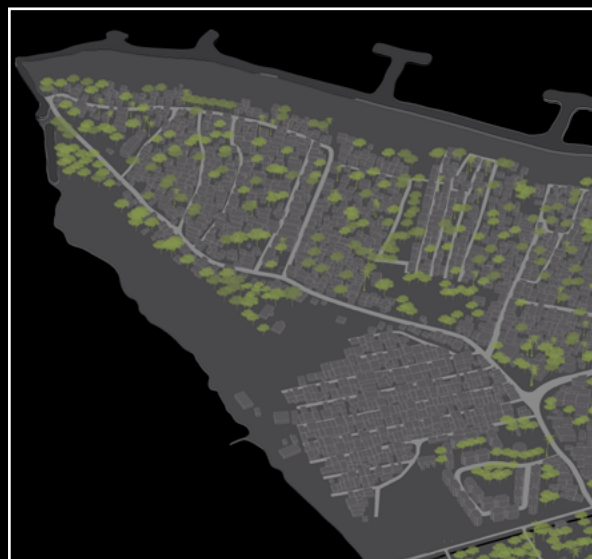


# Development Pathways

## ENNORE

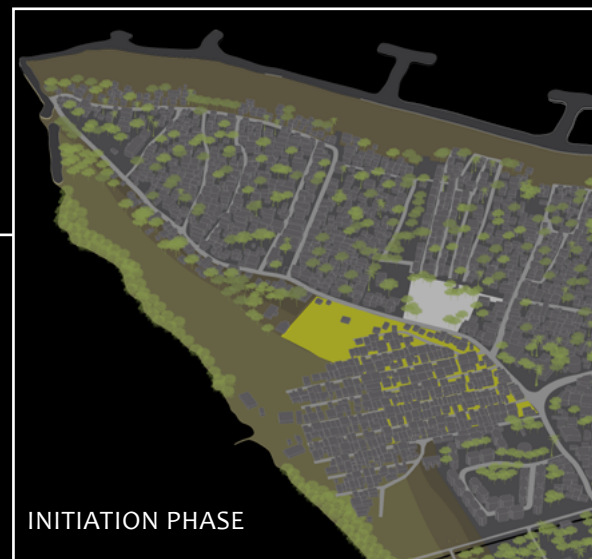
### Scenario 1

- Public sector control over decision-making with respect to ecological goals, execution by NGOs and public sector, consultation with other stakeholders
- Public sector control over decision-making and implementation with respect to the societal goals, activation by NGOs, consultation with community groups



#### EXISTING CONDITION

Assumptions: In-situ rehabilitation due to proximity to creek as the community depends on fishing for their livelihoods.



#### INITIATION PHASE

| Actor                 | Role                                                               |
|-----------------------|--------------------------------------------------------------------|
| CMDA                  | Delineation of buffer area                                         |
| TNSCB                 | In-situ rehabilitation proposed, temporary shelter area identified |
| NGOs<br>CRRT<br>TNPCB | Remediation work begins                                            |

### Scenario 2

- Public sector and NGOs have shared control over decision-making with respect to ecological goals, execution by other actors, including the community
- Public sector and community groups have shared control over decision-making with respect to the societal goals, implementation by private actors, activation by NGOs

1



#### EXECUTION PHASE

| Actor                 | Role                                                                 |
|-----------------------|----------------------------------------------------------------------|
| TNSCB                 | Rehabilitation through TNSCB tenements without community involvement |
| Private sector        | Mixed use buildings                                                  |
| NGOs<br>CRRT<br>TNPCB | Continuation of restoration and naturalisation of edge               |
| TNSDC                 | Skill development centres                                            |



#### ACTIVATION PHASE

| Actor             | Role                                          |
|-------------------|-----------------------------------------------|
| NGOs              | Public awareness creation in communities      |
| Community         | Community gardens and other appropriations    |
| Community<br>NGOs | Temporary markets, fairs and workshops        |
| Ward committee    | Retention area developed - large public space |

2



#### EXECUTION PHASE

| Actor                              | Role                                                                                        |
|------------------------------------|---------------------------------------------------------------------------------------------|
| Community<br>Private sector        | Rehabilitation by private sector in collaboration with community groups                     |
| Private                            | Mixed use buildings                                                                         |
| NGOs<br>CRRT<br>TNPCB<br>Community | Continuation of restoration and naturalisation of edge with local community groups involved |
| TNSDC                              | Skill development centres                                                                   |



#### ACTIVATION PHASE

| Actor                              | Role                                                                   |
|------------------------------------|------------------------------------------------------------------------|
| Community                          | Appropriation of living environments and public spaces by communities  |
| Community<br>NGOs                  | Temporary markets, fairs and workshops                                 |
| NGOs<br>CRRT<br>TNPCB<br>Community | Restoration continues as communities adapt to changing edge conditions |
| Ward committee                     | Retention area developed - large public space                          |



# Development Pathways

ENNORE

Scenario 2



**NODES**  
Corner functions connecting the communities to the primary link

**PRIMARY CORRIDORS**  
Primary link - mixed use buildings + large public spaces + market areas

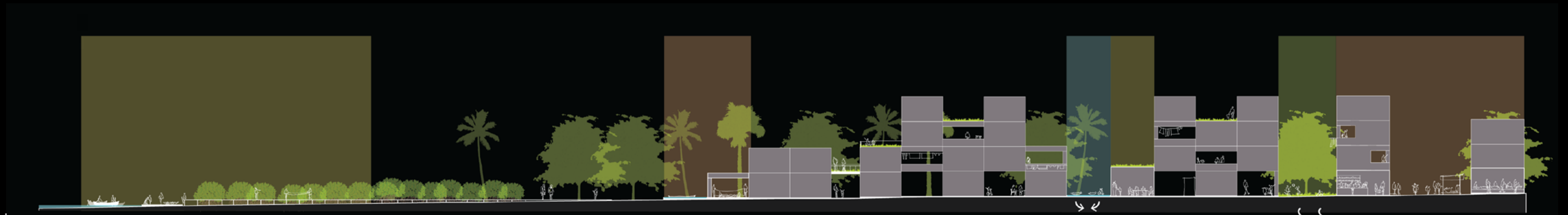
**SECONDARY LINKS**  
Secondary links connecting nodes with community spaces and gardens

**ZONES**  
Retention area and flexible gathering space for festivals linked to temple, centrally accessible

**EDGES**  
New edges of economic activity  
Renaturalised edges responding to creek health and flooding

## PERFORMANCE PHASE

Development of mixed use functions, spaces for local economy at the edges and public functions within the communities  
Settlements adapt to natural edge, and are protected by it



CREEK EDGE

Development &  
Conclusion



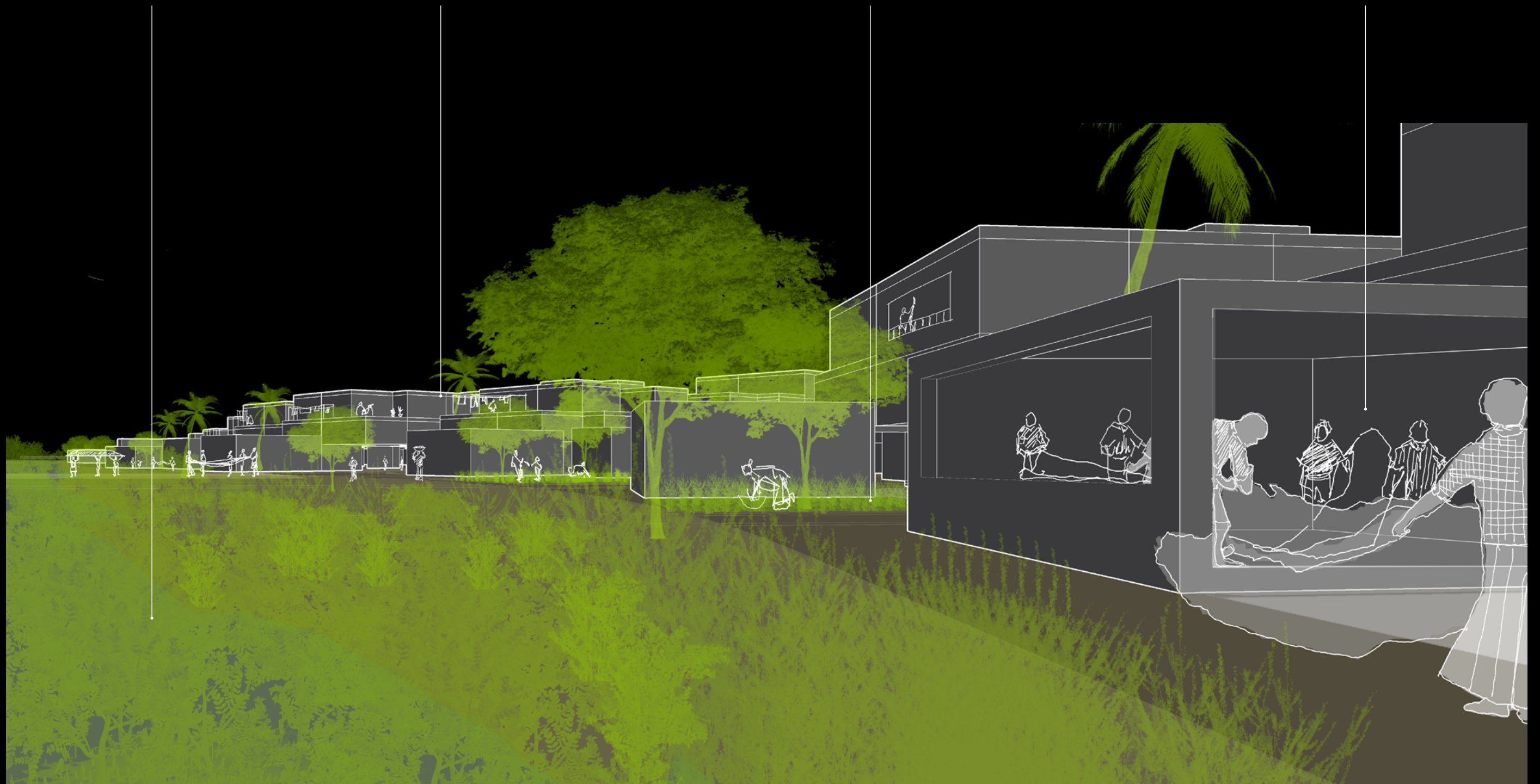
# Vision for Ennore

Bioremediated edges with mangroves to restore system health and protect the coastline from erosion and accretion

Incremental living spaces, offering residents the flexibility to build as they need, with integrated terrace greens and RWH systems

Open spaces adjoining the community spaces for community gardening or as pockets of play areas for children

Spaces for local economy (fishing) which could be used for gathering by community women or other self help groups



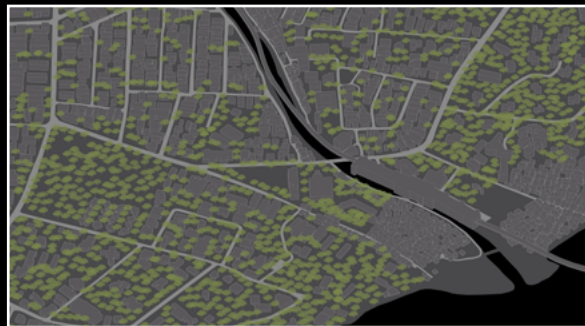


# Development Pathways

## R A PURAM

### Scenario 1

- Public sector control over decision-making with respect to ecological goals, execution by NGOs and public sector, consultation with other stakeholders
- Public sector control over decision-making and implementation with respect to the societal goals, activation by NGOs, consultation with community groups



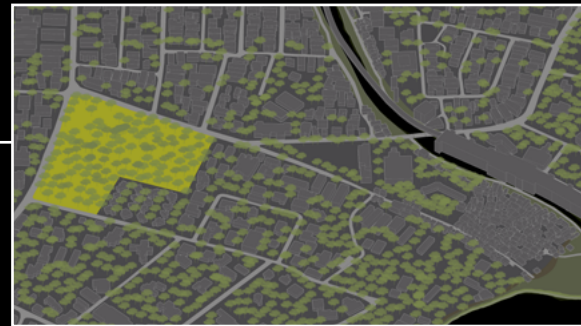
### EXISTING CONDITION

Assumptions: Scenarios are based on whether the OSR rules are changed by CMDA to allow housing functions

### Scenario 2

- Public sector and NGOs have shared control over decision-making with respect to ecological goals, execution by other actors, including the community
- Public sector and community groups have shared control over decision-making with respect to the societal goals, implementation by private actors, activation by NGOs

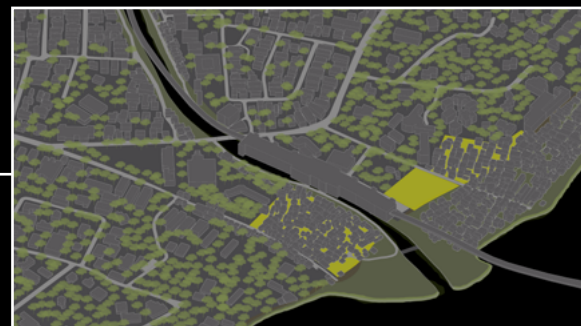
1



### INITIATION PHASE

| Actor                 | Role                          |
|-----------------------|-------------------------------|
| CMDA                  | Delineation of buffer area    |
| TNSCB                 | Rehabilitation areas selected |
| NGOs<br>CRRT<br>TNPCB | Remediation work begins       |

2



### INITIATION PHASE



### EXECUTION PHASE

| Actor                   | Role                                                                                  |
|-------------------------|---------------------------------------------------------------------------------------|
| TNSCB                   | Rehabilitation through TNSCB tenements without community involvement                  |
| Private sector          | Mixed use buildings                                                                   |
| NGOs<br>CRRT<br>TNPCB   | Continuation of restoration and naturalisation of edge                                |
| TNSDC<br>Private sector | Skill development centres and other public functions creating nodes close to the edge |



### EXECUTION PHASE

| Actor                              | Role                                                                                        |
|------------------------------------|---------------------------------------------------------------------------------------------|
| Community<br>Private sector        | Rehabilitation by private sector in collaboration with community groups                     |
| Private sector                     | Mixed use buildings                                                                         |
| NGOs<br>CRRT<br>TNPCB<br>Community | Continuation of restoration and naturalisation of edge with local community groups involved |
| TNSDC                              | Skill development centres and other public functions creating nodes close to the edge       |



### PERFORMANCE PHASE

| Actor             | Role                                         |
|-------------------|----------------------------------------------|
| NGOs              | Public awareness creation in communities     |
| Community         | Community gardens and other appropriations   |
| Community<br>NGOs | Temporary markets, fairs and workshops       |
| Private sector    | New public spaces along access route to edge |



### PERFORMANCE PHASE

| Actor                              | Role                                                                                        |
|------------------------------------|---------------------------------------------------------------------------------------------|
| Community                          | Appropriation of living environments and public spaces by communities                       |
| Community<br>NGOs                  | Temporary markets, fairs and workshops under MRTS spaces                                    |
| NGOs<br>CRRT<br>TNPCB<br>Community | Restoration continues as changing edge conditions offer opportunities for the community     |
| Ward committee                     | Retention area developed - large public space connecting the surrounding fabric to the edge |



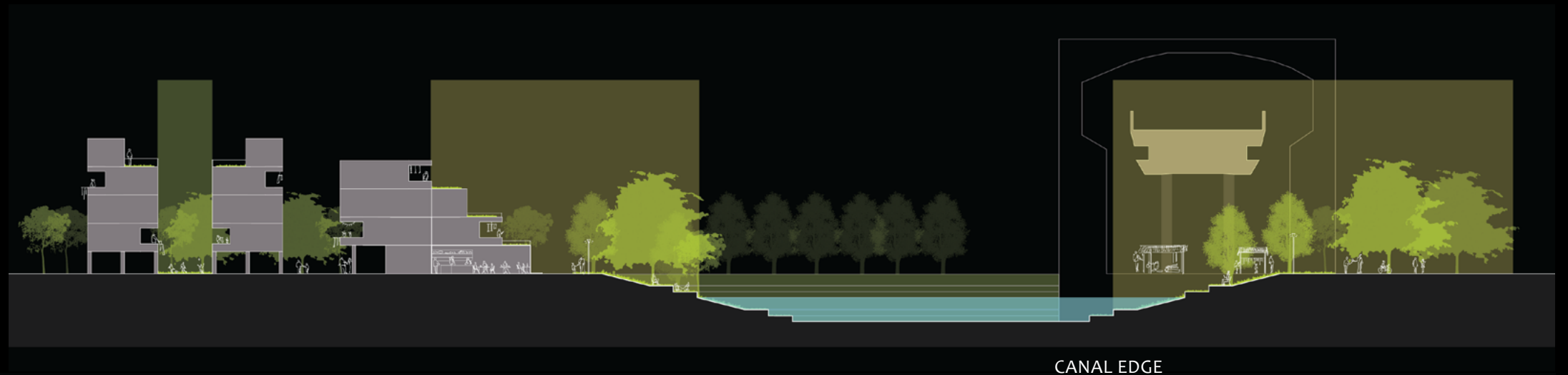
# Spatial Quality



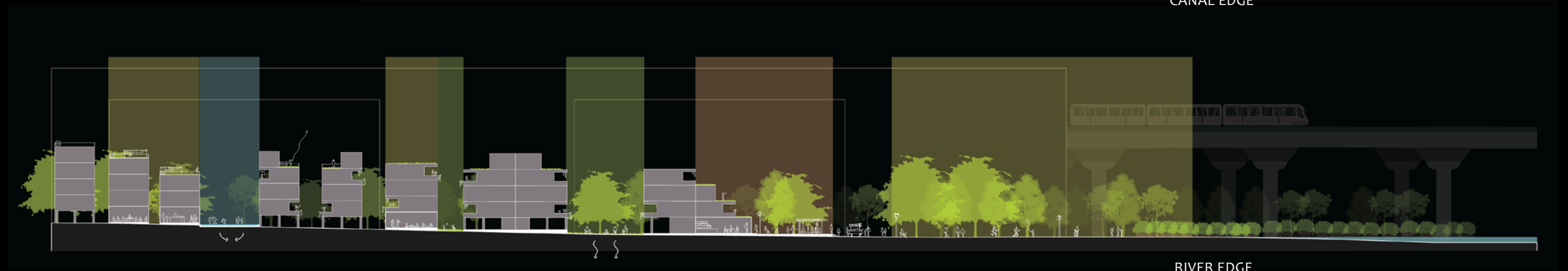
- NODES**  
Public spaces at nodes connecting the neighbourhoods to the canal edges to activate them
- PRIMARY CORRIDORS**  
Mixed use buildings + large public spaces + temporary event / market areas
- SECONDARY LINKS**  
Secondary streets connecting the primary link and the edge with community spaces
- ZONES**  
Retention and flexible gathering spaces connecting the settlements with the surrounding fabric
- EDGES**  
New ecological edge + public spaces and recreational activity along the river  
Renaturalised edges of the canal with nodes of public functions linking neighbourhoods

## PERFORMANCE PHASE

Development of spaces for public activity at the edges and mixed use functions along the access routes to the edge  
Settlements adapt to natural edge, and are protected by it  
Medium-sized public spaces as retention zones along primary corridor and flexible zones for temporary functions that attract people towards the edge



CANAL EDGE



RIVER EDGE



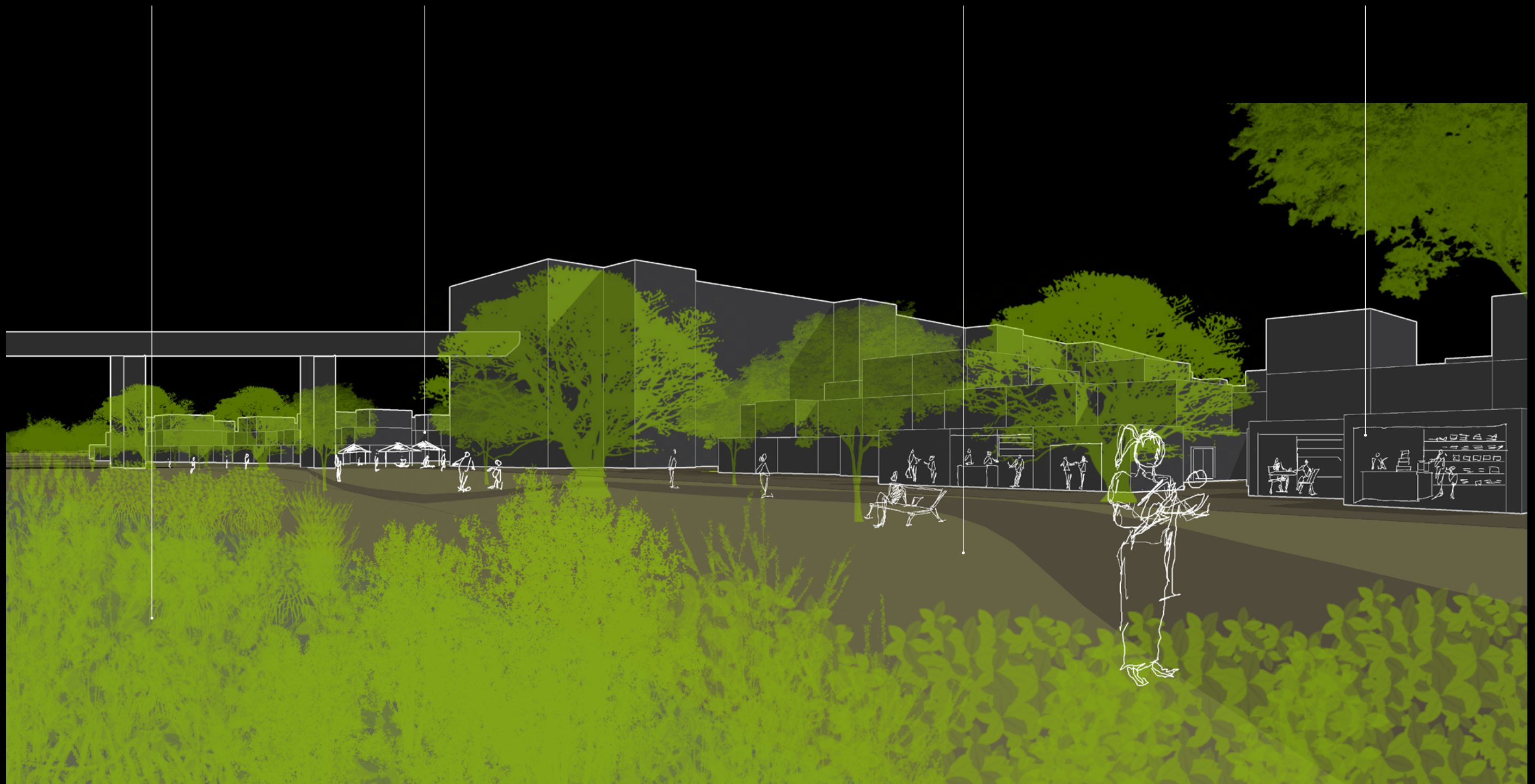
# Vision for R A Puram

Soft river edges to allow room for water level fluctuations and increase the biodiversity of the area, maintained by the local community

Spaces under the MRTS line used for temporary stalls and markets, activating the edge of the canal

Large leisure spaces in the buffer area for people of the city to enjoy the natural surrounding

Living spaces with shops adjoining them to offer economic opportunities for local community



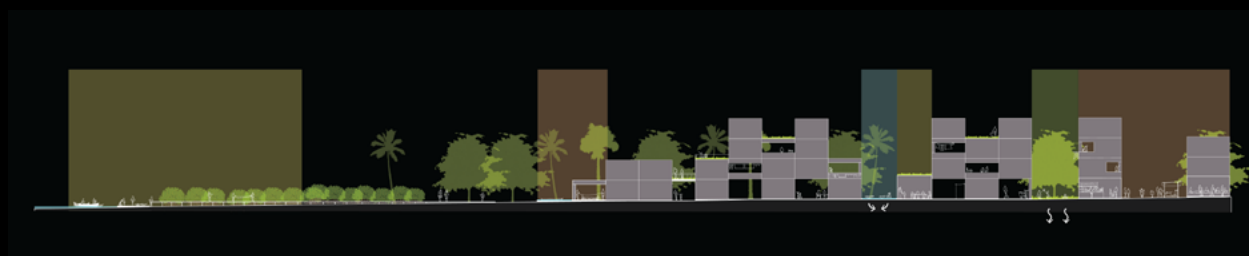


# Transferability

## Creek & Coastal edge

Vulnerable to coastal flooding - sea level rise

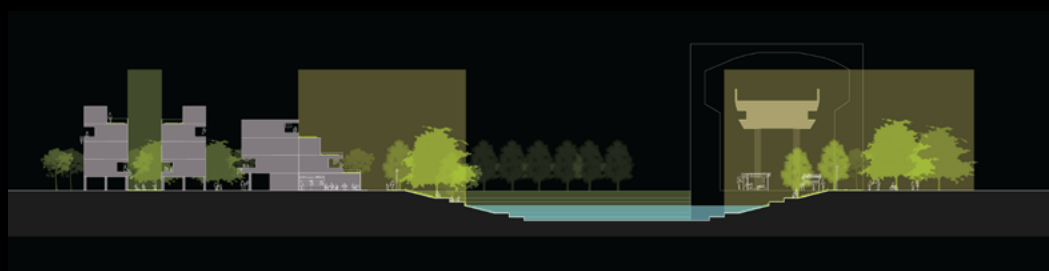
Residents dependent on natural ecology for livelihoods such as fishing activity



## Canal edge

Vulnerable to pluvial flooding

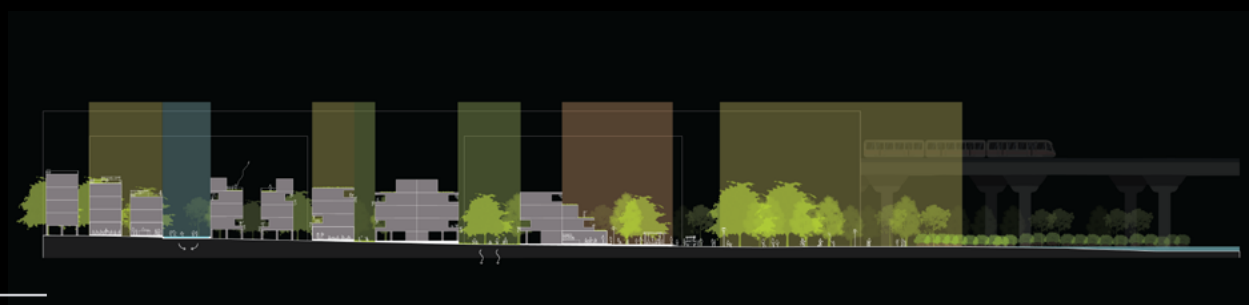
Residents are dependent on proximity to opportunities for livelihoods



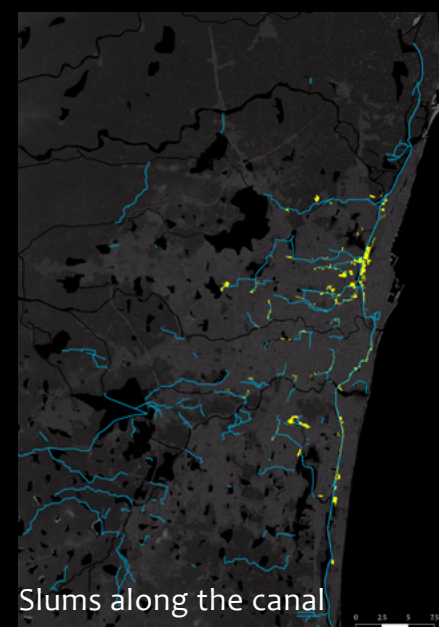
## River edge

Vulnerable to pluvial flooding

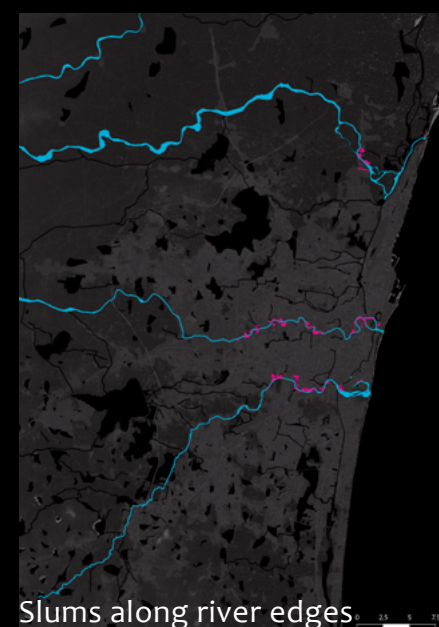
Residents are dependent on proximity to opportunities for livelihoods



Coastal slums



Slums along the canal



Slums along river edges

## Conditions for Transferability

Most of the adaptation measures are transferable to sites that have a similar edge conditions and ecological challenges as the critical cases.

However, the societal aspect, especially of the local culture and use of space, has to be considered in the shaping of the living environments, making it specific to the context. The context plays an important role in the measures, as it is linked with local development.

The framework is in itself transferable to other areas within the city and elsewhere. The specificity lies in the cultural value and components.



# Conclusions

## Research Sub-Questions

- RSQ. 1**  
What are the spatial conditions that contribute to climate vulnerability in Chennai?
- RSQ. 2**  
How can local culture guide adaptation measures within CMA?
- RSQ. 3**  
How can adaptive planning contribute towards spatial justice?
- RSQ. 4**  
What are the spatial adaptation measures required to mitigate climate effects in vulnerable areas within CMA?
- RSQ. 5**  
To what extent can the proposed adaptive measures unfold within the current territorial decision-making process?

**Main Research Question**  
How can local adaptation measures in vulnerable areas contribute towards systemic mitigation of climate effects in order to achieve environmental and spatial justice?

The distribution of the biophysical, socio-economic and institutional factors that contribute to climate vulnerabilty differ in their nature across the city. It is the combined effect of many such factors that exacerbates climate vulnerability in some places over the others, making them critical areas. In Chennai, the primary differences are in the biophysical conditions (exposure) and the socio-economic characteristics of the settlements.

As explained in each case, the local socio-economic characteristics and cultural identities that are expressed through space, offer insights into the requirements of these communities and their core attachment to their place. The integration of the cultural component within local development by linking societal and ecological challenges to create spatial challenges, helps guide adaptation measures.

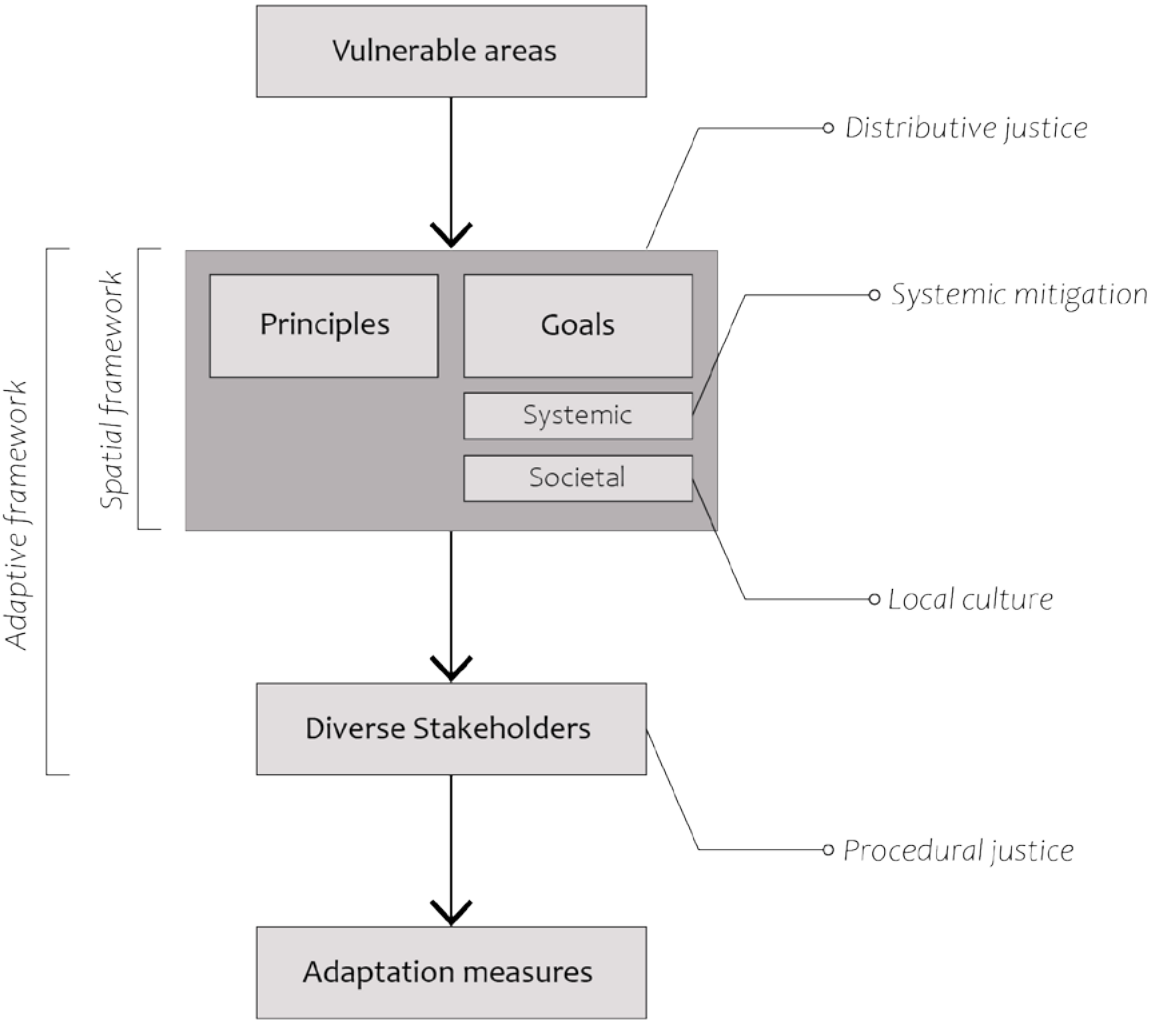
Adaptive planning encompasses a diverse set of stakeholders or actors that could carry out adaptation measures based on common goals. The spatial framework, with the spatial elements and the principles guide the translation of the goals into the actions. The flexibility that the framework offers allows a broader set of actors, including the communities, to be a part of the adaptation process, making it just.

The measures are tailored to each case with some overlapping actions between the two. This is considered taking ecological and societal challenges together in the development of networks, nodes and spaces that afford multiple functions. These measures come together, enabled by the spatial framework, to create the spatial vision.

The current decision-making process falls short in several ways. The transformations rely heavily on the government bodies (public sector) with little to no involvement of the residents themselves. In addition, the key regulating bodies lack the integration of spatial rules that pertain to climate hazards . These are the bottlenecks in the governance process in carrying out adaptation measures. The adaptive planning model offers the flexibility of a multiple-actor setting.

The local adaptation measures outlined in the project involve coordination among various agencies and stakeholders in carrying them out. Most importantly, it addresses the concerns of the poor while addressing challenges brought on by climate. In this regard, instead of just viewing the poor as being at risk from climate threats, but also involving the residents in

actively managing their environment and contributing to mitigation efforts, would be a key element in spatial justice - the procedural aspect. The societal and ecological components of the project are addressed spatially and procedurally.





# 9 Reflection

## Introduction to chapter

This chapter includes the following sections:

### Reflecting on Ethics and Project Value

- Ethical Considerations
- Scientific Relevance
- Societal Relevance

### Reflecting on Methodology

- Research and Design Components
- Potential for Transferability
- Research Limitations

### Reflecting on the Studio and Course



Reflecting on Ethics and Project Value

Ethical Considerations

On slums: Tamil Nadu has seen a consistent decrease in poverty over the years and the state has implemented successful pro-poor policies in the past. However, the dynamics have changed in the last decade or two, and this change has impacted the slum rehabilitation strategies in the city. What this thesis does is to offer a more integrated method of decision-making for rehabilitation that attempts to bring the slum inhabitants themselves into the process. However, the alternative strategies have taken into account the risk involved in upgrading and rehabilitation in-situ, thereby maintaining resettlement as an option. While this could potentially affect the communities in some ways, the issue has been addressed by defining a radius within which the resettlement could take place, in order to encourage a positive relationship with the ecology, and at the same time, remove them from risk.

On norms: The Chennai Metropolitan Development Authority (CMDA) has laid out a clear set of rules and regulations based on land use and zoning plans. However, there are many inconsistencies evident in the execution of projects, in which these norms are flouted by different parties – both private and public. This is also seen in the violation of the Coastal Regulation Zone (CRZ) norms by the industries encroaching highly ecologically sensitive areas. This posed a challenge in the realistic representation of planning processes and the project bases interventions on the assumption that the rules will be enforced no matter what. This could potentially affect the actual implementation of projects when, if not realised to the set standards, the interventions cause more harm than good to the communities at stake.

On resilience: When it comes to resilience, it is essential to define for whom and from what, but it is also crucial to make sure that resilience for one group does not mean vulnerability for another (Cote and Nightingale, 2012). The project addresses the vulnerability of the socio-economically weak in ecologically sensitive areas from climate-related events, and puts these sections of the society first. However, some of the strategies require some transformations that could affect other parties. For example, changing the land use of an area and acquiring land from private companies in strategic areas to house the vulnerable would pose short-term challenges for these parties. However, this has been addressed partially, through the consideration of providing incentives for them to cooperate.

Scientific Relevance

On systems: The project aims to add to the body of knowledge on adaptation to climate change. There is a large resource bank of theories on resilience and adaptation. However, a number of them are more explanatory rather than implementable in nature. This research aims to address resilience by identifying the system at stake in Chennai, and delineating adaptation measures for the system, thereby bringing the theory to ground.

On adaptation: This project addresses the current gap within the climate discourse, especially in cities like Chennai which largely focus on response strategies to mitigation of climate effects that are fixed and short-term, by proposing alternative strategies that focus on the long-term perspective of adaptability within the planning framework. This necessitates a framework that leaves room for flexibility in order to address uncertainties in ecological or societal conditions.

On culture: In addition, the project addresses some intangible and unmeasurable aspects of local culture and livelihoods, in order to tackle the inadequacy of adaptation strategies that position themselves primarily on the quantitative aspects. Furthermore, the adoption of principles of resilience of urban form to climate change (Dhar & Khirfan, 2017) addresses the roles that spaces and networks play in the adaptation process and their capacities to respond to systemic and local demands, thereby also allowing for the intangible aspects of culture and personal expression to be displayed.

Societal Relevance

The project aims to address the most vulnerable groups within the metropolitan area of Chennai to climate-related events. The planning process currently in place does not address the livelihoods of the socio-economically disadvantaged groups within the development plans. The current measures taken by the government in response to climate events result in forceful eviction and resettlement of informal settlements, without including the dwellers in the decision-making process. Thus, environmental injustice and spatial injustice are both prevalent in planning measures regarding slums in response to climate threats.

This project aims to propose a model of adaptation to climate events through socio-culturally driven strategies that are locally derived, in order to make the process more inclusive of diverse interests. In this process, the project aims to offer more a humane framework and actions within climate adaptation. In doing so, it also tries to improve the pro-poor policies in the city of Chennai.

In addition, by attending to the concerns of the ghettoisation of socio-economically underprivileged communities, the project attempts to offer opportunities of integration with the immediate context in the formal city, by increasing opportunities of interaction through local culture and economy. In this manner, the research tries to bridge the gap between the current (dominant) spatial narrative of ‘risk’ and the latent (inherent) qualities of a ‘place of opportunities’.



## Reflecting on Methodology

### Research and Design Components

The project research started with the analysis of the distribution of vulnerability conditions across the city’s informal settlements. The exploration of the various internal and external forces that contribute to vulnerability to climate-related hazards, was contrasted with an investigation into the elements of local culture and their spatial manifestations that need to be incorporated in climate adaptation measures

Therefore, the fieldwork was an essential part to be carried out in order to understand the local conditions. The field visits and interviews with researchers and practitioners, helped to consolidate my position in the project. The design component is derived from the analysis of the local conditions and potentials within the communities. The role of design here is to enable a range of possible actions by various actors tuned to suit the livelihoods of the local communities. The design constitutes a framework of potential scenarios, responding to different conditions, and guided by principles of resilience that keep the system in check.

### Potential for Transferability

The cases selected in this project are very diverse, but have similarities in characteristics related to the physical context and socio-economic conditions with other settlements across the city. These cases are found to have overlapping vulnerabilities, making them strategic cases in the project. The strategic actions prescribed to each case are transferable to contexts with similar characteristics, while some actions are particularly unique to the context. In addition, the methodology itself could be transferable to various other cities with similar characteristics.

### Research Limitations

The research is limited by data availability, especially of the slums in the city. Due to the differences in jurisdiction within the metropolitan area itself, slum data is not available in the entire region and hence, the cases adopted to illustrate the project have been selected from within the Greater Chennai Corporation (city) limits and not the Chennai Metropolitan Area limits. In addition, in order to address the authenticity of the data available, data has been collected from multiple sources, wherever possible, and correlated.

Since the project deals with the cultural dimension of adaptation, it is important to note that local culture is affected and shaped by climate hazards and vice versa. This project incorporates culture from visible observations and conclusions from interviews with the residents. Additionally, while this research does take into account views of residents living in these settlements, the results have been generalised from a limited number of interviews due to time constraints. In the actual implementation of such a project, should it ever happen, a larger set of respondents would be required to carry out an in-depth investigation at the neighbourhood scale.

## Reflecting on the Studio and Course

### On the Studio

The graduation studio options gave me a chance to ponder on my interests from the different vantage points that the studios offered and make my decision accordingly. The emphasis of the Planning Complex Cities studio, and more specifically the focus on issues of the Global South, of inefficient governance facing rapid development, complements the complexity that arises from relationships of power and overriding narratives in the topic of my project. A weak institutional capacity combined with emerging environmental challenges and increasing socio-economic disparities pose a multitude of problems relating to liveability in Chennai. The point where the project adds to the theme of the studio, is on adopting a change in outlook of the informal settlements in the city.

### On the Course

Through the course of the masters, various topics have been touched upon, with spatial justice and sustainability being a few of the core concepts that have stayed with me till the end and which are also a part of the elements tying this project together. Additionally, the multi-disciplinary setting offered in the course has reinforced the need for inclusivity in not just the outcome but also the in the process, which are key concepts that have been pursued within the project.





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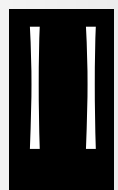
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# Appendix

## Contents

### Appendix I

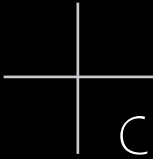
#### Contextualising Resilience

An integrated socio-ecological perception of the climate crisis in Chennai

### Appendix II

#### Fieldwork Compilation





# Contextualising Resilience

An integrated socio-ecological perception of the climate crisis in Chennai

## Abstract

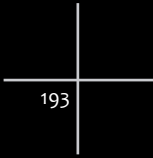
Chennai has been plagued by multiple climate events since the early 2000s. These events have had negative effects on both the ecology and the people of the city. However, the existing measures to mitigate climate effects largely focus on restoring and protecting ecology and building infrastructure, with an emphasis on regulations for governmental organisations, often neglecting to address the weaker sections of society. This has led to marginalization of these societies, exacerbating and shifting vulnerabilities, rather than reducing them. This essay discusses, through the lenses of perception, action and effects, the existing frameworks and policies in Chennai and their contribution towards mitigating climate effects. Further, it proposes a change in the perception of the problem, through a focus on resilience by adaptation, in order to bring about the desired results. By proposing a shift of approach from a one-sided perspective to an integrated perspective of society and ecology as inter-dependent agents within a system, the essay suggests the inclusion of all sections of society within existing planning frameworks in order to reduce negative effects within the social sphere, while building climate resilience.

### Key words

Socio-ecological resilience, climate change, slums, vulnerability, resilience by adaptation

## Structure of the paper

1. Introduction
2. Defining the problem: perception, action and effects
3. Integrated approach: theoretical standpoint
4. Situated application: change in perception, action and effects



Chennai has been prone to various extreme climate-related events, from coastal and pluvial flooding to drought and heatwave. Due to the rapid pace of growth of the city, and a lack of affordable housing, a number of informal settlements, or slums, can be found along edges of rivers, canals and infrastructure lines. These are often the most vulnerable areas within the city during the occurrence of climate hazards.

### Defining the problem

This essay will adopt a three-fold narrative to reveal the existing measures that are in place to address the mitigation of climate effects in Chennai. Firstly, it will address the perception of mitigation of climate hazards, with an emphasis on existing agencies, roles and outlooks. Secondly, it will elucidate the actions and measures that are being taken in the form of policies and frameworks, following the perception of the problem. Lastly, it will expose the effects of the aforementioned actions on the city’s weakest sections of the society.

### Towards an Integrated approach

From an understanding of the current processes of addressing the climate issue, the essay will attempt to propose a reframing of the three-fold narrative. The first part will focus on the theoretical position of the essay with respect to mitigation of climate effects by elaborating on the concept of resilience and ways of defining it. In the second part, drawing from the theoretical standpoint, the essay will discuss what resilience means within the context and attempt to situate it. The aim is to present an alternative perception to the problem, which in turn will facilitate the necessary action required to bring about desirable effects. The essay will conclude with recommendations and starting points for integrating the concept within existing planning frameworks.

### Defining the problem

As mentioned before, the narrative of prevailing responses to climate hazards in the city will be discussed under three lenses – perception, action and effects. The reason for viewing it under these lenses is to show the cause-effect relations that they have in policies and space.

### Perception

Climate hazards such as pluvial flooding, tsunami and drought are addressed under the umbrella of ‘disaster management’ in the country. The first National Disaster Management Authority (NDMA) was established in

2005, under the Disaster Management Act, 2005, to lay down policies, plans and guidelines for responses to disasters, be it natural or man-made. State Disaster Management Authorities (SDMA) and District Disaster Management Authorities (DDMA) were then set up for each state and district, which were responsible for preparing a disaster management plan in accordance with the Act. The Act defines disasters as catastrophes, calamities, grave occurrences or mishaps arising from natural or man-made causes, but fails to mention climate change as a part of this, implying that disasters are primarily sudden events. This does not account for gradual events such as sea level rise.

The City Disaster Management Plan (CDMP) formulated by the Greater Chennai Corporation in 2017, mentions the disaster management cycle (see Figure 1) as the typical action plan during occurrence of disasters. While the State Disaster Management Perspective Plan - 2018-2030 (SDMPP) does acknowledge community knowledge and tradition in responding to disasters, the CDMP refrains from outlining specific roles of non-governmental organisations and civil societies in such circumstances, focusing mostly on government-induced actions to prepare for, respond to, recover from and mitigate disasters. The policies framed are especially not inclusive of the weaker sections of the society, like the slums, in addressing their capacities to recover from disaster effects.

In order to fully understand the current perspective towards mitigation of climate effects in Chennai, it is necessary to also understand the present-day perspective towards slums in the city. Slums have always been an integral part of the political scene within the state. There has been a mutual dependence between the political parties and slums in the city in that the political parties relied on slums for votes and the slums relied on political parties for welfare and protection. However, over time, there has been a shift in the way slum policies have been formulated. This has been largely due to the viewing of slums as ‘risky’ to themselves and the rest of the city, and ‘at risk’ under the backdrop of environmental concerns (Divakar, 2019). With the economic neo-liberalisation of India in the 1990s, the city has been striving towards a global city aesthetic with private players entering the housing market. However, this vision did not include slums. The Tamil Nadu Slum Clearance Board (TNSCB) envisions Chennai as a slum-free city by 2023, shaping the way policies have been framed in order to satisfy other stakeholders.



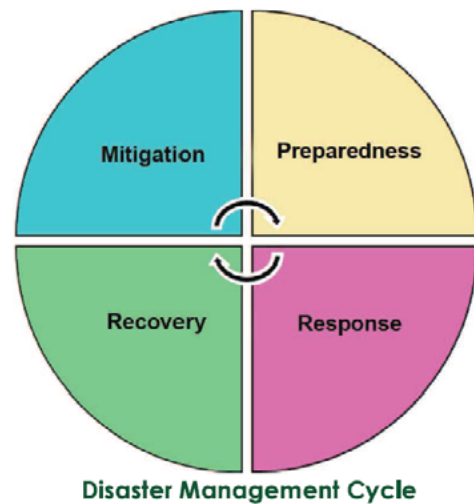


Figure 1: Concept adopted in the GCC Disaster Management Plan 2017. Retrieved from <http://www.chennaicorporation.gov.in/NorthMonSoon2017/cdmcb.pdf>

## Action

This perception of the management of climate hazards, has shaped the actions that have been taken to mitigate effects. In response to flooding at the peri-urban areas, the measures proposed by the SDMP are in the capacities of infrastructural additions such as flood walls, link canals, and conduit systems. The restoration of two major rivers in Chennai – the Cooum and Adyar rivers, have been proposed. The Integrated Cooum River Restoration Plan, the execution of which started in 2016, outlines measures such as

desilting, solid waste removal, treatment parks and fencing, along with rehabilitation and resettlement for slum dwellers along the river to make way for mangrove development, flora plantation, and riverfront development. Similarly, the ecological restoration of the Adyar creek and estuary, which was completed in two phases, has resulted in the creation of an Eco Park with increased faunal diversity and tidal interaction (see Figure 2). This project too, has forcefully evicted thousands of slum dwellers to welcome a use that is increasingly seen to align with the image of a ‘world-class’ city (Coelho & Raman, 2010). These projects view settlements along the rivers purely as causes of pollution, and acting on the problem, propose the construction of toilets and waste bins in order to prevent open defecation and waste disposal. Projects for the restoration of the Buckingham Canal, Kovalam and Ennore are also in the pipeline. While these projects have the potential to address ecological remediation of the rivers, they have significant effects on the evicted dwellers, as the next section will explain. A critique on the Disaster Management Act states the following:

“There is a growing recognition towards the United Nations Guiding Principles on Internal Displacement which include people displaced internally due to natural disasters. It categorically states that it is the primary responsibility of the state to prevent and avoid arbitrary displacement of its people. The act appears to have concentrated more on disaster management through government system rather than focusing on the fact that the

affected communities also have a right to relief and rehabilitation as well as the right not to be displaced unnecessarily.” (Sarkar & Sarma, 2006)

Meanwhile, the Chennai Metropolitan Development Authority (CMDA), which is responsible for guiding the development within the Chennai Metropolitan Area (CMA), introduced a Special Transfer of Development Rights (Special TDR) as a compensation to slum dwellers encroaching waterways and road edges or any other land owned by the government, when the land is claimed back to restore original use (Chennai Metropolitan Development Authority, 2008). This TDR grants dwellers Floor Space Index (FSI) that could be used to develop houses elsewhere. This required the identification and approval by the TNSCB. Although the guidelines state that the TDR cannot be used in Coastal Regulation Zones, Aquifer Recharge areas and the Redhills catchment areas, a number of the resettled tenements lie in low-lying flood plains of the city.

## Effects

The ecological restoration measures taken so far have not particularly led to a cleaner river or increased protection. Nonetheless, increased biodiversity is a positive sign. In order to determine the effectiveness of these strategies against flood risk, one would have to wait for the next intense downpour or cyclone. However, the effects that forceful eviction and resettlement has on the slums are manifold. The problems faced by the relocated dwellers are captured under different dimensions – geographical, socio-economic, and physical.

**Geographical:** There have been instances of flooding in the resettlement tenements constructed in Semmenchery, and Perumbakkam (see Figure 3) and Ezhil Nagar (see Figure 4) colonies in Okkiyam Thoraipakkam during the 2015 floods, as they lie on the flood plains in the peripheries of the city (Coelho, 2016a). In addition, residents were exposed to fires and constant smoke since this area was close to the largest dump yard in the city.

**Socio-economic:** Having been shifted to the peripheries, there is an added loss of livelihood due to their increased distance from economic opportunities (see Figure 5), resulting in severe money crunches and prolonged indebtedness (Coelho & Raman, 2010). The displacement also affects social ties and cultural links, intensifying the socio-spatial isolation of these communities, and reduces access to education and healthcare facilities. Further, the tenure security promised by the government requires the dwellers to pay rent to the government for 20 years, after which

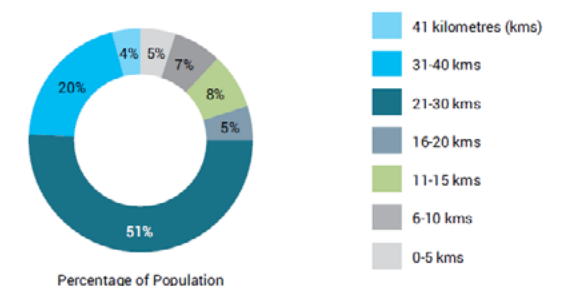


Figure 3: Divya, Annie. A view of the multistoried Perumbakkam Resettlement Colony built by Tamil Nadu Slum Clearance Board. Retrieved from <https://www.cag.org.in/blogs/tn-slum-clearance-board-through-lens-cags-audit-report-part-ii>.



Figure 4: TNSCB resettlement tenements at Ezhil Nagar seen flooded with sewerage water: a sorry state of affairs. Retrieved from <https://www.cag.org.in/blogs/when-poor-have-no-voice-brief-summary-hearing-national-green-tribunal-case-related-cooum>.

Distance of work place from Perumbakkam



Distance of work place from Ezhil Nagar

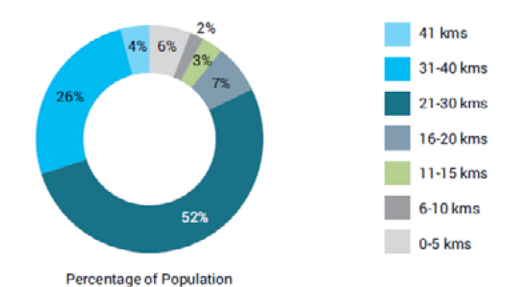


Figure 5: Travel distances between resettled locations and work places . Source: From Deluge to Displacement: The Impact of Post-flood Evictions and Resettlement in Chennai, 2017



Figure 2: Restoration Plan of Adyar Creek (58 acres). Retrieved from: [http://www.chennaiivers.gov.in/Adyar-Poonga-Phase1/images/location\\_big.jpg](http://www.chennaiivers.gov.in/Adyar-Poonga-Phase1/images/location_big.jpg)



they could acquire ownership of the land, meaning that there is an increase in living costs after resettlement.

**Physical:** There are multiple examples of resettlement colonies that had inadequate facilities and services even several years after resettlement, like Ambedkar Nagar and Kannagi Nagar. In Ambedkar Nagar, this included basic infrastructure and services liked piped drinking water, usable roads, adequate transport, storm water drains and electricity (Coelho, 2016b).

### Conclusion

The perspective that has been adopted by the government and other sections of the society, of ecological systems as separate entities requiring protection and of the weaker communities as being at risk or causes of pollution, results in measures that do not touch upon the positive relations that these communities have or could have with ecological systems. These measures then, are also not inclusive of these communities, resulting in unjust outcomes for them. However, the government itself plays a big hand in causing climate hazards. There is a need for an integrated perception of the problem that is not one-sided, but views ecology and society as inter-related components in a system. There is a need for policies and planning frameworks to address the resilience of these communities to climate hazards, both short-term and long-term. In addition, these policies and frameworks must be taken by environmentally just means.

### Integrated Approach

This essay proposes an alternate perspective to view the climate issue, through the adoption of the concept of socio-ecological resilience. The definition of resilience has evolved over time. One of the earliest definitions of the word describes it as “... a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables” (Holling, 1973). However there have been many researchers who have posed alternative definitions of the concept. The definitions range from ‘static resilience’ to ‘adaptive resilience’ and ‘transformative resilience’ (Davidson, et al., 2016). This essay elucidates the need for resilience by adaptation within planning and disaster response frameworks in Chennai, as will be explained in the subsequent sections, first through the establishment of a theoretical position, and subsequently, through a situated understanding.

### Theoretical standpoint

#### Systemic view: Socio-ecological resilience

From a purely ecological point of view, contemporary delineations of resilience have moved to an integrated understanding of the ecological and social dimensions. Here, the termed is defined as “... the capacity of linked social-ecological systems to absorb recurrent disturbances such as hurricanes or floods so as to retain essential structures, processes, and feedbacks; ... the degree to which a complex adaptive system is capable of self-organization (versus lack of organization or organization forced by external factors); and the degree to which the system can build capacity for learning and adaptation” (Adger, Hughes, Folke, Carpenter, & Rockstrom, 2005). The essence of socio-ecological systems (SES) lies in the shift from conceiving human-environment relations as separate systems, and towards an understanding that human systems are a part of, and in turn shape, ecological systems (Cote & Nightingale, 2012). Cote and Nightingale argue that it is necessary to delineate system boundaries and define whose environments and livelihoods are to be protected and why, through an analysis of issues of complex rationalities, power and authority. This puts the theory at the centre of the current issues in Chennai of worldviews, power and politics regarding climate hazards and slums. In this research identifying the system at stake, through the lens of the urban poor, helps in bringing it a step closer to defining ‘resilience for whom?’ and ‘at what cost to which others?’.

#### From mitigation to adaptation

Adger et al. define adaptation as an adjustment of a system – be it social, ecological or economic, in response to perceived or anticipated changes in climate stimuli and their effects in order to ‘alleviate adverse impacts of change or take advantage of new opportunities’ (Adger, Arnell, & Tompkins, 2005). They argue that this can be done through 1) building adaptive capacity and 2) implementing adaptation decisions. This approach re-iterates the importance of cross-scale dynamics in adaptation. Adaptation requires actions by multiple actors and at scales of governance. Hence, this is an integral part of re-conceptualising the perception of the climate issue in Chennai.

#### Identifying vulnerability

As a starting point to facilitating adaptation of a system, it is necessary to identify the factors affecting the vulnerability of that system. There have been multiple ways of conceptualising vulnerability to climate

change – as an end point, as a focal point and as a starting point. The concept of vulnerability as a starting point will be adopted here, by defining the term as the ability or inability of individuals or communities to respond to (cope with, recover from or adapt to) any external stress placed on their livelihoods and well-being (Kelly & Adger, 2000). However, it is necessary for an assessment of the biophysical factors that shape vulnerability, which are linked with specific hazards. In the hazards-of-place model, the biophysical and social factors contribute to overall place vulnerability. (Cutter, Boruff, & Shirley, 2003). Assessing biophysical vulnerability addresses factors such as elevation, proximity, physical conditions that are naturally vulnerable to a hazard. When it comes to assessing social vulnerability, Kelly and Adger’s concept of the ‘architecture of entitlements’ comes into play. They define these as the various factors that shape the availability of entitlements, or rights/ privileges, how they evolved over time and the broader political context that shapes the formation and distribution of entitlements, such as poverty, inequalities and institutional structures (Kelly & Adger, 2000). Therefore, identifying the factors defining vulnerability will help delineate adaptation measures for the communities.

#### Bringing justice into the equation

As seen from the overview of the current measures in Chennai, the exclusion of vulnerable groups in the decision-making process has led to unjust outcomes for these communities. This reinforces the notion that procedural justice is as important a factor, if not more, in climate adaptation, as distributive justice. Here, procedural justice refers to ‘fairness in access to democratic decision-making by individuals, groups or nations’ (Adger, Paavola, & Huq, 2006). The value of putting the most vulnerable first and emphasising universal participation are some of the cornerstones, as put forth by Adger, Paavola and Huq, of justice in adaptation to climate change.

### Conclusion

This shift from a point of view that focuses purely on mitigation, persistence and resistance is necessary because this approach views the ecological system as something that must be resisted by the society, and vice versa. This perspective must be replaced by one that recognizes that the social and ecological systems are inextricably linked and always affect and shape one another and that the social system has the potential to be drivers of climate adaptation and mitigation. This approach emphasises the synergistic aspects of climate

adaptation and mitigation. In addition, recognising the potential in the most vulnerable sections of society to facilitate adaptation and turn the table, so to say, through just and fair means, seems to be crucial in building resilience to climate change and related hazards.

### Situated application

#### Change in perception

As discussed above, the shift from a focus on persistence and mitigation (the static) to the inclusion of adaptation is necessary in order to prevent the shifting of vulnerabilities and other effects mentioned in the first section. This requires a change in perception of the problem from the slums as polluters and ‘at risk’ or ‘risky’ to slums being important agents of change in climate adaptation. According to the 2011 Census data, slum population in Chennai was about 1,342,337, which constituted roughly 28.89% of the total population of Chennai city at the time (Census 2011 India, 2011). According to a study by Society for Participatory Research in India (PRIA) and Indicus Analytics on economic contribution of informal settlements, roughly 7.53% of the GDP of India is contributed by informal settlement dwellers (Society for Participatory Research in India & Indicus Analytics, 2014). It is important to recognize the potential and contribution of slum dwellers in the city’s economy. For example, in Chennai, a number of slums are dependent on fishing for their livelihoods. These slums, most often found either in coastal edges or river edges close to the sea, depend on proximity to the sea for survival. Resettlement and rehabilitation schemes in the past have evicted some of these slums from coastal areas and accommodated them in multi-storey tenements in the urban peripheries, without considering loss of livelihoods. While economic contribution is important, the recognition of slum dwellers as people who have the right to space within the city, is an essential starting point for outlining specific measures for these areas. In this regard, cultural links with the place becomes an important role in driving adaptation.

#### Why adaptation?

The current processes of urbanization and dealing with climate disasters prove to be unjust, in procedure and outcomes, for the vulnerable sections of the society, especially the slums. Therefore, measures for adaptation to changing climate and related hazards are necessary in order to avoid effects and vulnerabilities created by existing response measures. This must be done by delineating system boundaries, through



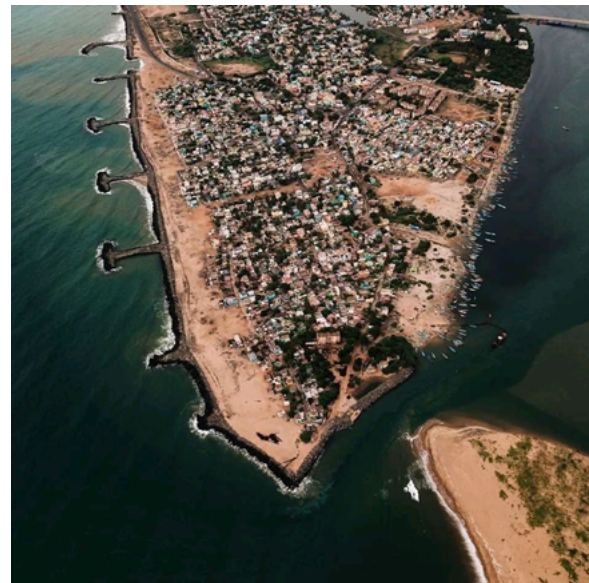
answering the questions, ‘resilience for whom?’ and ‘resilience of and to what?’. The need for targeting the vulnerable is central in creating just and inclusive frameworks in the city.

### Change in action

The SDMP recognizes the need for resilience in its preparedness measures for disasters. However, it recognizes resilience in the context of mitigation and persistence to hazards, rather than adaptation to hazards. Therefore the specific measures outlined for this are also actions in preparation for disasters, and recovery actions. There is a need to integrate strategies that help build adaptive capacities of the vulnerable communities and identify stakeholders involved in implementing adaptation decisions. However, the CDMP bares no mention of resilience-building for the communities. Currently, there are multiple levels of disaster management plans (national, state and district/city levels), and each plan maintains a different approach to address climate hazards.

In addition, Chennai joined the 100 Resilient Cities organization as a member city in 2014, and since then a Chief Resilience Officer has been appointed for the city. In June 2019, the Chennai Resilient Strategy was published, an elaborate plan charting out resilience building actions under five pillars – 1) healthy and planned urbanisation, 2) water systems, 3) disaster preparedness, 4) governance ecosystem and 5) Chennai’s vulnerable communities. Tackling the resilience of vulnerable communities, the framework incorporates strategies such as flexible tenure security arrangements, the revival of the Sites and Services model, which was initiated and supported by the World Bank to provide affordable incremental housing, and facilitating in-situ upgradation of slums wherever possible, stressing the importance of inclusive measures. Similarly, addressing the resilience of water systems, measures include water-sensitive design and employing natural infrastructure to buffer coasts. While a lot of the actions mentioned in the strategy are inclusive and just, and do indicate links with other actions, the plan, at this level, does not discuss specific climate adaptation strategies for vulnerable communities.

Non-governmental organisations play an important role in mobilising resources during hazard situations. This was evident during the 2015 floods in Chennai, when a number of civil societies and NGO’s came out in aid of the affected. These institutions could be used as leverage to decentralize decision-making and facilitate inclusion of various communities, including the very vulnerable.



Figures 6: Harish T. Presence of many coastal settlements dependent on fishing – Ennore. Retrieved from: [www.facebook.com/mycitychennai](http://www.facebook.com/mycitychennai).

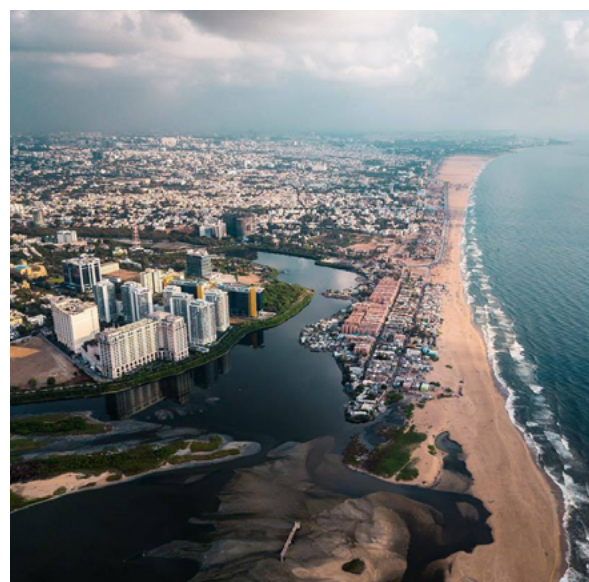


Figure 7: Harish T. Srinivasa Puram coastal settlements. Retrieved from [www.facebook.com/mycitychennai](http://www.facebook.com/mycitychennai).

The presence of numerous documents and plans for the city with overlapping concerns poses a problem of redundancy and effective execution. Therefore, a well-structured, comprehensive plan at the city level is required, incorporating resilience-building as concrete strategies, inclusive of diverse stakeholders. This has to be done by delineating specific systems that are under risk. Currently, the edges of water bodies are places that most people within the city do not often visit due to their polluted state and the perception of slums along these edges as ‘risky’. Therefore, upgrading slum infrastructure, providing basic services, and facilitating

mobility and ease of access to the waterfront could potentially restore the ecological value as well as the human-nature interaction within the urban area. The CMDA must be able to coordinate various agencies involved in decision-making at different levels, as they set out development guidelines for the metropolitan area. This involves strict regulation of development in ecologically sensitive areas and necessary measures to prevent violation of developmental rules.

### Change in effects

All climate hazard-related measures must identify actions for non-governmental organisations, civil society and the most vulnerable, in order to make them truly inclusive. The desired effects of long-term stability and reduced vulnerabilities to climate effects could be achieved through systemic adaptation of vulnerable communities, with the help of flexible frameworks, and governmental and non-governmental support, in order to build resilience. Actions that not only reduce the unfair distribution of burdens and resources, but also reduce the unfair processes involved in making these decisions are bound to have significant effects in reducing the vulnerabilities mentioned in the initial assessment.

### Conclusion and discussion

Through this essay, it has been shown that the manner of perceiving the problem of climate change and related hazards, of certain sections of society,

of what constitutes an ideal city, of ecological values and others, have shaped the way reforms and policies have been framed till date. The emphasis on disaster preparedness and mitigation of effects, without the inclusion of climate-related hazards and their effects in the long-term perspective has meant an over-reliance on government-led institutions in mitigation. Strong political interests, economic concerns, social stigma, and environmental concerns have put the slum dwellers in Chennai in the most vulnerable position with regard to climate change. However, a change in perception is challenging, and yet, very necessary.

While this essay provides a step in pointing to the direction that the cities like Chennai need to move towards, the process of successfully implementing adaptation decisions requires coordination of multiple actors at multiple levels, who have the will to tread the path. The first step would be to identify and document all slums, creating a database of these areas and mapping vulnerability. This is the most important step, as each community is diverse, with different challenges, strengths, weaknesses and potentials. This will only come with a willingness to put the most vulnerable first, and this depends on the perception of what constitutes a ‘world-class’ city, as Chennai aspires to be. While the state of Tamil Nadu has been a leader in pro-poor policies, it is high time that the state and city recognise the need to facilitate long-term sustenance and growth during the climate crisis by reinforcing resilience by adaptation of communities that are most vulnerable.



Figure 8: Beema. Urur Olcott kuppam - a coastal settlement. Retrieved from [www.facebook.com/mycitychennai](http://www.facebook.com/mycitychennai).





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# Fieldwork Compilation

## Interviews with stakeholders

Krishna Mohan – Chief Resilience Officer, Chennai

KT Ravindran & Seetha Raghupathy – Architects & urban designers

Karen Coelho – Anthropologist

Vanessa Peter – Policy researcher

U. Manimekalai – Senior planner, TNSCB

## Visit to Ennore and R A Puram

### Questionnaire

Name:

M / F

Age:

What is your source of income, economic activity?

What are your social/cultural activities and which are your communal spaces?

Mobility – How do you commute daily/seasonally and where?

What do you do during floods/rain?

Who owns the land? Do you pay for rent and services?

What are the facilities or resources that you have and lack?

What is the hierarchy – institutional arrangements in place? How do you communicate with the government?

What do you like about living here as opposed to flats?

What is your relationship with the river/creek?

How long have you been living here?

பெயர்:

ஆண் / பெண்

வயது:

உங்க வரமானம் மற்றும் தொழிலுக்கான ஆதாரம் என்ன?

நீங்க எல்லாரும் எங்க ஒன்றாக சூட்டிங்க ? அங்க பொழுதுபோக்க என்ன செய்வீங்க?

நீங்க வழக்கமா எங்க போவீங்க ? எப்படி பயணம் செய்வீங்க?

மழை மற்றும் வள்ளம் வர காலத்தல என்ன பண்ணுவீங்க?

நிலத்துக்கு சொந்தக்காரர் யார்? நீங்க வாடகை மற்றும் மற்ற பயன்பாடுகளுக்கு ஏதாவது பணம் செலுத்திறீங்களா?

உங்களிடம் என்ன வசதி வலங்கள் இருக்கு? என்ன இல்ல, என்ன பற்றாக்கறயை இருக்கு?

அடித்தடித்த அதிகார நிலையில் யார இருக்காங்க? உங்க கோரிக்கையை அரசாங்கத்துக்கு எப்படி கொண்டுவோய் சேர்ப்பீங்க?

அடிக்கமாடி கடியிரப்பில இருக்கிறதக்கு பதிலா இங்க இருக்கிறதல என்ன பிடிச்சிருக்கு?

நதி மற்றும் ஓடையுடனான உங்கள் உறவு என்ன?

நீங்க எத்தன வருஷமா இங்க இருக்கீங்க?





# Fieldwork Compilation

## Questionnaire Answers

| SITE      | AREA NAME                                                                                        | COMMUNITY POPULATION       | NAME         | AGE |
|-----------|--------------------------------------------------------------------------------------------------|----------------------------|--------------|-----|
| R A Puram | Sathya Nagar, Arignar Anna Nagar, Annai Teresa Nagar, Annai Sathya Nagar, Dr. Radhakrishna Puram | > 50000                    |              |     |
|           |                                                                                                  |                            | Dayalan      | 61  |
|           |                                                                                                  |                            | Siva         | 30+ |
|           |                                                                                                  |                            | Meena        | 24  |
|           |                                                                                                  |                            | Bhupathi     | 45  |
|           |                                                                                                  |                            | Rajathi      | 55  |
|           |                                                                                                  |                            | Karpagam     | 67  |
|           |                                                                                                  |                            | Shanthi      | 50  |
|           |                                                                                                  |                            |              |     |
|           |                                                                                                  |                            | Nagamma      | 65  |
|           |                                                                                                  |                            | Aiyamma      | 45  |
|           |                                                                                                  |                            | Community    |     |
| Ennore    | Nettukuppam                                                                                      | 1000 families, 5000 people |              |     |
|           |                                                                                                  |                            | Baskar       | 46  |
|           |                                                                                                  |                            | Alimuthu     | 40  |
|           |                                                                                                  |                            | Ammavasai    | 32  |
|           |                                                                                                  |                            | Visu         | 35  |
|           |                                                                                                  |                            | Krishnan     | 38  |
|           |                                                                                                  |                            | Senthil      | 35  |
|           |                                                                                                  |                            | Desappan     | 40  |
|           |                                                                                                  |                            | Selvamani    | 48  |
|           |                                                                                                  |                            |              |     |
|           |                                                                                                  |                            | Jayapreetha  | 37  |
|           |                                                                                                  |                            |              |     |
|           |                                                                                                  |                            | Mohana       | 24  |
|           | Kattukuppam                                                                                      | 300 families               |              |     |
|           |                                                                                                  |                            | B Sherif     | 49  |
|           |                                                                                                  |                            | Vigneshwaran | 26  |
|           |                                                                                                  |                            |              |     |
|           |                                                                                                  |                            | Chellamal    | 47  |
|           |                                                                                                  |                            | Tamilselvi   | 23  |
|           |                                                                                                  |                            |              |     |
|           |                                                                                                  |                            | Ellamma      | 45  |

| GENDER | NO. OF YEARS LIVING THERE | SOURCE OF INCOME / ECONOMIC ACTIVITY                                             |
|--------|---------------------------|----------------------------------------------------------------------------------|
| M      | 43                        | Grows cows for milk to sell                                                      |
| M      | All his life              | Employment at Madras Boat Club restaurant                                        |
| F      | 20                        | Coffee machine operator in office, Husband: coolie                               |
| F      | > 30                      | Household work, peeling onions for street vendors, daily wages, coolie           |
| F      |                           |                                                                                  |
| F      |                           |                                                                                  |
| F      |                           |                                                                                  |
| F      | > 40                      | House work                                                                       |
| F      |                           |                                                                                  |
|        |                           | Other jobs: construction, daily wages                                            |
| M      | 3 or 4 generations        | Fishing for the half the day, few in EB                                          |
| M      |                           |                                                                                  |
| M      |                           |                                                                                  |
| M      |                           |                                                                                  |
| M      |                           |                                                                                  |
| M      |                           |                                                                                  |
| M      |                           |                                                                                  |
| M      |                           |                                                                                  |
| F      |                           | None                                                                             |
| F      |                           | None, husband works in EB, children educated and looking for jobs                |
| M      | > 40                      | Fishing, was a glass cutter before                                               |
| M      |                           | Kamaraj port - morning, 3 shifts, fishing at other times, less salary from crabs |
| F      | 11 in this house          | 75                                                                               |
| F      |                           |                                                                                  |
| F      | 22                        | Fish sales - Buys from Kasimedu, sells in Meenjur                                |



# Fieldwork Compilation

## Questionnaire Answers

| SOCIAL / CULTURAL ACTIVITIES                   | DAILY COMMUTE                                                 | SEASONAL COMMUTE                                       |
|------------------------------------------------|---------------------------------------------------------------|--------------------------------------------------------|
| Kovil thiruvizha - community                   |                                                               |                                                        |
| Empty ground for kids to play in               | MBC                                                           |                                                        |
| Aadi maasam thiruvizha                         | Boat Club road                                                |                                                        |
|                                                | Adyar                                                         |                                                        |
| Individual house                               | HM Hospital (before)                                          |                                                        |
| Kovil                                          |                                                               |                                                        |
|                                                |                                                               |                                                        |
|                                                |                                                               |                                                        |
| Net work, kovil thiruvizha, Royapuram - cinema | Daily - walk                                                  | Bus/auto                                               |
| Kovil thiruvizha                               |                                                               | Sometimes outside - hometown visits                    |
| weddings                                       |                                                               |                                                        |
| net work under shade                           | 1.5 hrs by boat to fishing location - Pulicat (Pazhaverkaadu) | bus/train                                              |
|                                                |                                                               |                                                        |
| TV, Mostly family, not community               |                                                               | Cinema, kalyana mandapam, mall - 2-wheeler with family |
| TV                                             | Work - goes by train, returns by auto                         | Thiruvizha, wedding - bus                              |
|                                                |                                                               |                                                        |

| FLOOD REHABILITATION                                              | LAND OWNERSHIP                                               | PATTA (Y/N) | FACILITIES & SERVICES HAVE                                      |
|-------------------------------------------------------------------|--------------------------------------------------------------|-------------|-----------------------------------------------------------------|
| Kalyanamandapam                                                   | TNSCB                                                        | N           | temporary clinic, pharmacy & doctor, ration, water, electricity |
| Railway station                                                   |                                                              |             |                                                                 |
| Chathram - Kapaleeshwar kovil                                     |                                                              |             | Metro water                                                     |
| Railway station                                                   |                                                              | N           | Electricity, makeshift arrangements to prevent water            |
| Hostel                                                            | Kovil Land                                                   | N           | Tank water, electricity                                         |
| Mandapam                                                          |                                                              |             |                                                                 |
|                                                                   |                                                              |             |                                                                 |
|                                                                   |                                                              |             |                                                                 |
| Community house                                                   | Own, cannot rent out/sell to people from outside Nettukuppam | Y           | borewells                                                       |
| Government school or temple Mandapam - Samudayakutam              | Own, pay taxes - house, water, drainage                      | Y           | Govt school - till 8th grade                                    |
| Tsunami did not affect houses, floods - community house           | Own, paying taxes                                            | Y           | School, water - wells                                           |
|                                                                   |                                                              |             |                                                                 |
| The street did not get flooded as it is elevated, others - school | Rented                                                       | N           | Septic tank, drainage connection                                |
| Floods did not affect house, others - kovil                       | Rented - thatched house                                      | N           | Tap/can water                                                   |
|                                                                   |                                                              |             |                                                                 |



# Fieldwork Compilation

## Questionnaire Answers

| VICES<br>LACK                                                                 | COMMUNICATION<br>WITH GOVT                                                                            | LIKE ABOUT THE PLACE                         |
|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|----------------------------------------------|
| school, library, common playground, hospital                                  | Community head (himself)                                                                              |                                              |
| Drainage                                                                      |                                                                                                       |                                              |
| Drainage, septic tank, road                                                   |                                                                                                       |                                              |
| Drainage                                                                      | Approach Minister's house as a group                                                                  |                                              |
|                                                                               |                                                                                                       |                                              |
|                                                                               |                                                                                                       |                                              |
| septic tank, drainage built but not functional, jettys                        | Community head communicates with MLA                                                                  | Proximity and space, will move if given jobs |
| septic tank, drainage built but not functional, have to pay extra despite tax | Community head changes every 2 years<br>Try to solve problems within community, if not, approach govt | Proximity, will move if given job + house    |
| some houses do not have toilets                                               |                                                                                                       |                                              |
| septic tank, drainage built but not functional,                               | Community head changes every few years, Council of 3 heads and 5 subheads -> community -> govt        | Grassy area, govt built quarters later       |
|                                                                               |                                                                                                       |                                              |
| parks to play for kids                                                        |                                                                                                       | May move, if offered homes elsewhere         |
| pucca house, no toilet at home                                                | Council of about 7 people communicate with authority                                                  | Work, relatives                              |
|                                                                               |                                                                                                       |                                              |

| RELATIONSHIP WITH RIVER/CREEK                                                  | COMMENTS                                                                                                                                                                                                               |
|--------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Used to go swimming when water was clean                                       |                                                                                                                                                                                                                        |
| Some people used to fish in clean waters                                       |                                                                                                                                                                                                                        |
| Played in water over 10 years back                                             |                                                                                                                                                                                                                        |
|                                                                                |                                                                                                                                                                                                                        |
| No relationship                                                                | Ground water is salty                                                                                                                                                                                                  |
|                                                                                |                                                                                                                                                                                                                        |
|                                                                                |                                                                                                                                                                                                                        |
| Fully dependant as a source of income                                          | 1. Industries let hot water into the creek, destroying aquatic life 2. No loan for education, no subsidies 3. Mouth of river/creek encroached upon, not wide enough to receive all water from Kosasthalaiyar and canal |
| Fear of water coming closer                                                    | Each house = 3 cents (~120 sqm) Waste segregation information                                                                                                                                                          |
| There was a relationship before, when water quality was good, even for cooking | Each house = 1.25 - 1.5 cents (~50 - 60 sqm)                                                                                                                                                                           |
|                                                                                |                                                                                                                                                                                                                        |
|                                                                                | Metro water for eac house - not potable/fit for drinking                                                                                                                                                               |
| No fish anymore, strained                                                      | Open defecation, 1 or 2 public toilets only, 3 kids                                                                                                                                                                    |
|                                                                                |                                                                                                                                                                                                                        |



